muswellbrook shire council

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15 August 2019

Project No. 2019-2020-0381

Final Report

on

REF for the proposed Thompson St Intersection Upgrade/Signalisation Work.

"This REF report prepared by CARDNO (Cardno ref: 80519059; Final Version received date 17.07.2019) has been determined as the final version in accordance with acceptance by Manager, Roads, Drainage and Technical Services and in accordance with the EP&A act 1979 part5."

Delegated Council Officer

Kellie Scholes

Manager Roads Drainage and Technical Services

MSC Magiq Doc ID# 1020799, 1028992, 1020800

Project Review of Environmental Factors

Intersection Upgrade, Thompson Street and New England Highway

Prepared for

Muswellbrook Shire Council

18 July 2019

Cardno®

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Executive Summary

The Proposal

Cardno (NSW/ACT) Pty Ltd (Cardno) has prepared this Review of Environmental Factors (REF) on behalf of Muswellbrook Shire Council (MSC) under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the proposed upgrade of the intersection at Thompson Street and the New England Highway, Muswellbrook.

Key features of the proposal include:

- New traffic lights at the Thompson Street/ New England Highway intersection
- Median alteration including:
  - Adding a median to Thompson Street
  - Reducing the extent and increasing the width of the northern median on the New England Highway accommodating the addition of a pedestrian rail and traffic lights
  - Providing RMS type SM kerb to the median south of the intersection on the New England Highway
- Signalised pedestrian crossings at all three approaches to the intersection
- Lane widening on the left turn into Thompson Street from New England Highway
- Adjusted stormwater drainage infrastructure including kerb and gutter
- Addition of a 4m wide pedestrian footpath between pedestrian crossings on the eastern side of the New England Highway
- Installing and relocating of road markings and signage as required
- Acquiring a portion of the lot occupied by McDonalds (Lot 100, DP793194) in order to widen the left turn into Thompson Street, this involves:
  - Providing new kerb and gutter
  - Extending the existing pit to the new road surface
  - Possibly relocating water and Telstra services; this is subject to the council conducting a utility investigation prior to undertaking roadworks
  - Provide a new retaining wall on the property boundary
  - Reconstruction the pedestrian access to McDonalds to the standard of existing infrastructure
- Upgrading the drive way in residential Lot 4, DP 28425 to ensure safe access to the upgraded intersection

Construction is expected to commence in early 2020 financial year and would take approximately three (3) months to complete.

Need for The Proposal

The proposal accommodates the projected increase of traffic through the intersection due to future residential population growth and commercial development. The Thompson Street intersection was identified as a high priority for upgrade during a Traffic study conducted by MSC in 2010 based on capacity and safety criteria.

Proposal Objectives

The objectives of the proposal are to:

- Create safer access to Thompson Street and the New England Highway
- Increase functionality of the intersection
- Increase safety for pedestrians
- Consider the projected residential and commercial development growth of the area

Options Considered

- Do nothing
- Seagull intersection

> Signalized intersection including pedestrian crossing at all three approaches (the proposal)

Statutory and planning framework

All relevant statutory planning instruments have been examined in relation to the proposal. Development consent is not required for the subject activity by virtue of Clause 94 of State Environmental Planning Policy (Infrastructure) 2007(ISEPP). As the proposal is for a road intersection upgrade and is to be carried by MSC, it is to be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and is subject to an environmental impact assessment (this REF).

The purpose of this REF is to describe the proposed works, to document the potential environmental impacts of the proposal and to detail the protective measures to be implemented. In doing so, the REF helps fulfil the requirements of Part 5, Division 5.1 of the EP&A Act that the determining authority examine and consider to the fullest extent possible all matters affecting, or likely to affect, the environment by reason of the activity.

The *Roads Act 1993* provides for roads to be classified as Freeways, Controlled Access Roads, Tollways, State Highways, Main Roads, Secondary Roads, Tourist Roads, Transitways and State Works. The New England Highway is classified as a State Road.

Part 6, Division 1 Section 75 of the *Roads Act 1993* states that a public authority may not carry out road work on a classified road, being work that involves the deviation or alteration of the road unless the plans and specifications for the proposed work have been approved by RMS.

Community and stakeholder consultation

Targeted stakeholder and community consultation has been undertaken and will continue to be undertaken by MSC throughout the project.

MSC will implement an ongoing consultation strategy for the term of the proposal including the following:

> Ongoing consultation with RMS

> The REF shall be displayed publicly on the MSC website

> A community update will be letterbox dropped to residents and businesses regarding construction works and timing including planned traffic disruptions

> Targeted consultation with impacted residents regarding required acquisition and access improvements

Environmental Impacts

The main environmental impacts of the proposal are:

Soil and Water

The existing environment is highly developed. During the construction phase appropriate erosion and sediment controls shall be implemented to ensure minimal impacts to soil and water. Geotechnical investigations did not encounter groundwater during investigations and there is no significant water body in close proximity to the site. The operational phase of the proposal will not result in any impacts to soil, surface water or ground water.

Biodiversity

No threatened species, populations or ecologically endangered communities (EECs) are considered to be affected by the proposed works.

Traffic and Access

During construction, there will be moderate impacts to traffic due to necessary road closures required to complete the construction works. During the operational phase the proposal will result in improved safe access and useability of the intersection and significantly reduced delay times on right turns in and out of Thompson Street. Some delay in travel time along the New England Highway as a cumulative result of the close succession of traffic lights along this section of highway may be encountered.

Aboriginal and Non-Aboriginal Heritage

No known items or places of heritage significance would be affected by the proposed works. All construction personnel shall be made aware of their responsibilities in relation to Aboriginal and non-Aboriginal heritage protocol for unexpected finds relative to current legislation.

Air Quality

There is potential for some limited impacts on air quality during construction, however any potential impact is expected to be minor and short term. Air quality impacts during operation are not expected as a result of the proposed works.

Visual Amenity

The visual amenity of the site will be impacted in the short-term during construction. The addition of traffic lights, pedestrian crossings, increased road markings and signage will alter the existing landscape, however due to the developed nature of the site this impact is not considered significant.

Socio-Economic Impacts

The proposed works will potentially result in a minor impact on the socio-economic value of the location during the operational phase, due to traffic and accessibility disruptions. However, the operational phase of the proposal will have a positive impact on the socio-economic value of the location due to its increased functionality.

Waste Management

Waste generation would be minimised and managed through the application of conventional, appropriate methods implemented by the appointed Contractor.

The safeguards and mitigation measures identified in this REF would help minimise any potential adverse impacts.

Justification and Conclusion

The proposed intersection upgrade works are consistent with the statutory and non-statutory framework in NSW. It is expected the proposal would result in positive outcomes, with the principal benefits being the improved safety, useability and reduced delays for the existing and the projected local population.

The REF concludes that the proposal is unlikely to have any significant or long term negative environmental impacts, providing the appropriate mitigation measures outlined in this REF are implemented.

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1 Introduction

1.1 Proposal Identification

Muswellbrook Shire Council (MSC) propose to upgrade the intersection of Thompson Street and the New England Highway, Muswellbrook (the proposal). The proposal includes:

- New traffic lights at the Thompson Street/ New England Highway intersection
- Median alteration including:
  - Adding a median to Thompson Street
  - Reducing the extent and increasing the width of the northern median on the New England Highway accommodating the addition of a pedestrian rail and traffic lights
  - Providing RMS type SM kerb to the median south of the intersection on the New England Highway
- Signalised pedestrian crossings at all three approaches to the intersection
- Lane widening on the left turn into Thompson Street from New England Highway
- Adjusted stormwater drainage infrastructure including kerb and gutter
- Addition of a 4m wide pedestrian footpath between pedestrian crossings on the eastern side of the New England Highway
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- Acquiring a portion of the lot occupied by McDonalds (Lot 100 DP793194) in order to widen the left turn into Thompson Street, this involves:
  - Providing new kerb and gutter
  - Extending the existing pit to the new road surface
  - Possibly relocating water and Telstra services; this is subject to the council conducting a utility investigation prior to undertaking roadworks
  - Provide a new retaining wall on the property boundary
  - Reconstruction the pedestrian access to McDonalds the standard of existing infrastructure
- Upgrading the drive way in residential Lot 4 DP 28425 to ensure safe access to the upgraded intersection

The main objective of the proposal is to Increase the safety, functionality and reduce delays at the intersection.

The location of the proposal is shown in Figure 1-1 and 1-2. The design is in **Appendix D.** Chapter 3 describes the proposal in more detail.

1.2 Purpose of the Report

This Review of Environmental Factors (REF) has been prepared by Cardno (NSW/ACT) Pty Ltd (Cardno) on behalf of MSC to assess the potential environmental impacts of works associated with the proposed upgrade of the intersection at Thompson Street and the New England Highway.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have an impact on the environment such that it would require an Environmental Impact Statement (EIS) under Division 5.1 of the EP&A Act
- Threatened species, populations and ecological communities listed under the NSW *Biodiversity Conservation Act 2016*
- Possible impact upon any indigenous or non-indigenous heritage items as defined by the *National Parks and Wildlife Act 1974* and *Heritage Act 1977*
- The potential for the proposal to impact any matter of national environmental significance or Commonwealth land that would require referral to the Commonwealth Environment Minister in accordance with the *Environmental Protection and Biodiversity Conservation Act 1999*

Based on the assessment outlined in this REF and provided the recommended environmental management and mitigation measures outlined in this REF are implemented, it can be considered that the proposal will have no significant impacts on the environment.

2 Need and Options Considered

2.1 Strategic Need for the Proposal

The proposal accommodates the projected increase of traffic through the intersection due to predicted future residential population growth and commercial development. A traffic study conducted by MSC in 2010 anticipates a 67% growth in residential population and an increase of 35,100m^2 of commercial development within the Muswellbrook LGA by 2037. The Thompson Street intersection was identified as a high priority based on capacity and safety criteria within the 2010 traffic study.

Since the traffic study was conducted, the Showground that is accessed via Thompson Street has been rezoned from RE2 Private Recreation to B5 Business Development. This change in zoning of the area has contributed to the need for the intersection upgrade in order to meet the areas strategic needs of the locality with an appropriate level of service.

2.2 Existing Infrastructure

Infrastructure within the site:

- The New England Highway comprises of four lanes of various lane size between 3.15m and 4m
- The left turning lane north bound into Thompson Street has a width of 2.9m
- The right turning lane south bound into Thompson Street has a width of 2.95m
- Thompson Street has a current width of 12m
- The intersection is currently non-signalised
- There is a 1.1m median featuring stormwater pits on the north side of the intersection
- A 3.3m vegetated median on the south side of the intersection
- Curb side stormwater pits exist on both sides of the corner of Thompson Street to the west of the site
- A footpath runs along the west of the New England Highway
- Telstra infrastructure exists at the north west and north east of the intersection
- Both roads feature street lighting
- Thompson Street and the New England Highway have a posted speed limit of 50km/h within the site.

Neighbouring infrastructure includes:

- Tafe NSW and Muswellbrook South Public School to the north west of the study area (There is a posted 40km/h school zone out of the north site extent on the New England Highway.)
- McDonalds Restaurant to the south
- Private residential development to the west
- A corridor of River Oaks *(Casuarina Cunninghamiana)* within a parcel of State Forest adjacent to a golf course to the east

2.3 Proposal Objectives and Development Criteria

2.3.1 Proposal Objectives

The objectives of the proposal include:

- Achieve acceptable Level of Service (LoS) at the intersection over a 10-year period
- Improve road safety and access to Thompson Street
- Provide additional intersection capacity to accommodate future traffic volume increases
- Minimise adverse impacts on the environment and the community

2.3.2 Development Criteria

The development criteria for the proposal include:

- Designing the proposal in a manner that is informed by environmental investigations to minimise adverse impacts while maximising environmental benefits
- Satisfying the technical and procedural requirements of Roads and Maritime and other stakeholders with respect to the design of the proposal works
- Optimising the concept design to ensure that the proposal can be practically and efficiently constructed and maintained while meeting all other proposal objectives
- Applying appropriate urban design, landscape and visual principles in the concept design of the proposal elements
- Designing all connections, modifications and improvements necessary to link the proposal works to the existing road system
- Planning temporary arrangements that minimise disruption to local and through traffic and that maintain access to adjacent properties during construction
- Developing, implementing and maintaining effective management systems for quality, work health and safety, environmental, proposal reporting, risk management, value management and value engineering, constructability assessment, safety audits and community participation

2.4 Alternatives and Options Considered

2.4.1 Methodology for selection of preferred option

A Traffic Study was conducted by MSC in 2010. The study collected data measuring the efficiency of the intersection as it currently operates and modelled the data based on the expected population growth of the area. The study considered the applicable control options that would improve functionality of the intersection, these options were then assessed considering neighbouring control measures (existing and proposed) and locality needs.

The preferred option determined in the traffic study was later reassessed by council based on the rezoning of the showground area for commercial development.

2.4.2 Options Considered

There were three possible options for the intersection.

- Option 1: Do nothing, leave the intersection as it is with its current give-way control

This option fails to meet the strategic need for the proposal and does not consider risk reduction of the intersection function.

- Option 2: Upgrade to full seagull arrangements providing a sufficient storage capacity for turning movements.

This option is viable based on the historic traffic data. However, based on the rezoning of the showground area there is expected to be an increase to access of Thompson Street from the New England Highway.

- Option 3: New signals with pedestrian crossings at all three approaches (preferred option).

2.4.3 Preferred Option

Option 3: New signals with pedestrian crossings at all three approaches.

This option is preferable as it facilitates safe access to Thompson Street for vehicles and pedestrians. The rezoning of the showground from RE2 private recreation to B5 business development is expected to result in increased traffic through the intersection.

Option 3 was selected due to meeting the following criteria:

- Provides the best technical design to deliver road network improvements in general accordance with the proposal objectives
- Overall congestion would be reduced and traffic flows improved while maintaining safety. In particular it would significantly reduce the delay on right turns at the intersection
- It would also provide a solution that could be built with minimal environmental impacts and accommodate planned and future development in the area

3 Description of the Proposal

3.1 The Proposal

The proposal consists of upgrading the intersection at Thompson Street and the New England Highway. The proposal includes:

- New traffic lights at the Thompson Street/ New England Highway intersection
- Median alteration including:
  - Adding a median to Thompson Street
  - Reducing the extent and increasing the width of the northern median on the New England Highway accommodating the addition of a pedestrian rail and traffic lights
  - Providing RMS type SM kerb to the median south of the intersection on the New England Highway
- Signalised pedestrian crossings at all three approaches to the intersection
- Widening the Lane turning left into Thompson Street from New England Highway
- Adjusted stormwater drainage infrastructure including kerb and gutter
- Addition of a 4m wide pedestrian footpath between pedestrian crossings on the eastern side of the New England Highway
- Installation and relocating of road markings and signage as required
- Acquiring a portion of the lot occupied by McDonalds (Lot 100 DP793194) in order to widen the left turn into Thompson Street, this involves:
  - Providing new kerb and gutter
  - Extending the existing pit to the new road surface
  - Possibly relocating water and Telstra services; this is subject to the council conducting a utility investigation prior to undertaking roadworks
  - Provide a new retaining wall on the property boundary
  - Reconstruction the pedestrian access to McDonalds the standard of existing infrastructure
- Upgrading the drive way in residential Lot 4, DP 28425 to ensure safe access to the upgraded intersection

Detailed Design is provided in **Appendix D**.

The proposal boundary is shown by **Figure 1-2.** All construction works are confined to the road reserve with the exception of the acquisition of 81.26m^2 of Lot 100, DP 793194 and the provision of a new drive way for the residential Lot 4, DP 28425 and replacement of the driveway of Lot 6, DP28425 post construction.

3.1.1 Location of the proposal

The proposed works involve upgrading the intersection that joins the New England Highway to Thompson Street in Muswellbrook LGA. Muswellbrook is approximately 110kms north west of Newcastle (**Figure 1-1**).

The proposal works will be confined within the road reserve at Thompson Street on the New England Highway and an 81.26m^2 section of Lot 100 DP 793194 which is currently occupied by the McDonalds carpark and landscaping (**Figure 1-2**). Additionally, the proposal involves providing a new driveway with a turning bay on residential Lot 4 DP 28425 and the alteration of the section of drive way on Lot 6, DP28425 to facilitate safe access to the intersection for the resident (**Figure 1.3)**.

The locality surrounding the site is comprised of:

- Tafe NSW, Muswellbrook and Muswellbrook South Public School (zoned R1 General Residential), to the north
- Residential property (zoned R1 General Residential), to the west
- A parcel of trees (zoned RU3 Forestry) opening onto a private golf course (zoned RE2 Private Recreation), to the east
- A McDonald's (zoned B2 Local Centre), to the south

The site is to be confined to the road reserve and the site acquisition mentioned above.

Figure 1-1 Study Area

Figure 1-2 Study Area

Table 1-3 Driveway Works

3.2 Design

3.2.1 Design Criteria

The Detailed Design can be found in **Appendix D.**

3.2.2 Engineering Constraints

The project has some minor engineering considerations, to sufficiently extend the left turning lane the council will need to acquire 81.26 m^2 of the lot that McDonalds occupies. There is Telstra and water services that may require relocation, this is to be determined by a utility investigation prior to construction. Existing stormwater pits will need to be extended to the new road surface.

3.2.3 Major Design Features

Major features of the intersection upgrade include:

- A new footpath tying into the existing footpath on the north west of the New England Highway joining the existing footpath
- A new footpath on the east side of the New England Highway, joining the crossings
- Kerb realignment on both the north and south corners of Thompson Street
- Signalised pedestrian crossings at each of the three approaches
- Traffic lights at each of the three approaches

3.2.4 Drainage

The drainage design includes extensions of and adjustments to existing pit and pipe infrastructure. Work would include:

- Retaining three of the existing median stormwater pits on the median at the north of the intersection, extending the inlet to the new kerb and providing a section of new pipe connecting a new pit at the extent of the median.
- Replacing the existing pit on the New England Highway adjacent to Lot 4 DP28425 and connecting to the existing pipe on the kerb.
- Providing a new stormwater pit on Thompson Street, adjacent to Lot 4 DP 28425 and a new section of pipe connecting the pit to the existing network.
- Extending the existing pit on Thompson Street, adjacent to Lot 100 DP 793194 to the new road surface with a class D lid. The contractor will engage a structural engineer for the extension design prior to construction.
- The existing pit adjacent to Lot 100 DP 793194 on the New England Highway will have its curb inlet removed and will be connected to the existing pipe. A new stormwater pit will be installed along the kerb realignment, with a new stormwater pipe joining it to the existing pipe network.
- The junction pit at the south east of the intersection on the New England Highway to be converted to a curb inlet pit (SA2).

The kerb designed for the east of the intersection contains drainage battering into a drainage line in the neighbouring parcel of state forest.

3.3 Construction

The following construction details are indicative only. The following assumptions are based on the information provided detailed design (**Appendix D**). The Contractor shall be ultimately responsible for preparing and seeking approval from council for the final method of construction.

3.3.1 Methodology

<u>Site Establishment</u>

- Establish the site compound area and designate area(s) for all storage, waste management and parking areas for vehicles and machinery
- Installation of temporary fencing around the perimeter of the site to prevent unauthorised access

- Implementing traffic management measures
- Installing environmental controls, including tree protection measures
- Relocation of light poles (where specified)

Drainage work would include:

- Reconstruct / covert existing pits
- Excavate for new pits and pipe connections
- Compact subgrade
- Place and compact bedding material
- Place pipe
- Fill and compact material around the pipe
- Place erosion protection at new pipe outlets where required.
- Installation of erosion and sediment controls
- Delivery of equipment, machinery and materials to the site compound.

Pavement work would include:

- Preparation of new lane surfaces by grading and milling machine
- Lay gravel base / sub-base layers for new pavements (where required)
- Apply asphaltic concrete pavement using pavers and rollers
- Repair existing pavements where required
- Construct footpath connections.

Final work would include:

- Install line markings, signs and guide posts
- Decommission temporary facilities (such as site compounds)
- Clean up the site and dispose of all surplus waste materials
- Removal of construction traffic management and opening of the proposal to traffic

Site re-commissioning

Following the completion of the construction works, the following activities would be undertaken:

- Removal of erosion and sediment controls following adequate stabilisation of disturbed areas.
- Site recommissioning involving removal of site fencing, site compound, plant and equipment.

Site Rehabilitation

The work site would be progressively rehabilitated to minimise dust generation, erosion and sedimentation.

3.3.2 Construction hours and duration

MSC is planning to commence construction early in the 2020 financial year. Works would be undertaken during standard construction hours in accordance with the Interim Construction Noise Guidelines (DECC, 2009) where possible. It is anticipated that construction would take place over a period of approximately three (3) months.

Construction work would be carried out during standard hours where possible:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday: No work
- Public holidays: No work

To minimise disruption to traffic and to reduce the duration of construction, a substantial amount of work would likely be required to be carried out outside of these hours (night works) pending RMS approval. This includes

the relocating of existing utilities and services and some pavement work. For work required outside of standard hours, reasonable and feasible work practices to minimise noise nuisance (nominally set at 5 dBA above background noise levels) would be planned and implemented through a construction noise management plan. This would include notifying potentially affected residents and businesses. For further details refer to Section 6.5 of this REF.

3.3.3 Plant and Equipment

The construction machinery to be used during the construction of the proposal would be determined by the contractor. For the purposes of this assessment, it has been assumed that construction works would likely use the following machinery:

- Asphalt pavers
- Asphalt profiling machines
- Generators
- Lighting units
- Back hoes
- Hydraulic hammers
- Hand tools
- Line marking equipment
- Concrete saws
- Vibratory rollers
- Mobile cranes
- Concrete trucks and pumps
- Trucks and light utilities.

3.3.4 Earthworks

Excavations would be required to extend the road to accommodate the proposed footpath connections and to relocate utilities. The majority of the remaining construction work would be confined to existing road pavements and, therefore, earthworks would be generally confined to placement of subgrade material for small sections of new pavements and excavation for signage, traffic light and light pole footings.

3.3.5 Source and Quantity of Materials

Materials to describe include, but are not limited to:

- Engineering fill
- Pavement (composite and flexible)
- Sub base (composite and flexible)
- Sub base (composite)
- Base (composite and flexible: crushed rock and aggregate volume) To be determined during detailed design
- Asphalt and bitumen
- Concrete
- Kerbs
- Retaining wall
- Drainage materials: Precast Concrete and fibre reinforced concrete pipes

These materials are widely available across the regional area. They shall be transported either directly to site or to the site compound via agreed haul routes. Hazardous material shall be stored in contained areas and certain work activities that would involve using some of the above materials (such as minor maintenance and refuelling) shall only take place in contained areas. MSC would promote the use of locally-sourced materials

that contain a high recycled content and low embodied energy where they are cost and performance competitive and comparable in engineering performance.

3.3.6 Traffic Management and Access

Access to the proposal site would be directly from the New England Highway.

Traffic management and access controls shall be implemented under a construction Traffic Management Plan (refer to **Section 6.4.4**). Some temporary lane closures and minor temporary pedestrian diversions are likely to be required. These would occur in accordance with a Traffic Management Plan and, where necessary, a Road Occupancy Licence.

Where possible, the proposed construction work would be programmed to minimise impact on traffic using the New England Highway and the local road network.

Standard traffic management measures would be employed to minimise the short-term traffic impacts expected during construction. These measures shall be identified in a Traffic Management Plan (TMP) for the proposal and be developed in accordance with the Roads and Maritime Traffic Control at Works Sites Manual (Roads and Traffic Authority, 2010) and Roads and Maritime Specification G10 – Control of Traffic.

Traffic management measures may include:

- Modification of lane widths to facilitate the safe entry, exit and movement of plant and materials and to allow for construction staging of work
- Placement of separation barriers to protect traffic from the work site
- Reduced speed zones (where approved)

During construction, access to businesses and other private property shall be maintained, access to Lots 4 and 6 DP 28425 will be affected during the reconstruction of their driveway during this construction, affected residents are to be given appropriate notice outlined in the construction management plan. Pedestrian and cyclist routes would be managed daily to suit construction activities.

3.3.7 Ancillary Facilities

A construction compound shall be established prior to the commencement of construction. The Construction Environment Management Plan (CEMP) will include Construction Compound and Ancillary Facility Management Plan (CCAFMP) to meet applicable legislation.

The compound shall be used for the following:

- Site office
- Worker amenities
- Equipment and materials storage
- Temporary stockpiling

The compound shall not be within 40m of a waterway or within the dripline of native vegetation. The CCAFMP will consider environmental factors that stand to be impacted by the facility, including traffic and access concerns.

3.4 Public Utility Adjustment

There is the likelihood that Telstra and Water services may need to be relocated, there is to be a utility investigation undertaken prior to the commencement of the road works. Telstra utilities exist on both the east and west of the New England Highway. Water utilities exist west on the New England Highway.

3.5 Property acquisition

Table 1-4 Proposed Property Acquisition

Description	Total Area	Acquisition Type	Current Owner	Lot and DP	Land Use Zone (LEP)

McDonalds- Partial site acquisition necessary for widening of curb	81.26m^2	Required Acquisition	Private owner	Lot 100 DP 793194	B2 Local Centre

4 Statutory and Planning Framework

4.1 Local Environmental Plans

Muswellbrook Local Environmental Plan (LEP) 2009

Under the Muswellbrook LEP 2009 the proposal is located on land zoned R1 General Residential. With the land acquisition, being zoned B2 Local Centre.

The objectives of the zone B2 Local Centre are:

- To provide a range of retail, business, entertainment and community uses that serve the needs of people who live in, work in and visit the local area
- To encourage employment opportunities in accessible locations
- To maximize public transport patronage and encourage walking and cycling

The objectives of zone R1 General Residential:

- To provide for the housing needs of the community
- To provide for a variety of housing types and densities
- To enable other land uses that provide facilities or services to meet the day-to-day needs of residents

The ISEPP overrides the provisions of the Muswellbrook LEP and development consent under Part 4 of the EP&A Act is not required.

The proposed works will not conflict the objectives of the land zoning objectives providing infrastructure to support the objectives of the zoning and use of the land as General Residential and Local Centre.

4.2 State Environmental Planning

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road intersection upgrade and is to be carried by MSC, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not require development consent or approval under State Environmental Planning Policy (Coastal Management) 2018, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (State Significant Precincts) 2005.

Part 2 of ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in **Chapter 5** of this REF.

NSW State Environmental Planning Policy No 44 – Koala Habitat Protection

The Muswellbrook LGA is listed in Schedule 1 of SEPP44 – Koala Habitat Protection. As the Project is being conducted under the Part 5 EP&A Act pathway, SEPP44 does not apply to these works. However, the habitat definitions detailed in this instrument are useful in assessing the habitat suitability for this species within the Study Area.

Schedule 1 of SEPP 44 identifies areas of land that are classified as being 'Core Koala Habitat' and Schedule 2 identifies feed tree species pertaining to 'Potential Koala Habitat'. These areas are defined as follows:

- Core Koala Habitat is an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young), recent sightings, and historical records of population; and
- Potential Koala Habitat as areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Assessed against the definition of potential Koala habitat with reference to the feed tree species list in Schedule 2 of the SEPP, the Study Area is not considered to conform to potential Koala habitat.

4.3 Other Relevant NSW Legislation

There is a range of other State legislation that is relevant to the proposal. These instruments have been considered in **Table 3-2**, and the need for any additional permits, licenses or approvals for the proposal identified as applicable.

Table 1-5 Other Relevant NSW Legislation

Legislation	Agency	Relevance to the proposal	Action Required
NSW *Contaminated Land Management Act 1997*	Office of Environment and Heritage (OEH)	Relates to those areas where contamination presents a significant risk of harm to human health or some other aspect of the environment. Must report to the Environment Protection Authority (EPA) if contaminated land is encountered during construction that meets the duty to report contamination requirements under Section 60 of this Act.	None – Unless contaminated land is encountered during construction
NSW *Crown Lands Management Act 2016*	Department of Primary Industries (DPI) – Lands	The Act authorises councils to manage Crown land as if it were public land under the Local Government Act 1993 (LG Act) with the default classification of community land.	None – The proposal is not located on Crown Land
NSW *Heritage Act 1977*	OEH – Heritage Office	Relates to non-Aboriginal historic artefacts and/or sites (older than 50 years) if uncovered during construction.	None - Should any non-Aboriginal objects be uncovered during construction, construction should cease in the vicinity of the find and OEH should be notified immediately (**Section 6.6**).
NSW *National Parks and Wildlife Act 1974*	OEH	Relates to disturbance or destruction of any Aboriginal objects or places and removal of identified native species, populations and ecological communities. Is triggered if any works are proposed on or adjacent to any land dedicated under the Act.	None - Impacts on Aboriginal cultural heritage are not anticipated (refer **Section 6.6**). Should any Aboriginal objects be uncovered during construction, construction should cease in the vicinity of the find and OEH notified immediately (refer **Section 6.6**). The proposal does not intercept, or lie adjacent to, a National Park or Nature Reserve.
NSW *Protection of the Environment Operations Act 1997*	EPA	When a “scheduled” activity as listed under the POEO Act is conducted, a license is required from the NSW Environment Protection Authority (EPA) for the emission of pollutants from the site.	The proposed works are not identified as Schedule activities under this Act.

Legislation	Agency	Relevance to the proposal	Action Required
Biodiversity Conservation Act 2016 (BC Act)	OEH	The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The Biodiversity Assessment Method (BAM) made under the BC Act, is used to assess impacts to threatened species and calculate offset requirements. If any required 'test of significance' assessment indicates that there will be a significant impact to biodiversity, the proponent must carry out a BAM assessment in relation to the identified impacts.	None - No significant impacts on any threatened species, populations or endangered ecological communities (EECs) are anticipated (refer **Section 6.1**).
Biosecurity Act 2015 (Bio Act)	OEH	Provides for the management of biosecurity within NSW. One of the core principles of the Act is that biosecurity is a shared responsibility, with a key management tool as part of shared responsibility being the general biosecurity duty.	None - the REF has considered whether weeds are present within the Proposal area, and appropriate weed management measures are provided.
NSW *Waste Avoidance and Resource Recovery Act 2001*	OEH	The purpose of this Act is to minimise the consumption of resources and to control the management and disposal of any waste materials through waste avoidance, re-use and recycling in accordance with the principles of ESD.	None - The proposed activity would generate waste and is therefore required to consider the waste management hierarchy referred to in this Act (**Section 6.11**).
Water Act 1912	WaterNSW	The Water Act 1912 governs the issue of water licences for water sources in other areas. A licence is required to extract water from either a surface or groundwater source	None - No water extraction required for construction of the proposal.
NSW *Roads Act 1993*	RMS	Consent of the appropriate roads authority must be received in the event that there is a need to close, or conduct works on or over a public road.	RMS is the appropriate authority for this proposal. MSC shall obtain approval from RMS prior to commencement

4.4 Commonwealth Legislation

4.4.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation, focusing on matters of National Environmental Significance (MNES), with States and Territories having responsibility for matters of State and local significance.

Approval is required from the Commonwealth Minister for the Environment for any controlled action that may result in a significant impact on matters of MNES.

A search of the EPBC Act database (Protected Matters Search Tool) was undertaken on 20 May 2019. The nine matters of MNES protected under the EPBC Act are shown in **Table 1-6** which also identifies the potential for occurrence within 10km of the proposal.

Table 1-6 Matters of National Environmental Significance (MNES)

Matters of National Environmental Significance	Potentially Occurring
World heritage properties	None

National heritage places	None
Wetlands of international importance (listed under the Ramsar Convention)	1
Great Barrier Reef Marine Park	None
Commonwealth marine areas	None
Threatened ecological communities	4
Threatened species	29
Migratory species (protected under international agreements such as JAMBA, CAMBA and ROKAMBA)[1]	14
Nuclear Action	N/A

[1]Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)

As indicated in **Table 1-6**, four threatened ecological communities, 29 threatened and 14 migratory species have the potential to be located within 10km of the site. No threatened ecological communities were confirmed from the site, and no significant impacts on EPBC Act listed species or communities are anticipated.

The search results identify one (1) Wetland of international Importance near to the search area. The wetland identified in the search is the Hunter Estuary Wetland which is located 50 – 100km upstream and is not impacted by the proposed works.

Based on the outcomes of the assessment of potential impacts on biodiversity (refer **Section 6.1**), the proposed works are unlikely to have a significant impact on a MNES, and is therefore not considered to be a controlled action. Our assessment has concluded that no approval under the EPBC Act is required.

4.5 Confirmation of Statutory Position

The proposal is categorised as development for the purpose of a road and road infrastructure facilities and is being carried out by or on behalf of a public authority. Under clause 94 of the ISEPP the proposal is permissible without consent. The proposal is not State Significant Infrastructure or State Significant Development. The proposal can be assessed under Part 5 of the EP&A Act.

MSC is the determining authority for the proposal. This REF fulfils MSC's obligation under clause 111 of the EP&A Act to examine and consider to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

Part 6, Division 1 Section 75 of the *Roads Act 1993* states that a public authority may not carry out road work on a classified road, being work that involves the deviation or alteration of the road unless the plans and specifications for the proposed work have been approved by RMS.

The assessment of potential impacts found that it would be unlikely to cause a significant impact on matters of national environmental significance or the environment of Commonwealth land. A referral to the Australian Department of the Environment and Energy is not required.

5 Consultation

5.1 Consultation Strategy

Consultation shall be as per MSCs Community Consultation and Stakeholder Engagement Plan for the proposal. The plan shall identify key objectives and the desired consultation outcomes. Focusing on consultation with relevant Government agencies, stakeholders and the community affected by the proposal. The plan's overall objectives shall:

- Provide stakeholders with clear, relevant, timely and accurate information about the proposal, proposed changes and impacts
- Identify local issues to ensure the proposal aligns with community needs
- Inform and consult affected and interested stakeholder groups

A mix of communication channels will be used to communicate with the community and stakeholders throughout the proposal's development.

5.2 Community Involvement

MSC has engaged in consultation with Forestry, RMS, local residents and the owners of businesses, including McDonalds.

RMS has granted approval to the preliminary design and MSC will implement a consultation strategy involving the following:

- The REF shall be displayed publicly on the MSC website
- A community update will be letterbox dropped to residents and businesses, and additional stakeholders will receive the community update with a covering email / letter
- During the project consultation period potentially affected residents, businesses and other nearby stakeholders will be visited by project team staff to discuss the proposal and address their issues of concern. Project team staff will also schedule and meet with potentially affected residents and other stakeholders as requested

5.3 ISEPP Consultation

The proponent MSC has undertaken appropriate consultation with relevant council departments that stand to be impacted, as per the ISEPP outline for consultation with councils.

Issues that have been raised as a result of this consultation are outlined below in Table 5-1.

Table 1-4 Consideration of Consultation under the ISEPP

Is consultation with council required under clauses 13-15 of the Infrastructure SEPP?		
Is the proposal likely to have a substantial impact on the stormwater management services which is provided by council?	☐ Yes	☑ No
Is the proposal likely to generate traffic to an extent that will strain the existing road system in a local government area?	☐ Yes	☑ No
Will the proposal involve connection to a council owned sewerage system? If so, will this connection have a substantial impact on the capacity of the system?	☐ Yes	☑ No
Will the proposal involve connection to a council owned water supply system? If so, will this require the use of a substantial volume of water?	☐ Yes	☑ No
Will the proposal involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a minor or inconsequential disruption to pedestrian or vehicular flow?	☐ Yes	☑ No
Will the proposal involve more than a minor or inconsequential excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	☑ Yes	☐ No
Is the proposal located on flood liable land? If so, will the proposal change flooding patterns to more than a minor extent?	☐ Yes	☑ No
Is there a local heritage item (that is not also a state heritage item) or a heritage conservation area in the study area for the proposal? If yes,	☐ Yes	☑ No

does a heritage assessment indicate that the potential impacts to the item/area are more than minor or inconsequential?		
Is consultation with other agencies required under clause 16 of the Infrastructure SEPP?		
Is the proposal adjacent to a national park, nature reserve or other area reserved under the *National Parks and Wildlife Act 1974*?	☐ Yes	☑ No
Is the proposal adjacent to a declared aquatic reserve under the *Fisheries Management Act 1994*?	☐ Yes	☑ No
Is the proposal adjacent to a declared marine park under the *Marine Parks Act 1997*?	☐ Yes	☑ No
Is the proposal in the Sydney Harbour Foreshore Area as defined by the *Sydney Harbour Foreshore Authority Act 1998*?	☐ Yes	☑ No
Does the proposal involve the installation of a fixed or floating structure in or over navigable waters?	☐ Yes	☑ No
Is the proposal for the purpose of residential development, an educational establishment, a health services facility, a correctional facility or group home in bush fire prone land?	☐ Yes	☑ No

6 Environmental Assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered as required under Clause 228(1)(b) of the *Environmental Planning and Assessment Regulation 2000*. The factors specified in Clause 228(2) of the *Environmental Planning and Assessment Regulation 2000* are also considered in **Appendix A**. Site-specific safeguards are provided to ameliorate the identified potential impacts.

6.1 Biodiversity

6.1.1 Methodology

An ecological assessment incorporating both a desktop investigation and a site inspection was conducted in May 2019. Desktop resources accessed for the investigation included:

- NSW Environment and Heritage, BioNet database
- The Department of Energy and Environments, Matters of National Environmental Significances database
- ArcGIS
- MSC LEP 2009

A site inspection was conducted in May 2019 to ground-truth the data collected. The study area considered the ecological values within the proposal footprint and any areas likely to be affected by the proposal.

Impact significance was assessed in accordance with the following guidelines:

- Threatened Species Assessment Guidelines: The Assessment of Significance (DECCW, 2007)
- Significant Impact Guidelines 1.1: Matters of National Environmental Significance (Commonwealth Department of the Environment, 2013).

The above two guidelines define the processes to determine if a proposal's impacts are significant within the statutory meaning and definition of the corresponding Acts. They provide a statutory basis for defining the proposal's impacts by simply defining if a proposal is predicted to have a significant impact, which would trigger additional legal and statutory requirements and provisions.

6.1.2 Existing Environment

6.1.2.1 Flora

The proposal site is highly urbanised. Existing vegetation present within the study area includes ornamental cultivar shrubs and introduced grass and weeds. To The east there is a row of River Oaks *(Casuarina Cunninghamiana)* along the site boundary. 100m east from this boundary there is a Red River Gum (*Eucalyptus Camaldulensis*), these are an endangered population under the NSW Threatened Species Conservation Act 1995 (TSC Act).

9 threatened flora species, 14 migratory species and 4 threatened ecological communities listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and 7 Species listed under TSC Act (**Appendix C**) have been previously recorded within the broader area. The proposal site does not represent suitable habitat for these species and they are therefore not expected to be present.

6.1.2.2 Fauna

20 threatened fauna species listed under the EPBC Act and/or 35 the TSC Act have been previously recorded within the broader area (**Appendix C**). The proposal site does not represent suitable habitat for these species and were not identified during the site inspection.

6.1.2.3 Matters of National Environmental Significance Summary

Table 4-3 summarises the occurrence of matters of national environmental significances within a 10km radius of the proposed works. The full EPBC Act Protected Matters Report is available in **Appendix C**. The search identified four threatened ecological communities, 29 listed threatened species and 14 listed migratory species within the buffer zone; none of these matters are located within the study area and will not be impacted by the proposed works.

6.1.3 Potential Impacts

The proposal design details the following flora removal:

- A rose bush, lemon tree and cultivar shrub, on the private lot to the west of the intersection, these are shown in (**Figure 1-5**).
- Two non-native cultivar trees, on the McDonalds lot to the south (**Figure 1-6**).
- The detailed design features a singular tree marked for removal within the road reserve to the east, however during the site inspection the tree was not found and is assumed to be previously removed. **Figure 6-5** displays the proposed location of the tree on the site. The corridor of river oaks (*Casuarina Cunninghamiana*) pictured to the east of the study area are outside of the proposed works boundary, zoned as forestry and are not to be impacted by the proposal.

Figure 1-4 shows the trees that are marked for removal for the proposal. The yellow marking indicates the location on the plan that is marked for tree removal, however this location was already clear when the site inspection occurred.

Figure 1-4 Location of trees to be removed

Figure 1-5 Left, Cultivar landscape shrub marked for removal. Right, lemon tree marked for removal

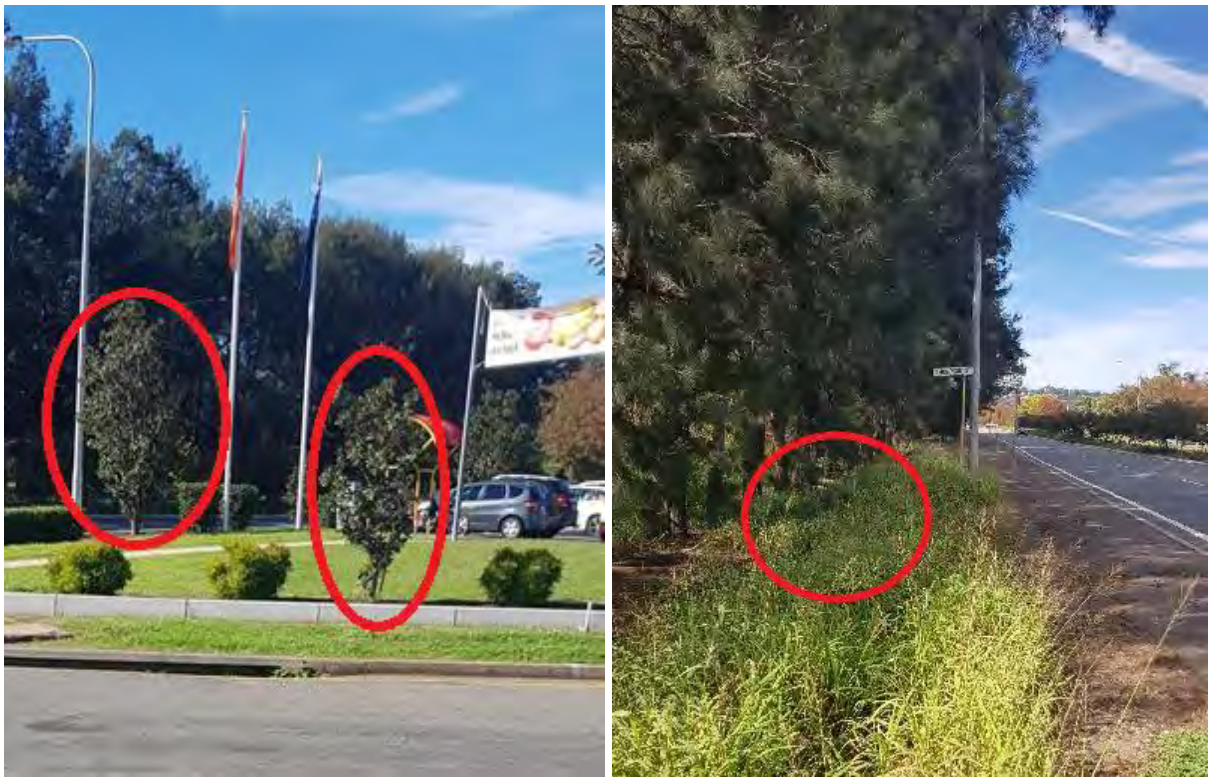

Figure 1-6 Landscaping trees to be removed from Lot 100 DP 793194 and Location of tree previously removed

The proposal is not expected to affect habitat for native flora or fauna, including any threatened species. Biodiversity impacts are therefore not expected. While several threatened birds and flying mammal species (i.e. Grey-headed Flying-fox and insectivorous bats) have been previously recorded within the broader area and may fly over / forage within the area investigated on occasion, none would be solely reliant upon the resources present such that the proposal would have a significant impact on the local or regional viability of these species, their populations or habitats. A summary of the previously reported threatened species in the broader area is in **Appendix C**.

The Study Area is located within an urbanized landscape. Local fauna utilizing the available habitat are adapted to the conditions of locality. Works are considered unlikely to significantly affect habitat utility for resident native fauna.

6.1.4 Safeguards and Management Measures

Table 1-5 Potential Biodiversity Impacts and Mitigation Measures

Potential Impacts	Mitigation Measures
Biodiversity	> Install project boundary fencing to ensure activities and ancillary facilities are restricted to the proposal footprint > Use previously cleared / disturbed areas during construction for ancillary facilities including parking areas for plant and construction vehicles and material storage
Native vegetation removal and reestablishment	> Minimize native vegetation and habitat removal through detailed design. The proposal retains all existing River Oaks *(Casuarina Cunninghamiana)* on the eastern boundary of the proposal area
General ecological mitigation	> Ensure any fauna encountered onsite would be managed in accordance with Biodiversity Guidelines, Guide 9 (fauna handling) (Roads and Maritime, 2016b).

Potential Impacts	Mitigation Measures
Sediment migration from areas of unconsolidated, exposed soil during development works into downslope areas of native vegetation	> Sediment fencing shall be installed below all areas of exposed soil during works.
Introduction of new weed species and pathogens downslope due to runoff from unconsolidated, exposed soil during development as well as in stormwater following development	> Appropriate runoff controls such as sediment fencing shall be installed prior to any soil disturbance works. > Any exogenous soil and water used on site (e.g. for dust suppression) shall be appropriately treated to minimize the rise of the introduction of new pests and diseases.
Unexpected threatened species impact	> If unexpected flora or fauna are discovered stop work immediately and implement the Roads and Maritime Unexpected Threatened Species Find Procedure in the Biodiversity Guidelines, Guide 1 (Roads and Maritime, 2016b).

6.2 Water

Hydrology, Surface Water, Flooding and Groundwater

6.2.1 Methodology

A desktop study involving reading the distance and elevation between the site and Muscle Creek available on Nearmaps on 15 May 2019.

GHD completed a geotechnical investigation at the site on behalf of MSC in May 2017, this involved fieldwork conducting a subsurface investigation, there were five test pits drilled for this this investigation. Soil samples recovered from the site were then testing in GHD's laboratory.

6.2.2 Existing Environment

The proposed works are within the Hunter River Catchment. Muscle Creek is located an approximate distance of 315m to the east. Surface levels within the site gently rise to the west of the New England Highway, with relatively flat land to the east.

The terrain gently drains towards Muscle Creek. The environment between the proposed works and the creek consists of a golf course that features altered terrain.

During the geotechnical investigation, groundwater was not encountered in any of the test pits, with soil profiles typically recording a slightly moist to moist moisture condition.

6.2.3 Potential Impacts

6.2.3.1 Construction

Construction works would involve ground disturbance, with which there is associated a potential for erosion and mobilisation of unconsolidated material. It is considered that the proposed works have the potential for minor sediment run off for a short time during the construction works.

During a large storm event there is the potential for stockpiled loose material and sediment to be washed into a drainage line bordering the east of the site and eventually entering Muscle Creek, this will be considered in the determining of stockpiling sites and will be avoided by implementing the measures in **Section 6.2.4**.

6.2.3.2 Operation

The proposal would upgrade existing cross drainage systems and extend (if required) cross drainage structures to suit the proposed road formation. Stormwater runoff from the road pavement would be controlled by new or modified piped drainage systems discharging to existing discharge points located downstream of the road corridor.

Overall, the proposed drainage structures would improve existing drainage conditions by providing sufficient hydraulic capacity to effectively convey stormwater flows. There is no additional flood and water quality risk expected during the operation of the proposal. Any increase in runoff volume as a result of the road

reconstruction and footpath addition would be negligible compared with the flows generated by the overall catchment.

6.2.4 Safeguards and Management Measures

Table 1-6 Potential Water Impacts and Mitigation Measures

Potential Impact	Mitigation Measures
Erosion and sedimentation from exposed soils, including areas cleared of vegetation and stockpile sites.	> Sediment and erosion control measures shall be installed and maintained in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004). > The contractor shall use dust suppression techniques as required during transport of material to and from the site. > Following the completion of works, the site shall be progressively rehabilitated to minimise the risk of transport of soil material from the site.
Water quality and hydrology	> Develop a soil and water management plan (SWMP) as part of the CEMP to manage potential surface water impacts during construction. This SWMP would include: ▪ A spoil handling plan to ensure proper dewatering, transport and/or disposal of any excavated spoil in accordance with relevant regulations ▪ A Spill Prevention and Control Plan. This shall include design, maintenance and effectiveness considerations ▪ Procedures for capturing and managing water during construction. This shall include procedures for treating construction water, such as settlement or possible off-site disposal at a suitably licenced waste facility ▪ Fuel and chemicals shall only be stored in bunded areas within the site compound
Import of material to the site for filling.	> In the event any material is imported to the site, it shall be clean and free of contaminants.
Accidental spills or leaks of fuel, oils or other chemicals during construction.	> Chemicals shall be stored in a suitably bunded / contained storage area. > A spill kit shall be kept on site and staff trained in its use. In the event of any accidental spills, works in the affected area will cease immediately and the incident reported immediately. Contaminants would be contained immediately, removed, and treated (if necessary), and disposed of at a suitably licensed facility in accordance with the Waste Classification Guidelines (EPA, 2014).

6.3 Soils

6.3.1 Methodology

A geo-technical report was produced by GHD on behalf of MSC in May 2017. This investigation involved fieldwork conducting a subsurface investigation, there were five test pits drilled for this this investigation. Soil samples recovered from the site were then testing in GHD's laboratory.

6.3.1.1 Database Search

A search of the EPA Contaminated Land Register was undertaken on 10 May 2019 (**Appendix C**).

A search of acid sulfate occurrence maps published on Australian Soil Resources Information System and a search of The NSW Shared Resource for Environmental Data (SEED) database was conducted on 14 May 2019 (**Appendix C**).

6.3.2 Existing Environment

6.3.2.1 Soils

In general terms, the subsurface conditions encountered at the Thompson Street and New England Highway intersection comprise alluvial soils consisting predominantly high plasticity clay of hard consistency. Low plasticity alluvial silt and low and medium plasticity sandy clay and clay fill were encountered at shallow depths less than 0.3 m.

While not encountered in the test pits (undertaken on the eastern side of the New England Highway), residual soils are expected to be encountered on the Thompson Street (western) side of the intersection. The site is situated within an area with no acid sulfate soils occurrence.

A review of the list of NSW Contaminated Lands register did not indicate any contaminated lands within the vicinity of the study area. However, it is noted that the Contaminated Lands Register is not exhaustive and there remains potential for contaminated land to be encountered during construction.

Contamination (such as heavy metals, benzene, toluene, ethylbenzene xylene and polycyclic aromatic hydrocarbons) could be present at proposal site associated with the degradation of road surfaces (asphalt in surface soils), road runoff impacted sediments within drainage lines next to the road and exhaust depositions, although the contamination is unlikely to be present in elevated concentrations.

6.3.2.2 Regional Geology

The Thompson Street intersection lies close to the geological contact between Quaternary aged alluvium, comprising silt, sand and gravel and the Permian aged Branxton Formation. The map infers that the Quaternary alluvium is located on the eastern side of the New England Highway, with the Branxton Formation located to the west.

6.3.3 Potential Impacts

6.3.3.1 Construction

Potential minor impacts to the soils and geology of the area would primarily occur during the construction period. Construction activities which could result in potential impacts to soil and geology include:

- Excavation and disruption of soil for additional footpaths, road widening and intersection improvements
- Movement of heavy vehicles across exposed earth
- Stockpiling of materials at construction sites, including crushed and waste construction materials
- Potential for spills / leaks of contaminating materials which could result in contamination of soil
- Unexpected contaminated soil
- Vegetation clearing and grubbing processes

6.3.3.2 Operation

The potential for erosion to occur during operation of the proposal would be minimal following the completion of the proposed works.

6.3.4 Safeguards and Management Measures

Table 1-7 Potential Soil Impacts and Mitigation Measures

Potential Impact	Mitigation Measures
Soil	- A site-specific Erosion and Sediment Control Plan/s (ESCP) shall be prepared and implemented. The Plan shall include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and

Potential Impact	Mitigation Measures
	specific controls and follow-up measures to be applied in the event of wet weather.
Erosion and sedimentation from exposed soils, including areas cleared of vegetation and stockpile sites.	> Sediment and erosion control measures shall be installed and maintained in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004). > The contractor shall use dust suppression techniques as required during transport of material to and from the site. > Following the completion of works, the site shall be progressively rehabilitated to minimise the risk of transport of soil material from the site.
Encounter contaminated material during construction	> If suspected contaminated material is encountered, construction shall cease in the vicinity of the find and the affected soils will undergo assessment in accordance the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM, 2013) and Part 4 of the *Waste Classification Guidelines* (EPA, 2014). If confirmed as contaminated, Council and the EPA shall be notified immediately, and a remediation plan developed to manage the contaminated material.
Import of material to the site for filling	> In the event any material is imported to the site, it shall be clean and free of contaminants.
Accidental spills or leaks of fuel, oils or other chemicals during construction	> Chemicals shall be stored in a suitably bunded / contained storage area. > A spill kit shall be kept on site and staff trained in its use. In the event of any accidental spills, works in the affected area shall cease immediately and the incident reported immediately. Contaminants shall be contained immediately, removed, and treated (if necessary), and disposed of at a suitably licensed facility in accordance with the Waste Classification Guidelines (EPA, 2014).
Stockpile management	> All stockpiles shall be designed, established, operated and decommissioned in accordance with Roads and Maritime Stockpile Management Procedures (RTA 2011a). Stockpile sites shall be located: • At least 10 m from the nearest waterway • In an area of low ecological significance • On relatively level ground
Topsoil	> Topsoil shall be stockpiled separately for possible reuse for the landscaping and rehabilitation works within the identified compound and stockpile sites.

6.4 Traffic and Transport

6.4.1 Methodology

MSC conducted a traffic study in 2010 modelling local traffic conditions at Muswellbrook and its immediate surroundings to assess traffic impacts by measuring traffic flow forecasts, speeds and volume/capacity ratios.

Key road works were input into the model. The study assessed the impact of identified developments on the road network and considered appropriate traffic management measures.

6.4.2 Existing Environment

The New England Highway is an 878-kilometre long highway in Australia running from Hexham at Newcastle, NSW at its southern end to Yarraman, north of Toowoomba, QLD at its northern end. The New England Highway is a key transport route for Muswellbrook and regionally for NSW, linking main regional towns through northern NSW. Thompson Street and Shaw Crescent are unclassified residential streets, servicing residence in the south of Muswellbrook with access to the New England Highway.

6.4.3 Potential Impacts

6.4.3.1 Construction

Details of the proposed construction activities, including an indicative methodology and work hours, are detailed in **Section 3.3.** Through traffic would be maintained on the New England Highway, Thompson Street and Shaw Crescent during construction; however, several general short-term traffic and transport impacts may occur to a varying degree. These include:

- Some temporary increases in travel times for vehicles due to speed limit restrictions around areas where construction activities need to be completed under traffic
- Short-term delays associated with construction traffic entering and exiting the construction site under traffic control
- Changes to the safe operating profile of the road network given the addition of construction traffic, including heavy vehicles, as well as temporary traffic controls
- Possible delays to bus journeys due to temporary traffic control measures. It is expected that buses would be affected in a similar way to general traffic
- Minor detours for pedestrians
- Minor kerbside parking changes

Construction activities would require a range of plant and equipment including light and heavy vehicles. The number of construction vehicle trips generated by the proposal would be small relative to highway traffic and is not expected to affect network performance.

Access to the residence at Lot 4 and 6 DP 28425 has the potential to be impacted during:

- Reconstruction of the drive way upgrade
- The possible utility relocation
- Works within the road reserve fronting their property

Access to the McDonalds restaurant Lot 100 DP 793194 has the potential to be impacted during:

- Realignment of the kerb
- The possible utility relocation
- Works within the road reserve fronting their property

The MSC will consult with impacted residence and businesses to ensure that all works that restrict property access occur at the least disruptive time as practically possible.

Safeguards and mitigation measures have been proposed to address the construction related impacts identified above (**Section 6.4.4**).

6.4.3.2 Operation

The Traffic Report produced by MSC states that within this 2.5km section of the New England Highway there are signals at Rutherford Road and a new set proposed for Bimbadeen Drive. Effective signals spacing will be about 500 meters with the addition of the proposed signals at Thompson Street. This will have negative implication on through traffic performance on the New England Highway. However, the intersection upgrade will result in a safer intersection, facilitating pedestrian use and a significant increase to the level of service for road users making right turns in and out of Thompson Street during peak periods.

The table below compares the delays anticipated at the intersection in 2037 if the intersection remains in its current operational state, compared to how it will operate in peak times with the signalized pedestrian crossings at all three aspects. The study considers expected residential population growth and commercial development.

Table 1-8 Intersection LoS prediction for 2037 based on control options

Year	Intersection	Intersection Control	AM Peak				PM Peak			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
2037	Thompson Street/New England Highway	Give-way	1.00	>300	F	148	1.00	>300	F	>300
2037	Thompson Street/New England Highway	New Signals	0.70	12	A	157	0.84	15	b	242

6.4.4 Safeguards and Management Measures

Table 1-9 Potential Traffic Impacts and Mitigation Measures

Potential Impacts	Mitigation Measures
Traffic management	> The Contractor shall comply with any Council requirements regarding traffic control and access. > A construction traffic management plan (CTMP) shall be prepared as part of the pre-construction planning. The plan shall detail how the traffic associated with the construction is to be managed in accordance with the Roads and Maritime Traffic Control at Work Sites (RTA 2010b), as well as relevant Australian Standards including AS1742 and the work site manual Roads and Maritime Specification G10. The TMP shall be submitted in stages to reflect the progress of work and would outline: ▪ Traffic control provided to manage and regulate traffic movements during construction, including minimising traffic switching. ▪ Maintain the continuous, safe and efficient movement of traffic for both the public and construction workers. ▪ Identification of haulage routes and ensuring impacts to local routes are minimised ▪ Determine temporary speed restrictions to ensure a safe driving environment around work zones ▪ Provision of appropriate warning and advisory signposting ▪ Include requirements and methods to consult and inform local community of impacts on local road network and traffic ▪ Consider other developments that may also be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic > The CTMP shall also be used to develop site-specific traffic management measures once the construction methods and haulage routes are finalised. These measures shall be developed as part of the site-specific traffic management plans to indicate how traffic would be controlled and managed during each stage of the construction. > A vehicle movement plan (VMP) shall be prepared as part of the CTMP. The VMP shall assess construction related heavy vehicle movements per shift in to and out of the construction site/s. The VMP would identify elements of the construction such as: ▪ Limiting the number of points where new alignments cross the existing road network ▪ Limiting the need to occupy areas of the existing road ▪ Identifying haulage routes for construction traffic ▪ Undertaking road condition surveys of local roads prior to construction
Access	> Disruption to property access - Council shall notify the relevant property owner in advance of the disruption in accordance with the relevant community consultation processes outlined in the CTMP and CEMP.

6.5 Noise and Vibration

6.5.1 Methodology

Cardno engaged noise and vibration specialist Muller Acoustic Consulting to complete a Noise and Vibration Assessment to include in the REF, the full report is in **Appendix B**. A theoretical assessment of road traffic noise was conducted to predict levels at the façade of the receivers using the Calculation of Road Traffic Noise algorithm, as developed by the UK Department of Transport. The method incorporates traffic volume and mix, type of road surface, vehicle speed, road gradient, ground absorption and shielding from ground topography and physical noise barriers.

Receiver locations, ground topography, current/future road alignment and other cadastral data (eg property boundaries) were obtained from electronic data provided by Roads and Maritime. The noise modelling was based on 3D elevation strings for the current road alignment and proposed road alignments (provided by Roads and Maritime). The noise impacts at residences have been quantified to the most exposed facades of receivers exposed to the proposal alignment at heights of either 1.5m or 4m above the ground elevation (depending whether the receiver dwelling is single or double storey).

6.5.2 Existing Environment

To establish the existing background noise environment of the area, unattended noise monitoring was conducted at the nearest receiver location to the proposal alignment. The monitoring location is representative of the surrounding noise catchment and was used to quantify existing traffic noise contributions and calibrate the noise model. The monitoring location is shown in **Figure 1** of the Noise assessment **in Appendix B.**

The measurements were carried out using Svantek Type 1, 957 noise analyser from Tuesday 21 May 2019 to Sunday 2 June 2019. Observations on-site identified the surrounding locality typical of a suburban environment with suburban sources and intermittent traffic noise audible.

Table 1-10 Background Noise Monitoring Summary

Background Noise Monitoring Summary						
Location	Measured background noise level, RBL, dBA			Measured LAeq, dBA		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
L1 (R5)	51	42	34	66	62	58

Note 1: Excludes periods of wind or rain affected data, meteorological data obtained from the Bureau of Meteorology Scone Airport (32.0335°S 150.8264°E)

6.5.3 Potential Impacts

The results of the assessment identify that the Construction of New Pavement and Kerbing has potential to generate the highest noise levels during the proposal.

Several activities are identified to exceed the highly noise affected Interim Construction Noise Guideline (ICNG) NML of 75dB. Therefore, reasonable and feasible work practices should be considered for the proposal. Maximum emissions from plant during excavation works are only anticipated to occur for a few days in duration and will be effectively managed with the aim of minimising noise emissions within the community.

Table 1-11 Construction Noise

Construction Scenarios & Fleet Sound Power Levels			
io Description	Typical Plant Included in Fleet	Overall Fleet Sound Power, dBA	Proposed Work Period

Site Mobilisation and Establishment of Traffic Controls	Truck (medium rigid) Service Vehicle Generator Lighting plant (for OOH)	102	Standard Hrs with potential for OOH
Drainage/Earthworks/Utility Relocation/Signal Installation	Excavator (tracked) 35t Front end loader 23t Dump truck Truck mounted crane Lighting plant (for OOH)	109	Standard Hrs with potential for OOH
Construction of New Pavement and Kerbing	Pavement laying machine Dump truck Asphalt truck & sprayer Concrete truck Smooth drum roller Concrete saw Lighting plant (for OOH)	118	Standard Hrs with potential for OOH
Line Marking and Signage Installation	Service Vehicle Hand Tools Line marking truck Lighting plant (for OOH)	99	Standard Hrs with potential for OOH

Noise modelling identifies that relevant NMLs for the proposal could be exceeded when each construction activity occurs at the near point of receivers.

6.5.4 Safeguards and Management Measures

Table 1-12 Potential Landscape and Visual Amenity Impacts and Mitigation

Potential Impacts	Mitigation Measures
Construction Noise	The CNVG and ICNG outline noise management and mitigation initiatives to minimise the impact and improve the acoustic amenity of receivers potentially affected by road construction proposals. The CNVG recommends several standard actions and mitigation measures that should be implemented on all construction proposals. The key actions include: > Management Measures ▪ Implementation of any proposal specific mitigation measures required ▪ Implement community consultation or notification measures ▪ Site inductions ▪ Behavioural practices ▪ Verification ▪ Attended vibration measurements ▪ Update/undertake Construction Environmental Management Plans

Potential Impacts	Mitigation Measures
	> Source Controls ▪ construction hours and scheduling ▪ construction respite period during normal hours and out-of-hours work ▪ equipment selection ▪ plant noise levels ▪ rental plant and equipment ▪ use and siting of plant ▪ plan worksites and activities to minimise noise ▪ reduced equipment power ▪ non-tonal and ambient sensitive reversing alarms ▪ minimise disturbance arising from delivery of goods to construction sites ▪ engine compression brakes > Path Controls ▪ shield stationary noise sources such as pumps, compressors, fans etc ▪ shield sensitive receivers from noisy activities > Receiver Controls ▪ Notification (letterbox drop or equivalent) ▪ Specific notifications (SN) ▪ Phone calls (PC) ▪ Individual briefings (IB) ▪ Respite Offers (RO) ▪ Respite Period 1 (R1) ▪ Respite Period 2 (R2) ▪ Duration Respite (DR) ▪ Alternative Accommodation (AA) ▪ Verification > The ICNG suggests all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise. > Australian Standard AS 2436-2010 (R2016) “Guide to Noise Control on Construction, Maintenance and Demolition Sites” sets out numerous practical recommendations to assist in mitigating construction noise emissions. > Recommendations provided in the ICNG and AS2436 include combinations of operational strategies, source noise control strategies, noise barrier controls, and community consultation. > It is estimated that adopting strategies contained in this standard may result in the following noise attenuation: ▪ Up to 10dBA where space requirements place limitations on the attenuation options available ▪ Up to 20dBA in situations where noise source noise mitigation measures (silencers, mufflers, etc) can be

Potential Impacts	Mitigation Measures
	combined with noise barriers and other management techniques. > Universal work practices that can be applied to the proposal (and all subsequent activities) include: ▪ Conduct toolbox talks pre-shift to communicate awareness regarding the importance of noise emission management ▪ Ensure site managers periodically check noise emissions at receivers adjacent to noisy activities so that potential problems can be rectified ▪ UHF radios will be used for communication with no yelling allowed ▪ No slamming of doors is allowed ▪ Plant will be parked in accessible and where possible shielded locations prior to being used for out of hours work ▪ Minimise the use of reverse alarms ▪ Site access will be gained via entry points most remote to receivers ▪ Minimise clustering of plant items > Management are to communicate to staff and contractors the importance of minimising noise emissions to the community when arriving and leaving site > A noise monitoring program is to be implemented to quantify noise emissions from construction activities and guide practical reasonable and feasible noise control measures

6.6 Aboriginal Heritage

6.6.1 Methodology

A search of the Aboriginal Heritage Information Management System (AHIMS), was conducted on 10 May 2019 to identify any potential Aboriginal heritage constraints for the project (refer to **Appendix C**).

6.6.2 Existing Environment

The AHIMS search identified one registered site within 1km of the locality, to follow up this result further searches were then conducted reducing the search location to 200m from the site, these searches resulted in no results found. Further no Aboriginal places are recorded in Muswellbrook under the *National Parks and Wildlife Act*. The subject site has been heavily disturbed by road construction and the installation of underground utilities.

6.6.3 Potential Impacts

Aboriginal cultural heritage impacts are not expected as a result of the proposal given the previously disturbed nature of the proposal location. The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage's Due diligence Code of Practice for the Protection of Aboriginal objects in NSW. It is considered unlikely that any sites or items of Aboriginal Significance would be disturbed by the construction or operation of the proposed works.

6.6.4 Safeguards and Management Measures

Table 1-13 Potential Aboriginal Heritage Impacts and Mitigation Measures

Potential Impacts	Mitigation Measures
Previously unidentified Aboriginal sites or items may be uncovered during construction. This risk is generally considered low due to the disturbed nature of the site.	> All construction personnel shall be made aware of their responsibilities in relation to Aboriginal cultural heritage, and in particular the relevant legislation. > If any previously sites, artefacts or items of cultural heritage significance to Aboriginal people are uncovered during the course construction, construction shall cease immediately in the vicinity of the find and Council and OEH must be notified for further advice. > If any suspected skeletal material is uncovered during construction, works must cease immediately and Council, OEH and the NSW Police shall be notified.

6.7 Non-Aboriginal Heritage

6.7.1 Methodology

A search of on the NSW State Heritage Register; and Muswellbrook LEP (2009) was conducted on May 10th 2019 and no Listed European heritage sites located within the study area were identified. (**Appendix C**)

6.7.2 Existing Environment

No Commonwealth or State listed heritage items or places were found to be recorded in the study area.

6.7.3 Potential Impacts

The potential to encounter previously unlisted items of heritage significants remain, however given the previously disturbed nature of the site this possibility is considered unlikely.

6.7.4 Safeguards and Management Measures

Table 1-14 Potential Non-Aboriginal Heritage Impacts and Mitigation Measures

Potential Impacts	Mitigation Measures
Previously unidentified non-Aboriginal sites or items may be uncovered during construction. This risk is generally considered low due to the disturbed nature of the site.	> The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime Services, 2015) shall be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. > Work shall only re-commence once the requirements of that Procedure have been satisfied.

6.8 Landscape Character and Visual Impact

6.8.1 Methodology

An assessment of the landscape character and visual amenity of the proposed development was conducted using the detailed design completed by GHD in May 2018 compared to online map database Nearmap and a site inspection on 13 May 2019.

6.8.2 Existing Environment

The Thompson Street and New England Highway intersection is bounded by residential housing to the west, medium dense trees and introduced grass and weeds (**Figure 1-7a**) followed by open grassed areas associated with a golf course to the east and a McDonalds restaurant and car parking to the south **(Figure 1-6b**). Surface levels gently rise to the west of the New England Highway, with relatively flat land to the east.

Figure 1-7 a) View of the eastern site boundary and b) south western aspect of the site

6.8.3 Potential Impacts

6.8.3.1 Construction

A short-term minor decline in visual amenity during construction is expected. The measures in **Table 1-15** would be implemented to manage and mitigate potential impacts on visual amenity during construction.

6.8.3.2 Operation

There will be a minor long-term impact to the landscape in the operational phrase due to the presence of traffic lights, increased road markings and signage. The realigning of the kerb in front of McDonalds requires the removal of two non-native cultivar trees. Due to the developed nature of the site these impacts shall be insignificant provided that the mitigation measures provided are followed.

6.8.4 Safeguards and Management Measures

Table 1-15 Potential Landscape and Visual Amenity Impacts and Mitigation

Potential Impacts	Mitigation Measures
Minor visual impacts during construction of the proposed works. Impacts would result from the presence of construction equipment and activities.	> The site shall be kept clean of general litter and tidy for the duration of works.

Potential Impacts	Mitigation Measures
	> Disturbed areas shall be re-instated and stabilized progressively, minimizing the footprint of the proposal at any one time.
Impact on Street Trees	> None of the River Oaks (*Casuarina Cunninghamiana)* shall be removed. > The Landscaping of the McDonalds car park boundary is to be returned to the equivalent of its existing visual value.

6.9 Socio-Economic

6.9.1 Existing Environment

The site provides access to the New England Highway for residents, enabling access to industry in towns and rural areas from Newcastle to Queensland. For local industry the intersection is significant as Thompson Street is the access point for the showground area that recently was rezoned from RE2 private recreation to B5 business development. A McDonalds restaurant is located on the corner of Thompson Street and the New England Highway.

The majority of the proposed works will occur within the existing road reserve that is zoned R1 General Residential, the land that will be acquired for the widening of the intersection is zoned B2 Local Centre.

6.9.2 Potential Impacts

6.9.2.1 Construction

Construction of the proposal is expected to take approximately 3 months to complete. Construction impacts that would affect the social and economic environment would generally be temporary and would include changes to noise and visual amenity, and changes to traffic, transport and access arrangements. These impacts have been discussed in the prior sections.

There will be a land acquisition of an 81.26m^2 section of Lot 100 DP to widen the intersection, access to this lot and to residential Lot 4 and 6 DP28425 will be impacted temporarily during construction, these potential impacts and mitigation measures are discussed in Section 6.4.

Buses that service the locality are expected to still operate as usual during construction.

Short-term traffic delays may occur to businesses and residents who utilise Thompson Street and the New England Highway.

6.9.2.2 Operation

Business Impacts

Once operational, the proposal will provide a positive impact for local and regional communities that will be accessing the business development at the showground site through increasing safety and improving accessibility to the area. The proposal and associated acquisition are in the best interest of the McDonalds that occupies that lot, as the finished development will improve the accessibility of the site and potentially increase revenue. The proposal would not directly impact any other local businesses or land uses.

Accessibility

The proposal involves no permanent reduction to property accesses. As noted in Section 6.4, the operation of the proposal may represent a minor increase in travel time for some road users, as the addition of the traffic lights will disrupt the flow of traffic on the New England Highway. However, it shall significantly reduce the delays experienced by road users making right turns at the intersection.

Community wellbeing and safety

The proposal would improve safety of both the local community and travelling public through the provision of signalised pedestrian which reduce the risk of vehicle and pedestrian conflicts. This represents a social benefit.

The overall impact of the proposal would be positive to local and regional land users as it would improve road safety and accessibility.

6.9.3 Safeguards and Management Measures

Table 1-16 Potential Socio-Economic and Land Use Impacts and Mitigation

Potential Impacts	Mitigation Measures
Impacts on business and community during construction	> At least two weeks prior to commencement of construction, potentially affected local businesses and residents shall be notified of the nature and likely duration of the proposal > Ongoing community consultation shall be undertaken
Complaints procedure	> A complaint handling procedure and register shall be included in the CEMP. > Complaints received shall be recorded and attended to promptly
Amenity	> Early and ongoing consultation and communication shall be undertaken with residents and local communities closest to construction works about construction activities, including timing, duration and likely impacts in particular where works are proposed outside of standard daytime construction hours.
Disruption to property access	> Access to properties in the proposal area shall be maintained during construction. If temporary changes to property access are required, alternative access arrangements shall be determined in consultation with the affected property's owners or tenants.

6.10 Air Quality

6.10.1 Existing Environment

The Muswellbrook air quality monitoring site located in Bowman Park on Lorne Street identifies the air quality of Muswellbrook as Good. The air quality of the study area is generally considered to be comparable to an urban environment. A major contributing source of air pollution for the local area is exhaust emissions from motor vehicles traveling along the New England Highway. Exhaust from these vehicles would include (but is not be limited to) the release of greenhouse gases as well as the production of small, airborne particulates, leading to poor air quality and human health effects.

6.10.2 Potential Impacts

6.10.2.1 Construction

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities associated with road construction. Primary sources of emissions of airborne particulate matter associated with the construction of the proposal would include:

> Excavation by backhoes and/or excavators

> Movement of soil and fill by trucks

> Wind erosion from unsealed surfaces and stockpiles

> Vehicle (exhaust) emissions

> Dust generated by the wheels of construction vehicles travelling along unsealed areas

There is potential for dust to cause nuisance impacts if activities are located close to sensitive receptors, such as residences. Sensitive receptors would be potentially impacted by increased dust levels. The magnitude of dust impacts would depend on the extent of soil disturbance at the particular location, the duration of activities and the local meteorology at the time, particularly the wind speed and direction.

As most work would be confined to existing pavements potential dust impacts are likely to be minor and manageable through the implementation of standard safeguards.

6.10.2.2 Operation

Air quality impacts during operation would mainly be from motor vehicle emissions, fuel combustion, fluid evaporation, brake and tyre wear, and re-suspended road dust. Traffic volumes are not expected to increase as a result of the intersection upgrade; hence air quality impacts due to operation of the proposal are not anticipated.

6.10.3 Safeguards and Management Measures

Table 1-17 Potential Air Quality Impacts and Mitigation

Potential Impacts	Mitigation Measures
Air Quality	> Dust mitigation and suppression measures to be implemented. > Methods to manage work during strong winds or other adverse weather conditions. > A progressive rehabilitation strategy for exposed surfaces.
Erosion and sedimentation from exposed soils, including areas cleared of vegetation and stockpile sites.	> Refer to relevant measures in **Section 6-3**.
Dust emissions associated with the transport of loose materials and vehicle movements both within and to/from the proposed work site.	> Materials shall be covered during transport to minimise dust emissions. > A stabilized site access shall be constructed to reduce tracking sediment off site from the wheels of vehicles exiting the site. The adjacent approaches will be kept free of dust during construction.
Exhaust emissions from vehicles and equipment used at the site.	> Plant and machinery shall not be left in idling. Engines should be turned off when vehicles are not in use. > Equipment, machinery and trucks shall be adequately maintained.

6.11 Other Impacts

Table 1-18 Other Potential Impacts and Mitigation Measures

Potential Impact	Mitigation Measure
Waste Disposal	> The ability to reuse the material would depend on its physical and chemical properties. > Uncontaminated material that is not suitable for use as structural fill could be used to line the utility trenches or in areas of landscaping. > Material unsuitable for construction use shall be transported offsite by a licensed contractor for disposal at a licensed waste management facility following testing and classification > Any unsuitable or surplus material shall be managed in accordance with Roads and Maritime policy, in order of preference: ▪ Reused as part of the proposal ▪ Transferred to another proposal site for use under the resource recovery exemption provisions of NSW

Potential Impact	Mitigation Measure
	Protection of the Environment Operations (Waste) Regulation 2014 ▪ Transferred to a stockpile site for a pre-identified future use on another proposal under the above exemption provisions ▪ Transferred offsite for use on another proposal under the above exemption provisions ▪ Transferred to a licenced waste recovery facility ▪ Disposed to a licenced facility either as a last resort or if the material contains either weed seed stock or elevated contaminants of concern. > Waste shall not be burnt on site. > Waste material, other than vegetation and tree mulch, shall not be left on site once construction has been completed. > Working areas shall be maintained, kept free of rubbish and cleaned up at the end of each working day.
Utilities could be damaged during construction works, which could cause a disruption to services.	> Consultation with all utility providers shall be undertaken prior to the commencement of works. > All project staff shall be made aware of the location of existing utilities and services, and they should be marked where appropriate.

6.12 Cumulative Impacts

Cumulative impacts have the potential to arise from the interaction of individual elements within the proposal as well as interaction with other projects that may be occurring or planned within the locality or the broader region. Clause 228(2) of *the Environmental Planning and Assessment Regulation 2000* requires that potential cumulative impacts be considered during the environmental impact assessment process.

Construction traffic volumes associated with the proposal would be relatively small. Impacts from the interaction with construction traffic from other development projects are therefore not expected. Traffic along the New England Highway will be delayed due to the proximity of traffic lights, existing and proposed along this section of the highway. However, traffic turning right at this intersection will see a significant reduction in delay.

Minimising impacts attributable to the proposal is the best way to address any potential cumulative effects and various measures have been proposed in throughout this chapter.

Table 1-19 Cumulative Impacts and Mitigation Measures

Potential Impacts	Mitigation Measures
Construction phase cumulative impacts	> The CEMP shall be revised to consider potential cumulative impacts from surrounding development activities as they become known. This shall include a process to review and update mitigation measures as new work begins or complaints are received.

7 Environmental Management

7.1 Environmental Management Plan

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

7.2 Summary of Safeguards and Management Measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 1-20.

Table 1-20 Summary of Safeguards and Management Measures

Environmental Aspect	Mitigation Measures
General	> If the scope of the proposal changes at any time a review of the REF may be required. > An environmental management plan is prepared and implemented prior to the commencement of works. > No new access tracks to be created for the proposal. > Parking of vehicles and storage of plant/equipment is to occur on existing paved areas. Where this is not possible, vehicles and plant/equipment are to be kept away from environmentally sensitive areas and outside the dripline of trees.
Biodiversity	> Install project boundary fencing to ensure activities and ancillary facilities are restricted to the proposal footprint. > Use previously cleared / disturbed areas during construction for ancillary facilities including parking areas for plant and construction vehicles and material storage. > Minimize native vegetation and habitat removal through detailed design. The proposal retains all existing River Oaks (Casuarina Cunninghamiana) on the eastern boundary of the proposal area. > Ensure any fauna encountered onsite would be managed in accordance with Biodiversity Guidelines, Guide 9 (fauna handling) (Roads and Maritime, 2016b). > Sediment fencing shall be installed below all areas of exposed soil during works. > Appropriate runoff controls such as sediment fencing shall be installed prior to any soil disturbance works. > Any exogenous soil and water used on site (e.g. for dust suppression) shall be appropriately treated to minimize the rise of the introduction of new pests and diseases. > If unexpected flora or fauna are discovered stop work immediately and implement the Roads and Maritime Unexpected Threatened Species Find Procedure in the Biodiversity Guidelines, Guide 1 (Roads and Maritime, 2016b).
Water	> Sediment and erosion control measures shall be installed and maintained in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004).

Environmental Aspect	Mitigation Measures
	> The contractor shall use dust suppression techniques as required during transport of material to and from the site. > Following the completion of works, the site shall be progressively rehabilitated to minimise the risk of transport of soil material from the site. > Develop a SWMP as part of the CEMP to manage potential surface water impacts during construction. This SWMP would include: ▪ A spoil handling plan to ensure proper dewatering, transport and/or disposal of any excavated spoil in accordance with relevant regulations ▪ A Spill Prevention and Control Plan. This shall include design, maintenance and effectiveness considerations ▪ Procedures for capturing and managing water during construction. This shall include procedures for treating construction water, such as settlement or possible off-site disposal at a suitably licenced waste facility > Fuel and chemicals shall only be stored in bunded areas within the site compound. > In the event any material is imported to the site, it shall be clean and free of contaminants. > Chemicals shall be stored in a suitably bunded / contained storage area. > A spill kit shall be kept on site and staff trained in its use. In the event of any accidental spills, works in the affected area will cease immediately and the incident reported immediately. Contaminants would be contained immediately, removed, and treated (if necessary), and disposed of at a suitably licensed facility in accordance with the Waste Classification Guidelines (EPA, 2014).
Soil	> A site-specific Erosion and Sediment Control Plan/s (ESCP) shall be prepared and implemented. The Plan shall include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather. > Sediment and erosion control measures shall be installed and maintained in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004). > The contractor shall use dust suppression techniques as required during transport of material to and from the site. > Following the completion of works, the site shall be progressively rehabilitated to minimise the risk of transport of soil material from the site. > If suspected contaminated material is encountered, construction shall cease in the vicinity of the find and the affected soils will undergo assessment in accordance the National Environment Protection (Assessment of Site Contamination) Measure (NEPM, 2013) and Part 4 of the Waste Classification Guidelines (EPA, 2014). If confirmed as contaminated, Council and the EPA shall be notified immediately, and a remediation plan developed to manage the contaminated material. > In the event any material is imported to the site, it shall be clean and free of contaminants. > Chemicals shall be stored in a suitably bunded / contained storage area. > A spill kit shall be kept on site and staff trained in its use. In the event of any accidental spills, works in the affected area shall cease immediately and the incident reported immediately. Contaminants shall be contained immediately, removed, and treated (if necessary), and disposed of at a suitably licensed facility in accordance with the Waste Classification Guidelines (EPA, 2014).

Environmental Aspect	Mitigation Measures
	> All stockpiles shall be designed, established, operated and decommissioned in accordance with Roads and Maritime Stockpile Management Procedures (RTA 2011a). Stockpile sites shall be located: ▪ At least 10 m from the nearest waterway ▪ In an area of low ecological significance ▪ On relatively level ground > Topsoil shall be stockpiled separately for possible reuse for the landscaping and rehabilitation works within the identified compound and stockpile sites.
Traffic and access	> The Contractor shall comply with any Council requirements regarding traffic control and access. > A construction traffic management plan (CTMP) shall be prepared as part of the pre-construction planning. The plan shall detail how the traffic associated with the construction is to be managed in accordance with the Roads and Maritime Traffic Control at Work Sites (RTA 2010b), as well as relevant Australian Standards including AS1742 and the work site manual Roads and Maritime Specification G10. The TMP shall be submitted in stages to reflect the progress of work and would outline: ▪ Traffic control provided to manage and regulate traffic movements during construction, including minimising traffic switching ▪ Maintain the continuous, safe and efficient movement of traffic for both the public and construction workers ▪ Identification of haulage routes and ensuring impacts to local routes are minimised ▪ Determine temporary speed restrictions to ensure a safe driving environment around work zones ▪ Provision of appropriate warning and advisory signposting ▪ Include requirements and methods to consult and inform local community of impacts on local road network and traffic ▪ Consider other developments that may also be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic > The CTMP shall also be used to develop site-specific traffic management measures once the construction methods and haulage routes are finalised. These measures shall be developed as part of the site-specific traffic management plans to indicate how traffic would be controlled and managed during each stage of the construction. > A vehicle movement plan (VMP) shall be prepared as part of the CTMP. The VMP shall assess construction related heavy vehicle movements per shift in to and out of the construction site/s. The VMP would identify elements of the construction such as: ▪ Limiting the number of points where new alignments cross the existing road network ▪ Limiting the need to occupy areas of the existing road ▪ Identifying haulage routes for construction traffic ▪ Undertaking road condition surveys of local roads prior to construction > Disruption to property access - Council shall notify the relevant property owner in advance of the disruption in accordance with the relevant community consultation processes outlined in the CTMP and CEMP.

Environmental Aspect	Mitigation Measures
Noise	> The CNVG and ICNG outline noise management and mitigation initiatives to minimise the impact and improve the acoustic amenity of receivers potentially affected by road construction proposals. The CNVG recommends several standard actions and mitigation measures that should be implemented on all construction proposals. The key actions include: ▪ Implementation of any proposal specific mitigation measures required ▪ Implement community consultation or notification measures ▪ Site inductions ▪ Behavioural practices ▪ Verification ▪ Attended vibration measurements ▪ Update/undertake Construction Environmental Management Plans > Source Controls ▪ construction hours and scheduling ▪ construction respite period during normal hours and out-of-hours work ▪ equipment selection ▪ plant noise levels ▪ rental plant and equipment ▪ use and siting of plant ▪ plan worksites and activities to minimise noise ▪ reduced equipment power ▪ non-tonal and ambient sensitive reversing alarms ▪ minimise disturbance arising from delivery of goods to construction sites ▪ engine compression brakes > Path Controls ▪ shield stationary noise sources such as pumps, compressors, fans etc ▪ shield sensitive receivers from noisy activities > Receiver Controls ▪ Notification (letterbox drop or equivalent) ▪ Specific notifications (SN) ▪ Phone calls (PC) ▪ Individual briefings (IB) ▪ Respite Offers (RO) ▪ Respite Period 1 (R1) ▪ Respite Period 2 (R2) ▪ Duration Respite (DR) ▪ Alternative Accommodation (AA) ▪ Verification > The ICNG suggests all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise. > Australian Standard AS 2436-2010 (R2016) “Guide to Noise Control on Construction, Maintenance and Demolition Sites” sets out numerous practical recommendations to assist in mitigating construction noise emissions. > Recommendations provided in the ICNG and AS2436 include combinations of operational strategies, source noise control strategies, noise barrier controls, and community consultation.

Environmental Aspect	Mitigation Measures
	> It is estimated that adopting strategies contained in this standard may result in the following noise attenuation: ▪ Up to 10dBA where space requirements place limitations on the attenuation options available ▪ Up to 20dBA in situations where noise source noise mitigation measures (silencers, mufflers, etc) can be combined with noise barriers and other management techniques. > Universal work practices that can be applied to the proposal (and all subsequent activities) include: ▪ Conduct toolbox talks pre-shift to communicate awareness regarding the importance of noise emission management ▪ Ensure site managers periodically check noise emissions at receivers adjacent to noisy activities so that potential problems can be rectified ▪ UHF radios will be used for communication with no yelling allowed ▪ No slamming of doors is allowed ▪ Plant will be parked in accessible and where possible shielded locations prior to being used for out of hours work ▪ Minimise the use of reverse alarms ▪ Site access will be gained via entry points most remote to receivers ▪ Minimise clustering of plant items > Management are to communicate to staff and contractors the importance of minimising noise emissions to the community when arriving and leaving site > A noise monitoring program is to be implemented to quantify noise emissions from construction activities and guide practical reasonable and feasible noise control measures
Aboriginal and non-Aboriginal heritage	> All construction personnel shall be made aware of their responsibilities in relation to Aboriginal cultural heritage, and in particular the relevant legislation. > If any previously sites, artefacts or items of cultural heritage significance to Aboriginal people are uncovered during the course construction, construction shall cease immediately in the vicinity of the find and Council and OEH must be notified for further advice. > If any suspected skeletal material is uncovered during construction, works must cease immediately and Council, OEH and the NSW Police shall be notified. > The Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime Services, 2015) shall be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. > Work shall only re-commence once the requirements of that Procedure have been satisfied.
Visual Amenity	> The site shall be kept clean of general litter and tidy for the duration of works. > Disturbed areas shall be re-instated and stabilized progressively, minimizing the footprint of the proposal at any one time. > None of the River Oaks (*Casuarina Cunninghamiana*) shall be removed. > The Landscaping of the McDonalds car park boundary is to be returned to the equivalent of its existing visual value.

Environmental Aspect	Mitigation Measures
Socio-economic	> At least two weeks prior to commencement of construction, potentially affected local businesses and residents shall be notified of the nature and likely duration of the proposal. > Ongoing community consultation shall be undertaken. > A complaint handling procedure and register shall be included in the CEMP. > Complaints received shall be recorded and attended to promptly. > Early and ongoing consultation and communication shall be undertaken with residents and local communities closest to construction works about construction activities, including timing, duration and likely impacts in particular where works are proposed outside of standard daytime construction hours. > Access to properties in the proposal area shall be maintained during construction. If temporary changes to property access are required, alternative access arrangements shall be determined in consultation with the affected property's owners or tenants.
Air quality	> Dust mitigation and suppression measures to be implemented > Methods to manage work during strong winds or other adverse weather conditions > A progressive rehabilitation strategy for exposed surfaces > Materials shall be covered during transport to minimise dust emissions. > A stabilized site access shall be constructed to reduce tracking sediment off site from the wheels of vehicles exiting the site. The adjacent approaches will be kept free of dust during construction. > Plant and machinery shall not be left in idling. Engines should be turned off when vehicles are not in use. > Equipment, machinery and trucks shall be adequately maintained.
Waste management	> The ability to reuse the material would depend on its physical and chemical properties. > Uncontaminated material that is not suitable for use as structural fill could be used to line the utility trenches or in areas of landscaping. > Material unsuitable for construction use shall be transported offsite by a licensed contractor for disposal at a licensed waste management facility following testing and classification > Any unsuitable or surplus material shall be managed in accordance with Roads and Maritime policy, in order of preference: ▪ Reused as part of the proposal ▪ Transferred to another proposal site for use under the resource recovery exemption provisions of NSW Protection of the Environment Operations (Waste) Regulation 2014 ▪ Transferred to a stockpile site for a pre-identified future use on another proposal under the above exemption provisions ▪ Transferred offsite for use on another proposal under the above exemption provisions ▪ Transferred to a licenced waste recovery facility > Disposed to a licenced facility either as a last resort or if the material contains either weed seed stock or elevated contaminants of concern. > Waste shall not be burnt on site. > Waste material, other than vegetation and tree mulch, shall not be left on site once construction has been completed.

Environmental Aspect	Mitigation Measures
	> Working areas shall be maintained, kept free of rubbish and cleaned up at the end of each working day.
Utilities	> Consultation with all utility providers shall be undertaken prior to the commencement of works. > All project staff shall be made aware of the location of existing utilities and services, and they should be marked where appropriate.

8 Conclusion

8.1 Justification

8.1.1 Social Factors

The proposed works have the potential to temporarily have a minor impact to the local community from the construction causing road delays, however the operation of the intersection will result in increased safety, functionality and reduced delays which will be beneficial for the locality.

8.1.2 Biophysical Factors

The proposed works are to occur within the road reserve and an 81.26m^2 section of land to be acquired on Lot 100 DP 793194 that is already developed with a car park and landscaping.

The proponent is to re-establish the landscaping being removed from Lot 100 DP 793194 to the equivalent of the preconstruction environment.

The proponent is also providing a new drive way for Lot 4 DP 28425, this involves the removal of three trees on the lot. These trees are also non-native ornamental species.

There is an additional marking for a tree to be removed within the road reserve at the east of the site, upon site inspection the tree was not located and is presumed to be previously removed. However, neighbouring the road reserve at this aspect is a pocket of state forest that the proposal is not to encroach upon.

The proposed works, including the removal of the flora mentioned above, are not expected to pose a threat to any potentially suitable habitats of any sensitive species.

8.1.3 Economy Factors

There is the potential for the local economy to experience a minor short-term negative impact due to the construction causing road delays, however the intersection upgrade will result in increased functionality, safety and a reduction to delays. The proposal will result in a positive impact for the local economy as it will improve the accessibility to the McDonalds and for potential future businesses that will be operating in the rezoned showground area. The proposed works have implemented the most cost-effective option that will provide an adequate level of service to the local community.

8.1.4 Public Interest

For the reasons mentioned above the intersection upgrade can be considered in the interest of the public, the proposed works have been thought out to meet the localities interested with a 40-year operational life expectancy.

8.2 Objects of the EP&A Act

Table 1-21 Objectives of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and	The proposal promotes the social and economic welfare of the community.

conservation of the State's natural and other resources	
5(a)(i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The proposal would improve safety. Social and economic impacts are assessed in **Section 6.9**. The assessment includes management measures to avoid and/or minimise impacts.
5(a)(iv) To encourage the provision of land for public purposes.	The proposal represents the improvement of a public asset.
5(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	The proposal would not affect native animals and plants. It would not have a significant impact on threatened species, populations and ecological communities, and their habitats.
5(a)(vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in Sections 8.2.1 – 8.2.4 below

This REF has assessed potential environmental impacts that may arise from the proposed works. The factors listed in the Commonwealth EPBC Act and under Clause 228(2) of the NSW EP&A Regulation have been addressed (**Appendix A)** to demonstrate that the likely impacts of the proposal on the natural and built environment have been fully considered.

8.2.1 Ecologically Sustainable Development (ESD)

The principles of ESD have been a consideration throughout the development of the proposal.

The EP&A Act recognises that ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are explored below in the context of the proposal.

8.2.2 The Precautionary Principle

In instances where there is uncertainty regarding the severity of environmental damage, measures will be implemented to prevent the worst-case scenario. In the context of this proposal, due to the developed nature of the site and the limited ecological interference, there is no threat of serious or irreversible environmental damage as long as the mitigation measures outlined in this report are implemented.

8.2.3 Intergenerational Equity

The life expectance of the intersection upgrade is 40years. The proposal has a negligible effect on intergenerational equity.

8.2.4 Conservation of Biological Diversity and Ecological Integrity

Due to the site, being an established intersection lacking substantial habitat capability, the affect to biodiversity is insignificant.

8.2.5 Improved Valuation, Pricing and Incentive Mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by a project, including air, water, land and living things. While it is often difficult to place a reliable monetary value on the residual, environmental and social effects of the project, the value placed on environmental resources within and around the corridor is evident in the extent of environmental investigations, planning and design of impact mitigation measures to prevent adverse environmental impacts.

8.3 Conclusion

The proposed intersection upgrade joining Thompson Street and the New England Highway is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration of conservation agreements and plans of management under the *National Parks and Wildlife Act 1974 (NSW)*, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts to traffic and the general landscape will be altered

Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would improve safety for vehicles and pedestrians. The proposal considers the anticipated growth of the area and accommodates the projected increase in traffic, reducing significant delays for vehicles making right turns at this intersection. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

There would be no significant impact on any other aspect of the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation the proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the Environment Protection and Biodiversity Conservation Act 1999. A referral to the Australian Department of the Environment and Energy is not required.

This REF has been prepared to meet the requirements of the Environment Protection and Biodiversity Conservation Act 1999 strategic assessment approval for Roads and Maritime Division 5.1 road activities. A referral to the Australian Department of the Environment and Energy is not required.

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10 Glossary

Term/Acronym	Description
AHIMS	Aboriginal Heritage Information Management System
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline
CTMP	Construction Traffic Management Plan
dBA	A-weighted Decibel
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW).* Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ICNG	*Interim Construction Noise Guideline 2009*
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007*
Km	Kilometres
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
m	Metres
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
NML	Noise Management Level
NSW	New South Wales
OEH	Office of Environment and Heritage
OOH	Out of hours works
RMS	Roads and Maritime Services
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SWMP	Soil and Water Management Plan

APPENDIX

A

CLAUSE 228(2) FACTORS AND MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE AND COMMONWEALTH LAND

Clause 228(2) Checklist

In addition to the requirements of the Is an EIS required? guideline (DUAP 1995/1996) and the Roads and Related Facilities EIS Guideline (DUAP 1996) as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Table 1-22 Clause 228(2) Factors

Factor	Impact
Any environmental impact on a community? In the short term there would be minor disruption to the community due to partial road closures. Following completion of construction works there would be a positive impact on the community providing improved safety of users.	Short term negative Long term positive
Any transformation of a locality? The proposed works would result in an upgrade to the existing intersection.	Long term positive
Any environmental impact on the ecosystem of the locality? The proposed works would have minor negative impacts on the locality. There is potential for longer term positive impacts via removal of noxious weeds and rehabilitation of the site.	Short term negative Long term positive
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality? There would only be short-term reduction of aesthetic value of this locality during the construction phase.	Short term negative
Any effect on the locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? Minor short term negative social impacts on visual amenity. There are no anticipated impacts of any sites of cultural heritage significance.	Short term negative
Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)? The proposed works would not have any impact upon the habitat of protected fauna.	Nil
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? No endangerment to any species of animal, plant or other form of life, whether terrestrial, aquatic or living in the air would occur.	Nil
Any long-term effects on the environment? There would be no long-term negative effects on the environment upon completion of the proposed activity, provided the mitigation measures described in Section 6 of this REF are implemented.	Nil
Any degradation of the quality of the environment? Mitigation measures in Section 6 would minimise potential impacts with the local environment sustaining no long-term degradation.	Short term negative
Any risk to the safety of the environment? There is not expected to be any risk to the safety of the environment.	Nil
Any reduction in the range of beneficial uses of the environment? The proposed works would not reduce the range of uses of the environment, except during construction period.	Short term negative

Factor	Impact
Any pollution of the environment? Mitigation measures outlined in Section 6 would reduce or eliminate the potential impacts to the environment.	Nil
Any environmental problems associated with the disposal of waste? All other waste generated by the proposed works would be re-used and recycled where possible. Disposal of all non-recyclable waste would be undertaken in an appropriate manner. There would be no environmental issues associated with the disposal of waste provided mitigation measures in Section 6 are implemented.	Nil
Any increase demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The proposed works would not increase demand on resources, natural or otherwise, which are, or likely to become in short supply.	Nil
Any cumulative environmental effects with other existing or likely future activities? Traffic along the New England Highway will be delayed due to the proximity of traffic lights, existing and proposed along this section of the highway. However, traffic turning right at this intersection will see a significant reduction in delay	Long-term minor negative

Consideration of EPBC MNES Matters

Under the environmental assessment provisions of the EPBC Act 1999, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of the Environment and Energy.

A referral is not required for proposed actions that may affect nationally listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and considering relevant guidelines and policies.

Table 1-23 Consideration of EPBC MNES Matters

Matter	Impact
Any environmental impact on World Heritage property? There are no World Heritage properties within the vicinity of the proposed works.	Nil
Any environmental impact on Ramsar wetlands of international significance? There are no wetlands of international importance within the vicinity of the proposed works.	Nil
Any environmental impact on Nationally listed or threatened species and communities? A search of the Protected Matters Search Tool revealed there are 29 threatened species that have the potential to occur within 10km of the construction site and four threatened communities. It is considered that there would be no significant impact to these species due to disturbed nature and lack of significant vegetation of the study area.	Nil
Any environmental impact on Nationally listed migratory species? There are fourteen listed migratory species that have the potential to occur within 10km of the construction site. It is considered that there would be no significant impact to these species due to the disturbed nature of vegetation of the study area.	Nil
Any environmental impact on Commonwealth marine areas? There would be no Commonwealth marine areas directly impacted upon as a result of the proposed works.	Nil
Does any part of the proposal involve nuclear action? The proposed works would not involve any nuclear action.	Nil

APPENDIX

B

NOISE REPORT

Construction Noise and Vibration Impact Assessment

Road Intersection Upgrade
Thompson Street and New England Highway
Muswellbrook, NSW.

Prepared for: Cardno (NSW/ACT) Pty Ltd
June 2019
MAC190858RP1

Muller Acoustic Consulting

Document Information

Construction Noise and Vibration Impact Assessment

Road Intersection Upgrade

Thompson Street and New England Highway, Muswellbrook, NSW.

Prepared for: Cardno (NSW/ACT) Pty Ltd
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MAC190858RP1	Draft	17 June 2019	Oliver Muller	

CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Cardno (NSW/ACT) Pty Ltd ('Cardno') to prepare a Construction Noise and Vibration Impact Assessment (CNVIA) to quantify emissions from the proposed Road Intersection Upgrade at Thompson Street and New England Highway, Muswellbrook, NSW (the 'proposal').

The proposed works are anticipated to be undertaken primarily during standard construction hours, although some out of hours (OOH) work may be required.

This report presents the results, findings and recommendations of the CNVIA of the proposal and has been prepared to accompany the Review of Environmental Factors (REF) being prepared by Cardno. The assessment has been undertaken in general accordance with the following documents:

- Protection of the Environment Operations Act 1997 (POEO Act);
- Environment Protection Authority (EPA) 2017, NSW Noise Policy for Industry (NPI);
- Roads and Maritime Services (Roads and Maritime) 2016, Construction Noise and Vibration Guideline (CNVG);
- Department of Environment and Climate Change (DECC) 2009, Interim Construction Noise Guideline (ICNG);
- Roads and Maritime Environmental Impact Assessment Procedure: Preparing an Operational Traffic and Construction Noise and Vibration assessment report (2016);
- Australian Standard AS 2436-2010 (R2016) Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- Roads and Maritime Services (Roads and Maritime) 2015, Noise Criteria Guideline (NCG);
- Department of Environment and Conservation (DEC) 2006, Assessing Vibration: A Technical Guideline; and
- British Standard BS 7385:Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2".

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

1.1 Objectives of this Assessment

The main objectives of this assessment are to quantify potential noise and vibration impact from the proposal, especially as several activities of the proposal may occur during out of hours periods.

Key areas addressed in this assessment report include:

- Provide a technical document that can support the overall REF for the proposal;
- Identification of sensitive receivers;
- Quantifying potential construction noise and vibration impact from the proposal based on proposal brief information; and
- Review reasonable and feasible control measures to mitigate noise and vibration emissions with aim of meeting noise management levels and relevant vibration criteria.

2 Existing Project Environment

2.1 General

The proposal proposes the construction of an intersection upgrade, road signal installations and street lighting upgrades at the Thompson Street and New England Highway Intersection, Muswellbrook, NSW. This locality comprises predominantly residential land uses with some commercial and active recreation receivers. The surrounding noise catchment consists of residential receivers situated to the southwest of the proposal site with the nearest proposed residential receivers about 10m from the proposal site.

Key activities associated with the proposal include:

- New traffic lights at the Thompson Street/ New England Highway intersection;
- Median alteration including:
  - Adding a median to Thompson Street;
  - Reducing the extent and increasing the width of the northern median on the New England Highway accommodating the addition of a pedestrian rail and traffic lights;
  - Providing RMS type SM kerb to the median south of the intersection on the New England Highway;
- Signalised pedestrian crossings at all three approaches to the intersection;
- Lane widening on the left turn into Thompson Street from New England Highway;
- Adjusted stormwater drainage infrastructure including kerb and gutter;
- Addition of a 4m wide pedestrian footpath between pedestrian crossings on the eastern side of the New England Highway;
- Installation and relocating of road markings and signage as required;
- Acquiring a portion of the lot occupied by McDonald's (Lot 100 DP793194) in order to widen the left turn into Thompson Street, this involves:
  - Providing new kerb and gutter and extending the existing pit to the new road surface;
  - Possibly relocating water and telecommunication services; this is subject to the council conducting a utility investigation prior to undertaking roadworks;
  - Provide a new retaining wall on the property boundary; and
  - Reconstruction of the pedestrian access to McDonald's to the standard of existing infrastructure;
- Upgrading the driveway in residential Lot 4, DP 28425 to ensure safe access to the upgraded intersection.

It is anticipated that construction would take place over a period of about three (3) months. The proposed hours of construction would primarily be based around standard hours for construction as per the ICNG although some works may be required outside of standard hours.

2.2 Receiver Review

A review of residential receivers situated surrounding the proposal site in close proximity to the proposal has been completed. The receivers are summarised in **Table 1** with **Figure 1** providing a locality plan showing the position of these receivers in relation to the proposal.

Table 1 Receiver Locations

Receiver	Receiver Addresses	Type of Receiver
R1	73 Maitland Street	Residential
R2	75 Maitland Street	Residential
R3	77 Maitland Street	Residential
R4	79 Maitland Street	Residential
R5	81 Maitland Street	Residential
R6	1 Shaw Crescent	Residential
R7	3 Shaw Crescent	Residential
R8	5 Shaw Crescent	Residential
R9	7 Shaw Crescent	Residential
R10	9 Shaw Crescent	Residential
R11	11 Shaw Crescent	Residential
R12	13 Shaw Crescent	Residential
R13	15 Shaw Crescent	Residential
R14	17 Shaw Crescent	Residential
R15	19-21 Shaw Crescent	Residential
R16	23 Shaw Crescent	Residential
R17	12 Shaw Crescent	Residential
R18	10 Shaw Crescent	Residential
R19	8 Shaw Crescent	Residential
R20	6 Shaw Crescent	Residential
R21	4 Shaw Crescent	Residential
R22	2 Shaw Crescent	Residential
R23	5-7 Thompson Street	Residential
R24	9 Thompson Street	Residential
R25	11 Thompson Street	Residential
R26	11A Thompson Street	Residential
R27	15 Thompson Street	Residential
R28	17 Thompson Street	Residential
C1	83-89 Maitland Street	Commercial
M1	91-93 Maitland Street	Motel
PR1	Lot 264 Muswellbrook	Active Recreation

FIGURE 1

LOCALITY PLAN

REF: MAC190858

0 30m

KEY	
R1	ASSESSED RECEIVER LOCATIONS
	APPROXIMATE PROPOSAL FOOTPRINT
L1	UNATTENDED MONITORING LOCATION

MAC
Muller Acoustic Consulting

*Imagery Source : nearmap

3 Noise Criteria

3.1 Existing Ambient Noise Environment

3.1.1 Unattended Noise Monitoring

To establish the existing background noise environment of the area, unattended noise monitoring was conducted at the nearest receiver location to the proposal alignment. The monitoring location is representative of the surrounding noise catchment and was used to quantify existing traffic noise contributions and calibrate the noise model. The location was selected taking into account other noise sources which may influence the readings, the proximity of surrounding receivers to the proposal, security issues for the noise monitoring device and gaining permission for access. The selected monitoring locations are shown in **Figure 1**.

The noise survey was conducted at the monitoring location in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise".

The measurements were carried out using Svantek Type 1, 957 noise analyser from Tuesday 21 May 2019 to Sunday 2 June 2019. Observations on-site identified the surrounding locality typical of a suburban environment with suburban sources and intermittent traffic noise audible.

Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dB(A). All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Data affected by adverse meteorological conditions have been excluded from the results in accordance with methodologies provided in the NPI. The results of long-term unattended noise monitoring are provided in **Table 1.** The noise monitoring charts for the background logging assessment are provided in **Appendix B.**

Table 2 Background Noise Monitoring Summary[1]

Location	Measured background noise level, RBL, dBA			Measured LAeq, dBA		
	Day	Evening	Night	Day	Evening	Night
	7am to 6pm	6pm to 10pm	10pm to 7am	7am to 6pm	6pm to 10pm	10pm to 7am
L1 (R5)	51	42	34	66	62	58

Note 1: Excludes periods of wind or rain affected data, meteorological data obtained from the Bureau of Meteorology Scone Airport (32.0335°S 150.8264°E 221m AMSL)

3.2 Interim Construction Noise Guideline

The assessment and management of noise from construction work is completed with reference to the Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to assist in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the EPA under the POEO Act (1997), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment.

The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks;
- Qualitative, which is suited to short term infrastructure maintenance (for projects with a typical duration of less than three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise emission predictions from construction activities to the nearest relevant receptors. The qualitative assessment methodology is a more simplified approach that relies more on noise management strategies. This study has adopted a quantitative assessment approach.

The quantitative approach includes identification of potentially affected receptors, description of activities involved in the proposal, derivation of the construction noise management levels, quantification of potential noise impact at receptors and, provides management and mitigation recommendations. **Table 3** summarises the ICNG recommended standard hours for construction.

Table 3 Recommended Standard Hours for Construction

Period	Preferred Construction Hours
Day (Standard construction hours)	Monday to Friday - 7am to 6pm Saturdays - 8am to 1pm Sundays or Public Holidays - No construction

The recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Work conducted outside of standard hours are considered out of hours work (OOH). OOH periods are divided into two categories representing evening and night periods and cover the hours listed below:

Period 1 (OOH1) (evening/low risk period): Monday to Friday – 6pm to 10pm, Saturdays – 1pm to 6pm, Sundays –-8am to 6pm.

Period 2 (OOH2) (night/medium to high risk period): Monday to Friday – 10pm to 7am, Saturdays/Sundays – 6pm to 7am (8am on Sunday mornings).

3.2.1 Construction Noise Management Levels

Section 4 of the ICNG details the quantitative assessment method involving predicting noise levels and comparing them with the Noise Management Level (NML) and are important indicators of the potential level of construction noise impact. **Table 4** provides the ICNG recommended $LA_{eq(15min)}$ NMLs and how they are to be applied.

Table 4 Noise Management Levels		
Time of Day	Management Level $LA_{eq(15min)}$[1]	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10 dB.	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $LA_{eq(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA.	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5 dB.	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Note 1: 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 construction noise management levels for noise assessment purposes and is the median of the ABL's.

3.2.2 Noise Management Levels

The Noise Management Levels (NMLs) presented in **Table 5** are based on the unattended noise data and have been derived in accordance with the NPI.

Table 5 Noise Management Levels and OOHW Periods –Receivers

Period	Monday to Friday	Saturday	Sunday	NML dB $LA_{eq(15min)}$
Residential/Motel				
Standard hours	7am to 6pm	8am to 1pm	N/A	61
OOHW Period 1 (OOH P1)	6pm to 10pm	6pm to 10pm	8am to 6pm	47
OOHW Period 2 (OOH P2)	10pm to 7am	10pm to 8am	6pm to 7am	39
Commercial				
When in use				70
Active Recreation				
When in use				65

3.3 Maximum Noise Assessment (Sleep Disturbance) Criteria

Section 4.3 of the ICNG (DECC, 2009) states that a sleep disturbance assessment is required where construction activities are planned to occur for more than two consecutive nights.

As proposed construction is anticipated to occur for in excess of 12 weeks in duration, an assessment of sleep disturbance has been completed.

The EPA's screening criteria (NPI, 2017) for sleep disturbance assessments states that the noise level from an intrusive source should remain below 52dB LA_{max} or not exceed the background noise level by more than 15dB.

Where noise levels have been calculated above the screening criteria, additional analysis should be undertaken, referencing guidance on maximum noise levels and sleep disturbance listed in the Road Noise Policy (RNP) (EPA, 2011). This guidance states:

- maximum internal noise levels below 50 to 55dBA are unlikely to wake sleeping occupants; and
- one or two noise events per night, with maximum internal noise levels of 65 to 70dBA, are not likely to affect the health and wellbeing of occupants significantly.

If noise levels over the screening criteria were identified, then additional analysis would consider factors such as:

- how often the events would occur;
- the time the events would occur (between 10pm and 7am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

The ICNG criteria are appropriate for assessing noise from continuous construction sources. However, maximum noise events are also required to be quantified. Transient events have the possibility of disturbing the sleep of nearby residents. On this basis, the maximum noise level from any construction activity should not exceed the screening criterion of 52dB L_{Amax} at assessed receivers.

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4 Operational and Construction Traffic Noise

4.1 Operational Road Noise

In accordance with Section 5.5 of the NCG (Roads and Maritime, 2015), the proposal is classified as minor work. Section 5.5 of the NCG is reproduced below:

'Some works may be primarily to improve safety. This may include minor straightening of curves, installing traffic control devices, intersection widening and turning bay extensions or making minor road realignments. These works are not considered redeveloped or new as they are not intended to increase the traffic carrying capacity of the overall road or accommodate a significant increase in heavy vehicle traffic.'

Road traffic noise criteria are provided in the Road Noise Policy (RNP) (DECCW, 2011) and Roads and Maritime's NCG. For this proposal, works on the New England Highway (Maitland Road) will be limited to minor works, including traffic signals, some lane widening works and additional turning lanes to accommodate the proposal.

In accordance with Section 5.5 of the Noise Criteria Guideline, minor road works are generally not required to be considered as part of an assessment as they are not considered new or a redevelopment as they do not increase the carrying capacity of the road or accommodate a significant increase in heavy vehicle traffic. Therefore, no criteria have been allocated to the existing New England Highway (Maitland Road) for this assessment. Notwithstanding, for completeness this assessment includes New England Highway (Maitland Road) traffic noise calculations so informative comparisons can be made for existing and future scenarios and to assess for 'acute' noise levels.

4.1.1 Acute Noise Criteria

Noise levels that are higher than 65dB $LA_{eq(15hr)}$ day or 60dB $LA_{eq(9hr)}$ night are categorised as 'acute' within the Environmental Noise Management Manual (ENMM, 2001). In such circumstances, noise mitigation should be investigated in accordance with the ENMM.

4.1.2 Cumulative Noise Criteria

Section 6.1 of the NMG states that when the total noise level from a project in the build year is 5dB or more above the relevant criteria, then it is considered to have exceeded the cumulative noise limit. Receivers where the cumulative noise limit is exceeded qualify for the consideration of noise mitigation.

Notwithstanding, Section 6.1 of the NMG states that the cumulative limit does not apply if the noise causing the cumulative limit to be exceeded is not assessed as part of the project (ie is minor works). Therefore, the cumulative noise criteria are not relevant to this assessment.

4.2 Traffic Assessment Methodology

A theoretical assessment of road traffic noise was conducted to predict levels at the façade of the receivers using the Calculation of Road Traffic Noise (CRTN) algorithm, as developed by the UK Department of Transport. The method incorporates traffic volume and mix, type of road surface, vehicle speed, road gradient, ground absorption and shielding from ground topography and physical noise barriers.

Receiver locations, ground topography, current/future road alignment and other cadastral data (eg property boundaries) were obtained from electronic data provided by Roads and Maritime. The noise modelling was based on 3D elevation strings for the current road alignment and proposed road alignments (provided by Roads and Maritime). The noise impacts at residences have been quantified to the most exposed facades of receivers exposed to the proposal alignment at heights of either 1.5m or 4m above the ground elevation (depending whether the receiver dwelling is single or double storey).

4.2.1 Assessed Scenarios

The following scenarios were adopted in this assessment:

- Scenario 1 – Existing Day;
- Scenario 2 – Existing Night;
- Scenario 3 – Proposed Day; and
- Scenario 4 – Proposed Night.

Traffic volume and traffic mix are not expected to change due to the proposal, therefore there is no requirement to assess the project at 10 years.

4.2.2 Calculation Parameters

Traffic counts were undertaken and supplied to MAC by Roads and Maritime. Road traffic counts were undertaken in 2016 by MetroCount.

Traffic volumes and percentage of heavy vehicles from the traffic counts were adopted to verify noise predictions for the proposal. Calculation parameters for this proposal are presented in **Table 6**.

Table 6 Road Traffic Noise Assessment Parameters

Parameter	Adopted Value					
	New England Highway (Maitland Road)				Thompson Street	
	East Bound		West Bound		Both directions[2]	
Road Speed Limit (km/hr)	50km/hr					
Percentage of Heavy Vehicles (%)	10% (Day 15hr)	20% (Night 9hr)	10% (Day 15hr)	20% (Night 9hr)	3% (Day 15hr)	3% (Night 9hr)
Average Hourly Traffic Volume	8,255 (Day 15hr)	1,114 (Night 9hr)	8,362 (Day 15hr)	958 (Night 9hr)	684	205
Road Surface	Sprayed Seal (current) / Dense Graded Asphalt (proposed)					
Source height	0.5m cars					
	0.5m truck tyres					
	3.6m truck exhausts					
Receiver height	1.5m or 4m above ground level (dependant on receiver)					
Receiver location	1m from the building façade					
Receiver façade reflection	+2.5dBA[1]					

Note 1: For calibration of calculated results, no façade correction has been added (ie logger results are 'free field').

Note 2: Based on 20% of peak flows for day and 10% peak flows for night of intersection counts (Muswellbrook Traffic Study, Parson Brinckerhoff (2010)).

Note 3: As per drawing No.22-18812-C515 (Roads and Maritime, 2019).

4.3 Operational Traffic Noise Results

4.3.1 Noise Assessment Validation

Road noise predictions for the New England Highway (Maitland Road) were compared to measured levels at logging location L1. **Table 7** presents results of the validation. Noise calculations demonstrate a consistency of ±<2dB tolerance when compared against measured levels, and are therefore within tolerances recommended by Roads and Maritime.

Table 7 Noise Assessment Validation Results

Measurement Location	Period	Predicted level LAeq dBA	Measured LAeq dBA[1]	Difference dBA
L1	Day ($LA_{eq(15hr)}$)	64.4	65.4	-1.0
	Night ($LA_{eq(9hr)}$)	59.5	58.3	1.2

Note 1: Noise levels rounded to nearest decimal, and are free field, (ie no façade correction).

4.3.2 Comparison of Existing and Future Road Traffic Noise Levels

In accordance with Roads and Maritime Procedure for Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report, an assessment of road traffic noise has been carried out for the existing and future road alignment. It is reiterated that the proposal is not expected to increase traffic volumes or change the traffic mix.

Noise levels for existing and future traffic were quantified by direct calculation to four nearest receivers to the proposal. **Table 8** presents the results of the road traffic noise assessment for each scenario. It is noted that the proposed scenario takes into account the final pavement type of the proposal which is dense graded asphalt. Replacing the existing spray seal pavement type with dense graded asphalt will result in a reduction of up to 4dB (see Table 3.1 of the ENMM).

Table 8 Road Traffic Noise Results

Receivers[1]	Day Predicted level, $LA_{eq(15hr)}$, dBA			Night Predicted level, $LA_{eq(9hr)}$, dBA		
	Scenario					
	1	3		2	4	Difference
	Day Existing	Day Proposed	Difference, dB	Night Existing	Night Proposed	dB
R1	69.1	65.1	-4.0	64.2	60.2	-4.0
R2	70.5	66.5	-4.0	65.6	61.6	-4.0
R3	64.8	60.8	-4.0	59.8	55.8	-4.0
R4	58.0	54.1	-3.9	53.0	49.0	-4.0

Note 1: Levels calculated to the most exposed façade, excludes dwelling structure and includes +2.5dB façade correction.

5 Construction Noise Assessment

5.1 Methodology

A computer model was developed to determine the acoustic impact of standard and OOH construction emissions to nearby receivers. The modelling incorporated existing topographical data for the subject site. Brüel and Kjær Predictor Type 7810 (Version 11.10) noise modelling software was used to assess the potential noise impact associated with the proposal. The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'.

5.1.1 Modelled Activities

Construction activities considered to potentially have the greatest noise impacts on nearby receivers were provided by Roads and Maritime and have formed the basis of this assessment.

5.1.2 Proposed Works and Construction Scenarios

Four construction scenarios were assessed for the proposed works and results for each scenario are presented in Table 9, together with the overall fleet sound power level and proposed work period.

Table 9 Construction Scenarios & Fleet Sound Power Levels			
Scenario Description	Typical Plant Included in Fleet	Overall Fleet Sound Power, dBA	Proposed Work Period
Site Mobilisation and Establishment of Traffic Controls	Truck (medium rigid) Service Vehicle Generator Lighting plant (for OOH)	102	Standard Hrs with potential for OOH
Drainage/Earthworks/Utility Relocation/Signal Installation	Excavator (tracked) 35t Front end loader 23t Dump truck Truck mounted crane Lighting plant (for OOH)	109	Standard Hrs with potential for OOH
Construction of New Pavement and Kerbing	Pavement laying machine Dump truck Asphalt truck & sprayer Concrete truck Smooth drum roller Concrete saw Lighting plant (for OOH)	118	Standard Hrs with potential for OOH
Line Marking and Signage Installation	Service Vehicle Hand Tools Line marking truck Lighting plant (for OOH)	99	Standard Hrs with potential for OOH

5.2 Construction Noise Results

Predictions have quantified levels from each nominated construction activity for the proposal and are presented in **Figure 2** to **Figure 5**. **Appendix C** presents the single point calculations for each scenario.

The results of the assessment identify that Activity 3 (Construction of New Pavement and Kerbing) has potential to generate the highest noise levels during the proposal.

Several activities are identified to exceed the highly noise affected ICNG NML of 75dB. Therefore, reasonable and feasible work practices should be considered for the proposal.

Notwithstanding, maximum emissions from plant during excavation works are only anticipated to occur for a few days in duration and will be effectively managed with the aim of minimising noise emissions within the community.

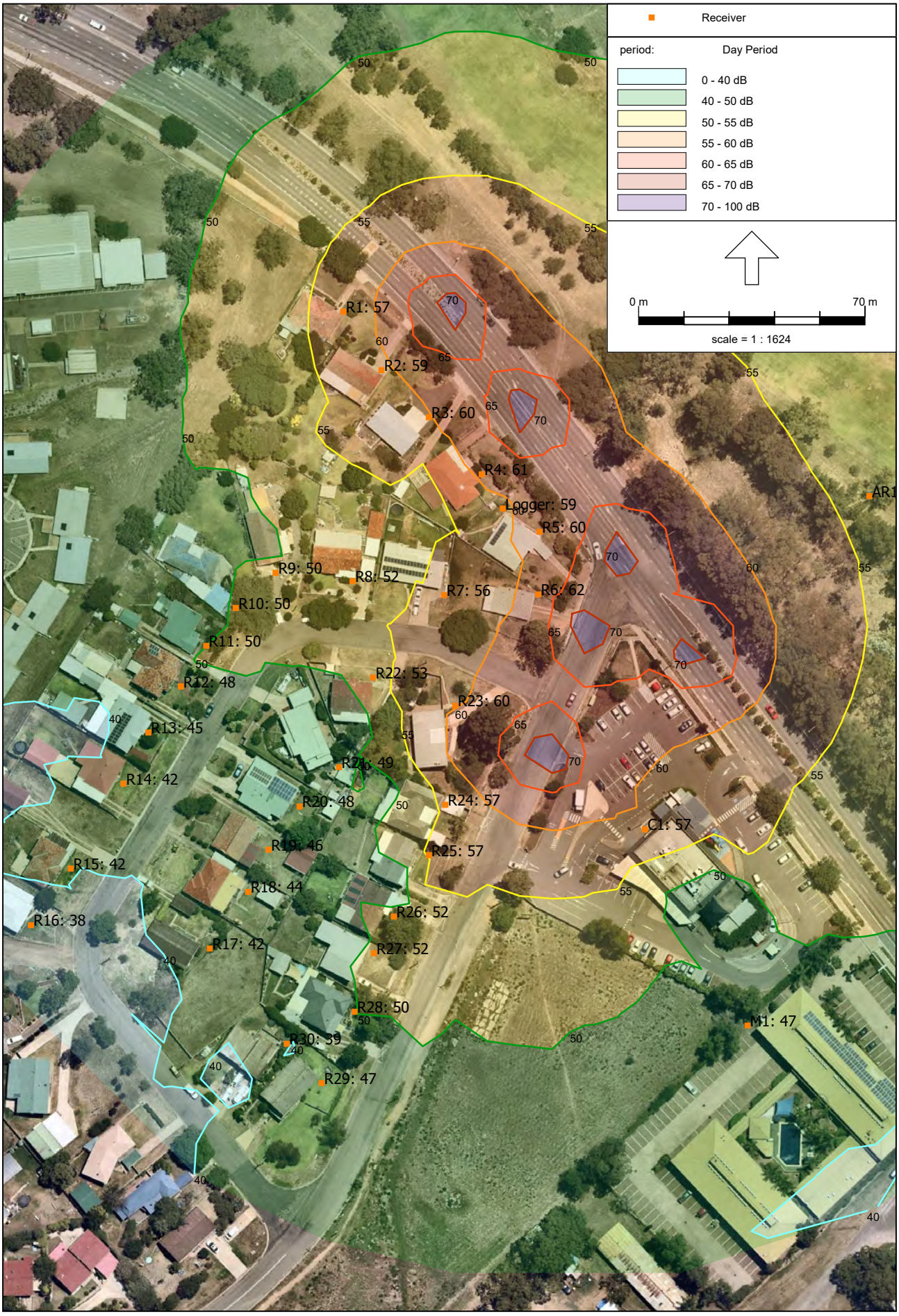
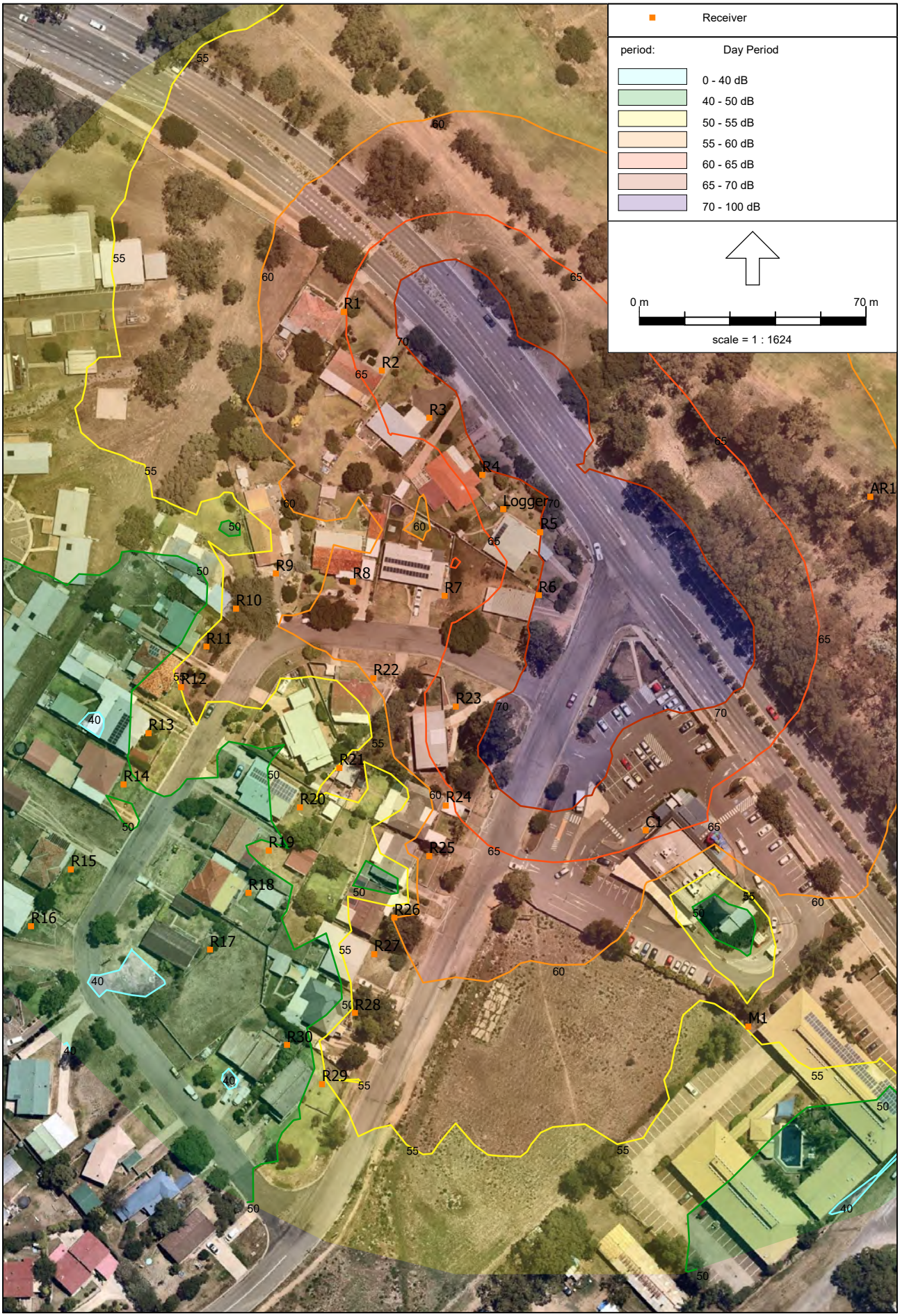

Receiver
period: Day Period
0 - 40 dB
40 - 50 dB
50 - 55 dB
55 - 60 dB
60 - 65 dB
65 - 70 dB
70 - 100 dB
0 m
70 m
scale = 1 : 1624
R1: 57
R2: 59
R3: 60
R4: 61
Logger: 59
R5: 60
R6: 62
R7: 56
R8: 52
R9: 50
R10: 50
R11: 50
R12: 48
R13: 45
R14: 42
R15: 42
R16: 38
R17: 42
R18: 44
R19: 46
R20: 48
R21: 49
R22: 53
R23: 60
R24: 57
R25: 57
R26: 52
R27: 52
R28: 50
R29: 47
R30: 39
C1: 57
M1: 47
AR1

Figure 3- Activity 2 Demolition of Existing Infrastructure and Excavation

Muller Acoustic Consulting Pty Ltd



Industrial noise - ISO 9613.1/2, [Construction - Construction-2 Demolition of Existing Infrastructure and Excavation] , Predictor V11.10

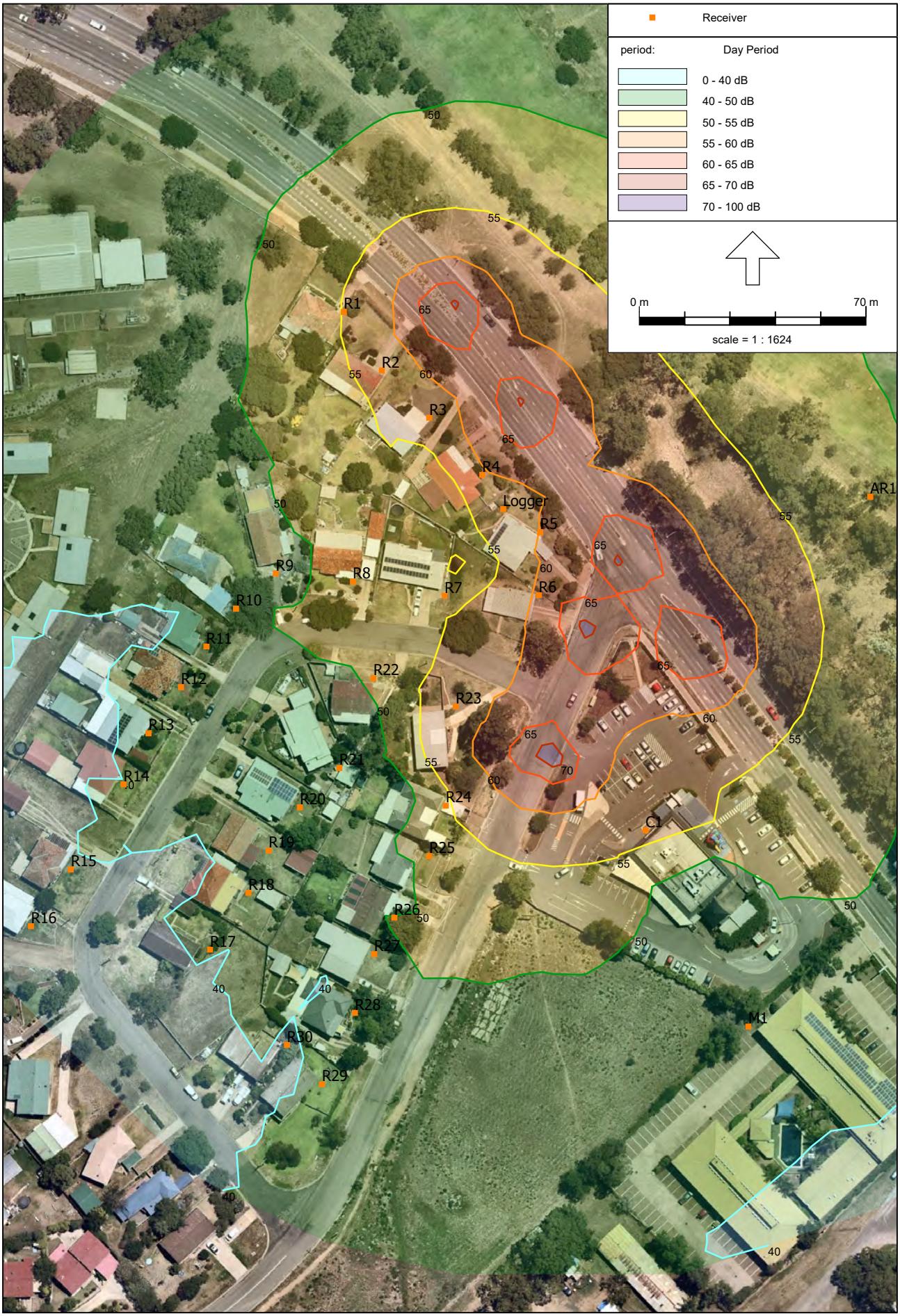
Figure 4 - Activity 3 Construction of New Pavement and Kerbing

Muller Acoustic Consulting Pty Ltd

Industrial noise - ISO 9613.1/2, [Construction - Construction-3 – Construction of New Pavement and Kerbing] , Predictor V11.10

Figure 5 - Activity 4 Line Marking and Signage Installation

Muller Acoustic Consulting Pty Ltd



Industrial noise - ISO 9613.1/2, [Construction - Construction-4 Line Marking and Signage Installation] , Predictor V11.10

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6 Feasible and Reasonable Mitigation Measures - Noise

Noise modelling identifies that relevant NMLs for the proposal could be exceeded when each construction activity occurs at the near point of receivers. The CNVG and ICNG outline noise management and mitigation initiatives to minimise the impact and improve the acoustic amenity of receivers potentially affected by road construction proposals.

The CNVG recommends several standard actions and mitigation measures that should be implemented on all construction proposals. The key actions include:

6.1 Management Measures

Management Measures include:

- implementation of any proposal specific mitigation measures required;
- implement community consultation or notification measures (refer to Appendix C of the CNVG for further details of each measure);
- site inductions;
- behavioural practices;
- verification;
- attended vibration measurements; and
- update/undertake Construction Environmental Management Plans.

6.2 Source Controls

Source Controls include:

- construction hours and scheduling;
- construction respite period during normal hours and out-of-hours work;
- equipment selection;
- plant noise levels;
- rental plant and equipment;
- use and siting of plant;
- plan worksites and activities to minimise noise.

- reduced equipment power;
- non-tonal and ambient sensitive reversing alarms;
- minimise disturbance arising from delivery of goods to construction sites; and
- engine compression brakes.

6.3 Path Controls

Path Controls include:

- shield stationary noise sources such as pumps, compressors, fans etc; and
- shield sensitive receivers from noisy activities.

6.4 Receiver Controls

Receiver Controls include:

- Notification (letterbox drop or equivalent);
- Specific notifications (SN);
- Phone calls (PC);
- Individual briefings (IB);
- Respite Offers (RO);
- Respite Period 1 (R1);
- Respite Period 2 (R2);
- Duration Respite (DR);
- Alternative Accommodation (AA); and
- Verification.

Furthermore, the ICNG suggests there are no prescribed noise controls for construction work, instead:

"all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise."

Seven key strategies in reducing construction noise emissions are outlined in Section 6 of the ICNG that should be applied on a case-by-case basis and include the following:

Strategy 1: Universal Work Practices;

Strategy 2: Consultation and Notification;

Strategy 3: Plant and Equipment;

Strategy 4: Onsite;

Strategy 5: Work Scheduling;

Strategy 6: Transmission Path;

Strategy 7: At residence (treatments) or other sensitive Land Uses (last resort).

In addition, Australian Standard AS 2436-2010 (R2016) "Guide to Noise Control on Construction, Maintenance and Demolition Sites" sets out numerous practical recommendations to assist in mitigating construction noise emissions.

Recommendations provided in the ICNG and AS2436 include combinations of operational strategies, source noise control strategies, noise barrier controls, and community consultation.

It is estimated that adopting strategies contained in this standard may result in the following noise attenuation:

- up to 10dBA where space requirements place limitations on the attenuation options available; and
- up to 20dBA in situations where noise source noise mitigation measures (silencers, mufflers, etc) can be combined with noise barriers and other management techniques.

6.5 Universal Work Practices

Universal work practices that can be applied to the proposal (and all subsequent activities) include:

- conduct toolbox talks pre-shift to communicate awareness regarding the importance of noise emission management;
- ensure site managers periodically check noise emissions at receivers adjacent to noisy activities so that potential problems can be rectified;
- UHF radios will be used for communication with no yelling allowed;
- no slamming of doors is allowed;
- plant will be parked in accessible and where possible shielded locations prior to being used for out of hours work;

- minimise the use of reverse alarms;
- site access will be gained via entry points most remote to receivers;
- minimise clustering of plant items;
- management are to communicate to staff and contractors the importance of minimising noise emissions to the community when arriving and leaving site; and
- a noise monitoring program is to be implemented to quantify noise emissions from construction activities and guide practical reasonable and feasible noise control measures.

6.6 Consultation and Notification

General

- inform affected residents and other sensitive land use occupants the levels of impacts, the associated duration of each activity and what is being adopted at the proposal to minimize noise impacts to the community. This information should be provided to the community seven days before commencement;
- provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual contact. In some areas, the proponent will need to provide notification in languages other than English. A website could also be established for the proposal to provide information;
- implement a site information board at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include standard and after-hours emergency contact details;
- maintain good communication between the community and proposal staff;
- appoint a community liaison officer where required to maintain good communications between community and staff.

Complaints Handling

- provide a readily accessible contact point, for example, through a 24-hour toll-free information and complaints line and give complaints a fair hearing;
- have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow;

- records of all community complaints will be maintained on an up-to-date complaints register; The records will include:
    - date and time of the complaint;
    - the means by which the complaint was made (telephone, mail or email);
    - any personal details of the complainant that were provided, or if no details are provided, a note to that effect;
    - the nature of the complaint;
    - any actions taken by the site supervisor/construction contractor in relation to the complaint, including any follow up contact with the complainant and the timing for implementing action; and
    - if no action was taken by site supervisor/construction contractor in relation to the complaint, the reason why no action was taken.
- community complaints will be allocated to a responsible Roads and Maritime or Roads and Maritime contractor's representative immediately to facilitate the implementation of corrective actions. The details of the complaint will also be circulated to the applicable construction personnel for action, where required.

6.7 Plant and Equipment and On Site

- as far as practical, locate lighting plant away from sensitive receivers;
- no reversing of vehicles (reverse alarms) during out of hours work (i.e. the vehicles will do a complete U turn if they are required to change direction or have spotters);
- use of air brakes is not permitted;
- all plant will be driven in a conservative manner (no over-revving);
- machinery will not be permitted to 'warm-up' before the nominated working hours or adjacent to receivers;
- where possible, machinery will be located/orientated to direct noise away from the closest sensitive receivers;
- undertake regular maintenance of machinery to minimise noise emissions. Maintenance will be confined to standard daytime construction hours and where possible, away from noise sensitive receivers;
- the quietest suitable machinery reasonably available will be selected for each work activity;

- all machinery will have efficient low noise muffler design and be well-maintained;
- the offset distance between noisy items of plant/machinery and nearby sensitive receivers will be maximised;
- queuing of vehicles is not to occur adjacent to any residential receiver/catchment;
- where queuing is required, for example due to safety reasons, a site entry position will be selected that is well removed from receivers/catchments. Where this is not feasible, engines are to be switched off to reduce their overall noise impacts on receivers;
- where practicable, ensure the coincidence of noisy plant/machinery working simultaneously in close proximity to sensitive receivers is avoided; and
- keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).

6.8 Work Scheduling

- schedule work when neighbours are not present (for example, commercial neighbours, colleges and schools may not be present outside business hours or on weekends);
- schedule noisy activities around times of high background noise (local road traffic or when other local noise sources are active) where possible to provide masking or to reduce the amount that the construction noise intrudes above the background;
- care should be taken to minimise noise from any refueling at night and ensure plant is as far as practical from receivers when refueling;
- optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads;
- designate access routes to the site, through consultation with potentially noise-affected residences and other sensitive land uses, and make drivers aware of nominated vehicle routes;
- provide designated on-site truck waiting areas away from residences and other sensitive land uses. Truck waiting areas may require bunding or walls to minimise noise;
- provision of the dedicated staff/contractor car parking area away from residences is considered a practical and effective noise control measure to minimise impacts of staff entering and leaving the proposal; and

- schedule delivery of materials (i.e. retaining walls or pre-fabricated structures) to occur during the day or early evening periods to avoid noise emission associated with deliveries.

6.9 Transmission Path

- where possible eliminate or reduce the line-of-sight from noise emission sources to residences or other sensitive land uses using temporary barriers or mobile screens;
- temporary noise barriers can be constructed from hoardings or pvc curtains attached to temporary fences. Stockpiles and shipping containers are also effective barriers;
- consider mobile screens for work that is static or plant that will be stationary for the duration of the work (i.e. drainage work, or around compressors and generators);
- erect temporary noise barriers at shift start up to ensure that noise during the entire shift is minimized; and
- consider the height of mobile screens when adjacent to multistory dwellings to ensure adequate height to remove line of site to from the source to the elevated receiver.

6.10 At residence (treatments) or other sensitive Land Uses (last resort)

- examine and implement, where feasible and reasonable, the option of relocating noise-affected occupants for short periods of time, such as when high noise levels from construction occur at night and there are no feasible and reasonable ways of reducing noise levels. For example, the proponent could offer alternative accommodation or other respite measures (such as movie tickets) where mitigation is sought and there are no feasible and reasonable work methods available.

6.11 Additional Mitigation Measures

Standard noise mitigation and management measures in accordance with the ICNG would be implemented for the proposal where practicable. The CNVG (Roads and Maritime, 2016) outlines a range of additional mitigation measures which are recommended in order to manage the potential impact. The additional CNVG measures reproduced in **Table 10** will be considered by Roads and Maritime following incorporation of feasible and reasonable mitigation measures for the proposal outlined in Section 5.5. **Appendix D** provides a detailed definition of each additional mitigation measure listed below.

Table 10 Triggers for Additional Mitigation Measures - Airborne Noise				
Perception	Predicted airborne noise level at receiver		Additional mitigation measures Type[1]	Mitigation Levels[2]
	dB(A) above RBL	dB(A) above NML		
All hours				
75dBA or greater			N, V, PC, RO	HA
Standard Hours: Mon - Fri (7am – 6pm), Sat (8am – 1pm), Sun/Pub Holidays (Nil)				
Noticeable	5 to 10	0	-	NML
Clearly Audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML+10
Highly intrusive	> 30	> 20	N, V	NML+20
OOH Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Pub Hol (8am – 6pm)				
Noticeable	5 to 10	< 5	-	NML
Clearly Audible	10 to 20	5 to 15	N, R1,DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly intrusive	> 30	> 25	V, IB, N R1, DR, PC, SN	NML+25
OOH Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Holidays (6pm – 7am)				
Noticeable	5 to 10	< 5	N	NML
Clearly Audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML+15
Highly intrusive	> 30	> 25	AA, V, IB, N, PC, SN, R2, DR	NML+25

Note 1: AA = Alternative accommodation, R1 = Respite Period 1, V = Validation of predicted noise levels (not required for proposals less than 3 weeks), PC = Phone calls, IB = Individual briefings (not required for proposals less than 3 weeks), SN = Specific notifications, N = Notification, R2 = Respite Period 2, SR = Duration Respite

Note 2: Perception = relates to level above RBL, NML = Noise Management Level (see Appendix D) HA = Highly Affected (> 75 dB(A) - applies to residences only)

Based on the construction noise modelling assessment, the derived triggers for additional mitigation measures for each activity during each assessment period has been established. The following colour ID's have been assigned to Additional Mitigation Trigger Categories presented in **Table 11**.

Table 11 Triggers for Additional Mitigation Measures – Colour Coding Key	
Level of Perception	Colour ID
Noticeable	Blue
Clearly Audible	Green
Moderately Intrusive	Yellow
Highly Intrusive	Red

The relevant triggers for additional mitigation measures for residential receivers during standard construction hours are presented in **Table 12**.

Table 12 Residential Receivers and Triggers for Additional Mitigation - Standard Hours

Receivers	Construction Scenario, $LA_{eq(15min)}$			
	1	2	3	4
R1	47	55	63	45
R2	49	57	65	47
R3	50	57	65	48
R4	51	58	66	49
R5	50	58	66	48
R6	52	60	68	50
R7	46	53	61	44
R8	42	49	57	40
R9	40	47	55	38
R10	40	48	56	38
R11	40	47	55	38
R12	38	45	53	36
R13	35	41	49	33
R14	32	38	46	30
R15	32	37	45	30
R16	28	31	39	26
R17	32	36	44	30
R18	34	40	48	32
R19	36	41	49	34
R20	38	43	51	36
R21	39	45	53	37
R22	43	50	58	41
R23	50	58	66	48
R24	47	55	63	45
R25	47	54	62	45
R26	42	49	57	40
R27	42	50	58	40
R28	40	48	56	38

The relevant triggers for additional mitigation measures for residential receivers during OOH1 are presented in **Table 13.**

Table 13 Residential Receivers and Triggers for Additional Mitigation - OOH1

Receivers	Construction Activity, $L_{Aeq(15min)}$			
	1	2	3	4
R1	47	55	63	45
R2	49	57	65	47
R3	50	57	65	48
R4	51	58	66	49
R5	50	58	66	48
R6	52	60	68	50
R7	46	53	61	44
R8	42	49	57	40
R9	40	47	55	38
R10	40	48	56	38
R11	40	47	55	38
R12	38	45	53	36
R13	35	41	49	33
R14	32	38	46	30
R15	32	37	45	30
R16	28	31	39	26
R17	32	36	44	30
R18	34	40	48	32
R19	36	41	49	34
R20	38	43	51	36
R21	39	45	53	37
R22	43	50	58	41
R23	50	58	66	48
R24	47	55	63	45
R25	47	54	62	45
R26	42	49	57	40
R27	42	50	58	40
R28	40	48	56	38

The relevant triggers for additional mitigation measures for residential receivers during OOH1 are presented in **Table 14.**

Table 14 Residential Receivers and Triggers for Additional Mitigation - OOH2

Receivers	Construction Activity, $LA_{eq(15min)}$			
	1	2	3	4
R1	47	55	63	45
R2	49	57	65	47
R3	50	57	65	48
R4	51	58	66	49
R5	50	58	66	48
R6	52	60	68	50
R7	46	53	61	44
R8	42	49	57	40
R9	40	47	55	38
R10	40	48	56	38
R11	40	47	55	38
R12	38	45	53	36
R13	35	41	49	33
R14	32	38	46	30
R15	32	37	45	30
R16	28	31	39	26
R17	32	36	44	30
R18	34	40	48	32
R19	36	41	49	34
R20	38	43	51	36
R21	39	45	53	37
R22	43	50	58	41
R23	50	58	66	48
R24	47	55	63	45
R25	47	54	62	45
R26	42	49	57	40
R27	42	50	58	40
R28	40	48	56	38

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7 Assessment of Construction Vibration Impact

British Standard BS 7385:Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2", gives guidance on the levels of vibration which building structures could be damaged. BS7385 also takes into consideration the frequency of the vibration which is critical when assessing the likelihood of building damage.

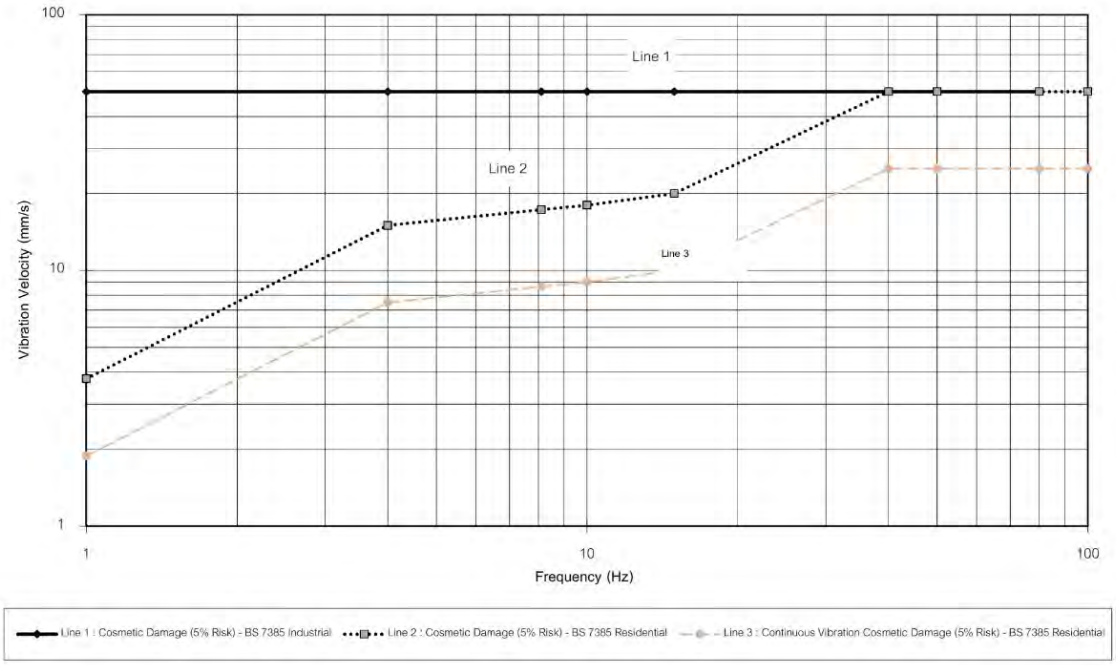
Guide values are set for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to result in a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial/industrial buildings are presented in **Table 15**, with a visual representation presented in **Figure 6**. Where sources of continuous vibration may give rise to dynamic magnification due to resonance, the values provided in **Table 15** should be reduced by 50%, this is especially the case with respect to Peak Particle Velocity (PPV) at lower frequencies.

Table 15 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Figure 6 – Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage



7.1 Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DECC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80 Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 16.

Table 16 Examples of types of vibration (from Table 2.1 of the guideline)		
Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990)	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

7.1.1 Continuous Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to continuous vibration (1-80 Hz), the criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. **Table 17** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 17 Criteria for Exposure to Continuous Vibration			
Place	Time[1]	Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
Residences	Day	0.28	0.56
	Night	0.20	0.40
Offices	Day or Night	0.56	1.1
Workshops	Day or Night	1.1	2.2

Note: rms velocity (mm/s) and vibration velocity value (dB re 10^{-9} mm/s) values given for most critical frequency >8Hz assuming sinusoidal motion.

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

7.1.2 Impulsive Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to impulsive vibration (1-80 Hz), these criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. Impulsive vibration (as defined in Section 2.1 of the guideline) is generally associated with infrequent activities that create up to three (3) distinct vibration events in an assessment period e.g. occasional dropping of heavy equipment, occasional loading and unloading. **Table 18** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 18 Criteria for Exposure to Impulsive Vibration

Place	Time[1]	Assessment Criteria	
		Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night-time	0.14	0.28
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices	Day or Night-time	18.0	36.0
Workshops	Day or Night-time	18.0	36.0

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

7.1.3 Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted RMS (root mean square) acceleration levels over the frequency range 1-80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, a (t) is the frequency-weighted RMS of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in **Table 19**.

Table 19 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration

Location	Daytime		Night-time	
	Preferred Value, m/s1.75	Maximum Value, m/s1.75	Preferred Value, m/s1.75	Maximum Value, m/s1.75
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am

Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

7.2 Vibration Assessment

The major potential sources of construction vibration include vibrating rollers. Generally, rolling would take place along the alignment prior to road resurfacing, or when relocation of services has occurred. Peak levels of vibration from rolling typically occurs as the roller stops to change direction and a resonance is created as the roller (and vibrator) is stationary.

Table 20 provides the minimum working distances for the use of various vibration intensive sources to nearby receivers to meet cosmetic damage and human response criteria. For the largest vibration generating source (18t vibratory roller), compliance with the cosmetic damage criteria is expected where the minimum offset distance of 20m is maintained from the nearest residential receivers.

Notwithstanding, once the final vibratory plant has been selected a review minimum offset distances should be conducted. Where minimum working distances are exceeded, vibration monitoring should be undertaken at the nearest effected residence to ensure levels satisfy relevant structural criteria.

Table 20 Minimum Working Distances or Vibratory Plant (m)

Plant item	Rating / Description	Minimum working distance	
		Cosmetic damage (BS 7385)	Human response (OH&E Vibration guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

Note: Source, CNVG (Roads and Maritime, 2016)

8 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Construction Noise and Vibration Impact Assessment to quantify potential noise and vibration emissions from the proposed Road Intersection Upgrade at Thompson Street and New England Highway, Muswellbrook, NSW.

The assessment has quantified potential noise emissions for the following four construction scenarios:

Scenario 1 - Site Mobilisation and Establishment of Traffic Controls;

Scenario 2 - Drainage/Earthworks/Utility Relocation/Traffic Signal installation;

Scenario 3 - Construction of New Pavement and Kerbing; and

Scenario 4 - Line Marking and Signage Installation.

The results of the assessment demonstrate that emissions from the proposal have the potential to be above the applicable NML's for all assessed receivers for all four construction scenarios.

However, the estimated noise emissions associated with construction works for all scenarios during standard hours do not trigger the Road and Maritime additional mitigation measures as predicted noise levels are within 20dB of the RBLs.

Estimated noise emissions associated with construction works are expected to be above the applicable NMLs during OOH1 and OOH2 periods following implementation of reasonable and feasible noise controls (ie as per Section 6), especially Scenario 3. Therefore, additional mitigation measures are recommended to be implemented as recommended as per **Appendix D** for all scenarios during out of hours works.

Impacts associated with vibration emissions are not anticipated for the proposal as offset distances exceed the minimum required distance of 20m. Notwithstanding, a review of vibration sources should be undertaken once plant types are confirmed and be properly managed.

Road traffic noise levels associated with the proposal are anticipated to reduce compared to existing levels. The key component in achieving a noise reduction is adoption of dense graded asphalt instead of spray seal for the surface of the road. As per the ENMM, dense graded asphalt results in a reduction of up to 4dB compared to spray seal.

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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**.

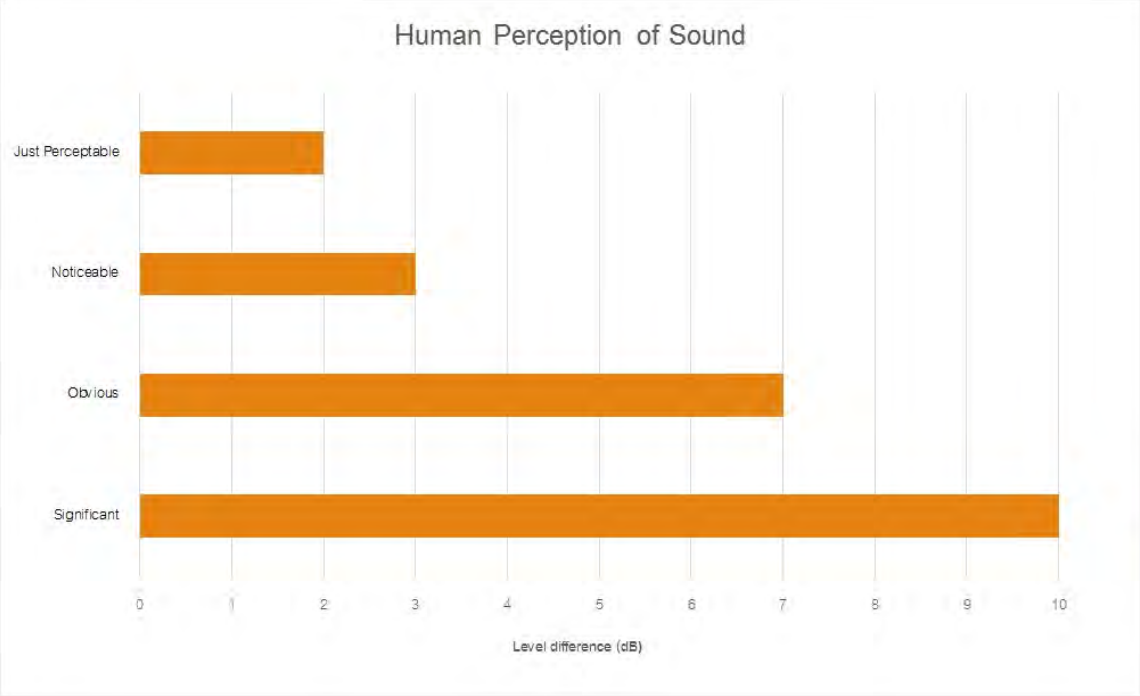
Table A1 Glossary of Terms

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 NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities include sources such as construction and holiday period traffic.
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

Figure A1 – Human Perception of Sound



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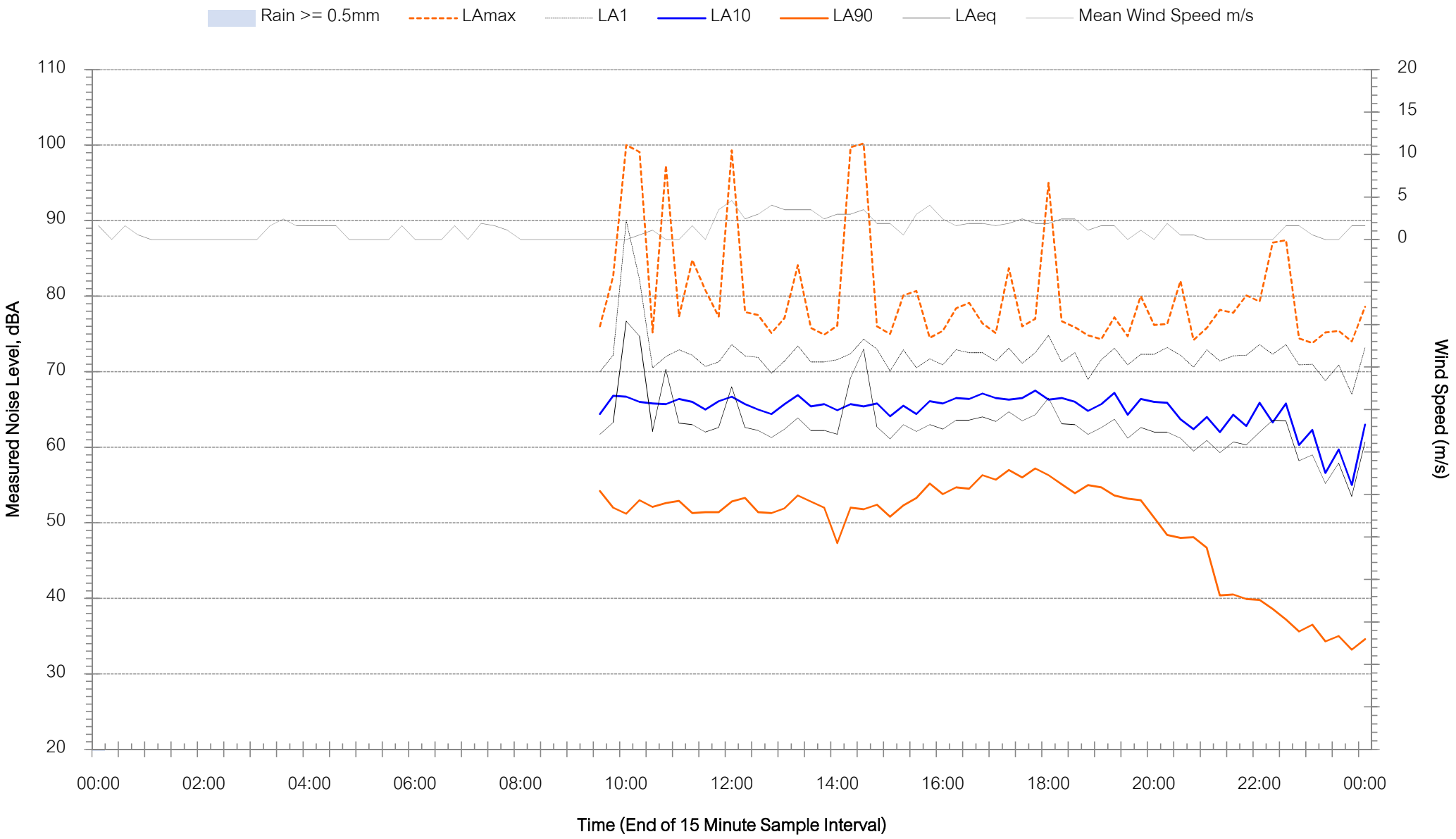
Appendix B - Noise Monitoring Charts

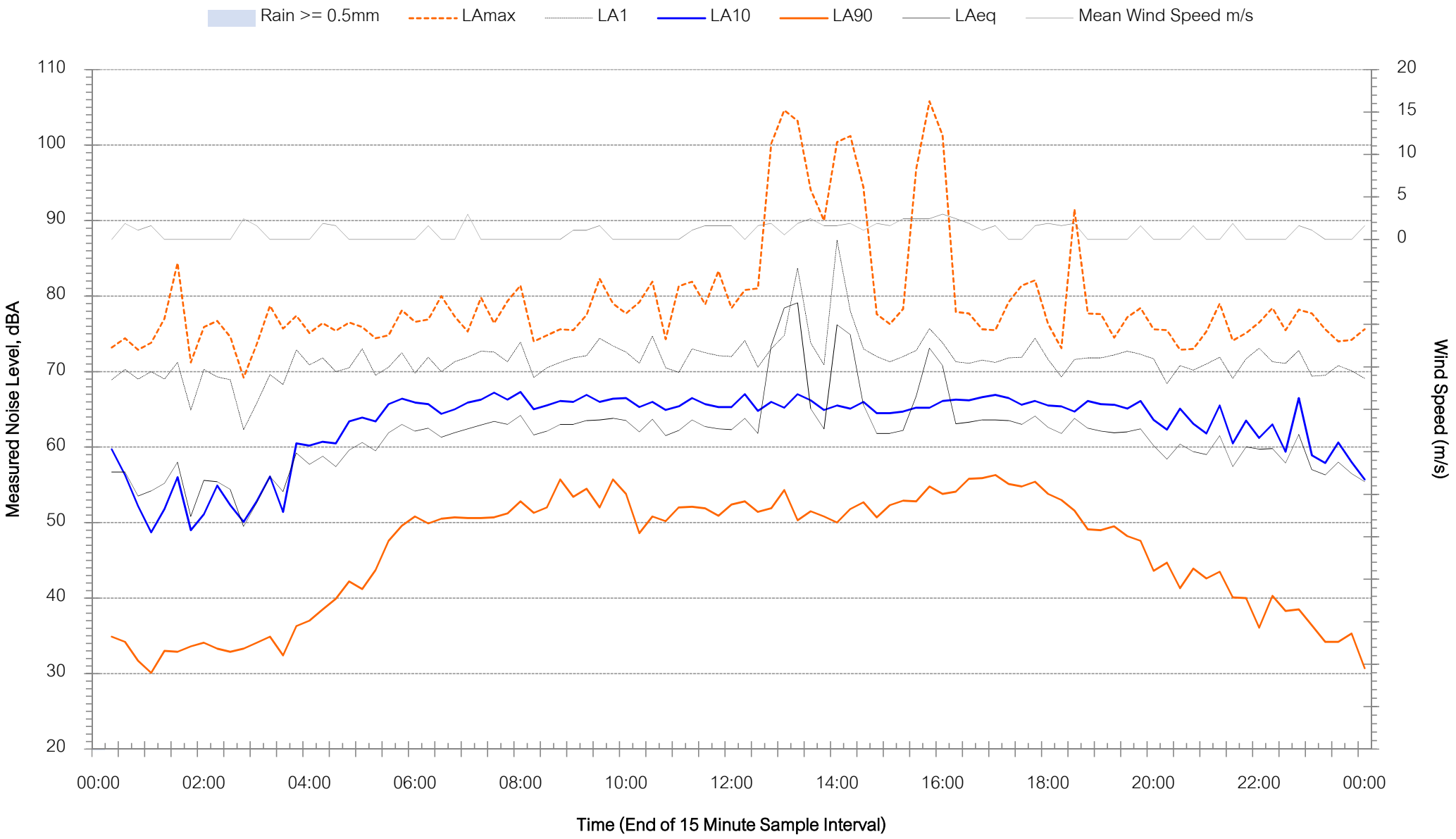
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Tuesday 21 May 2019



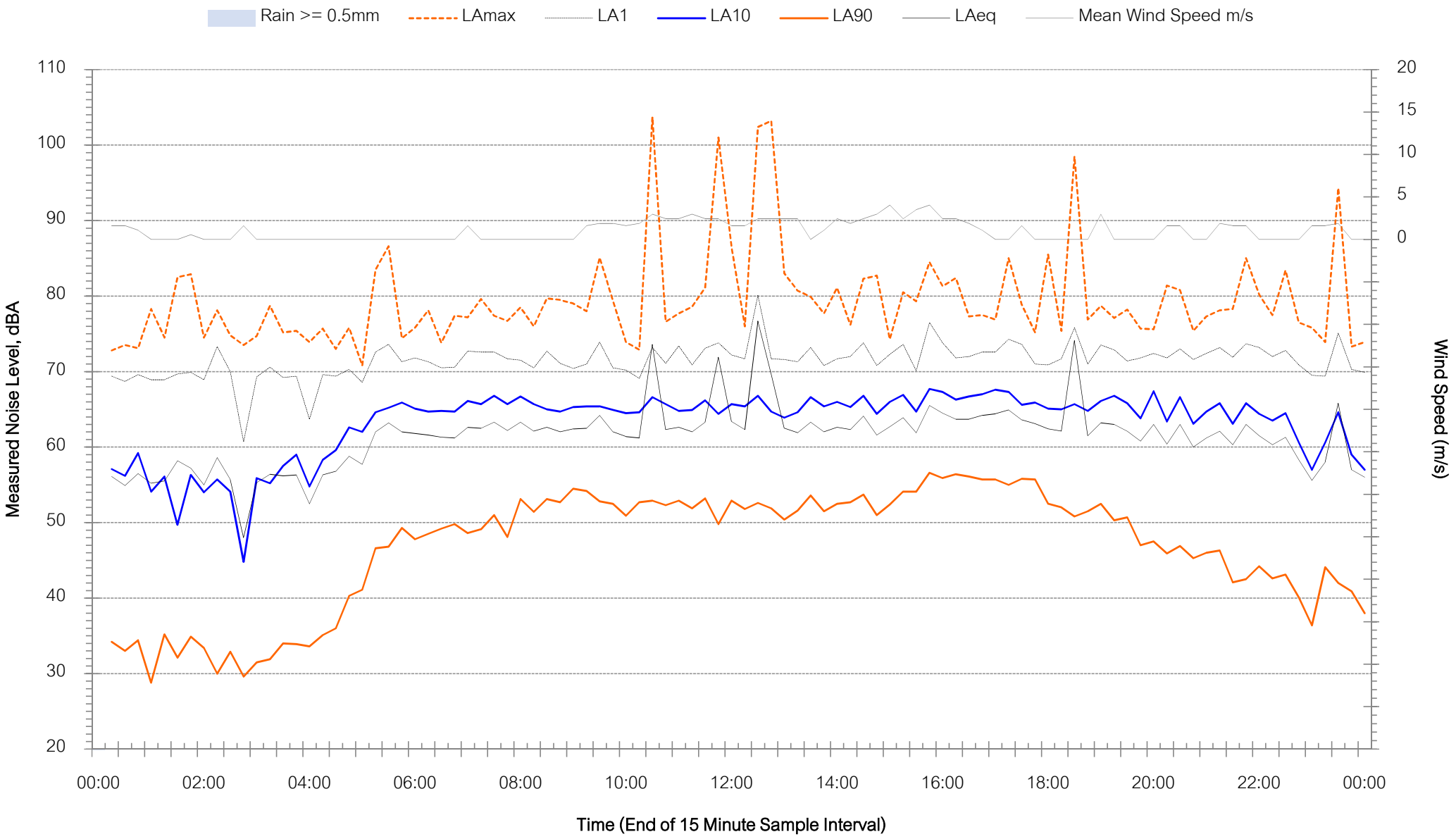
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Wednesday 22 May 2019



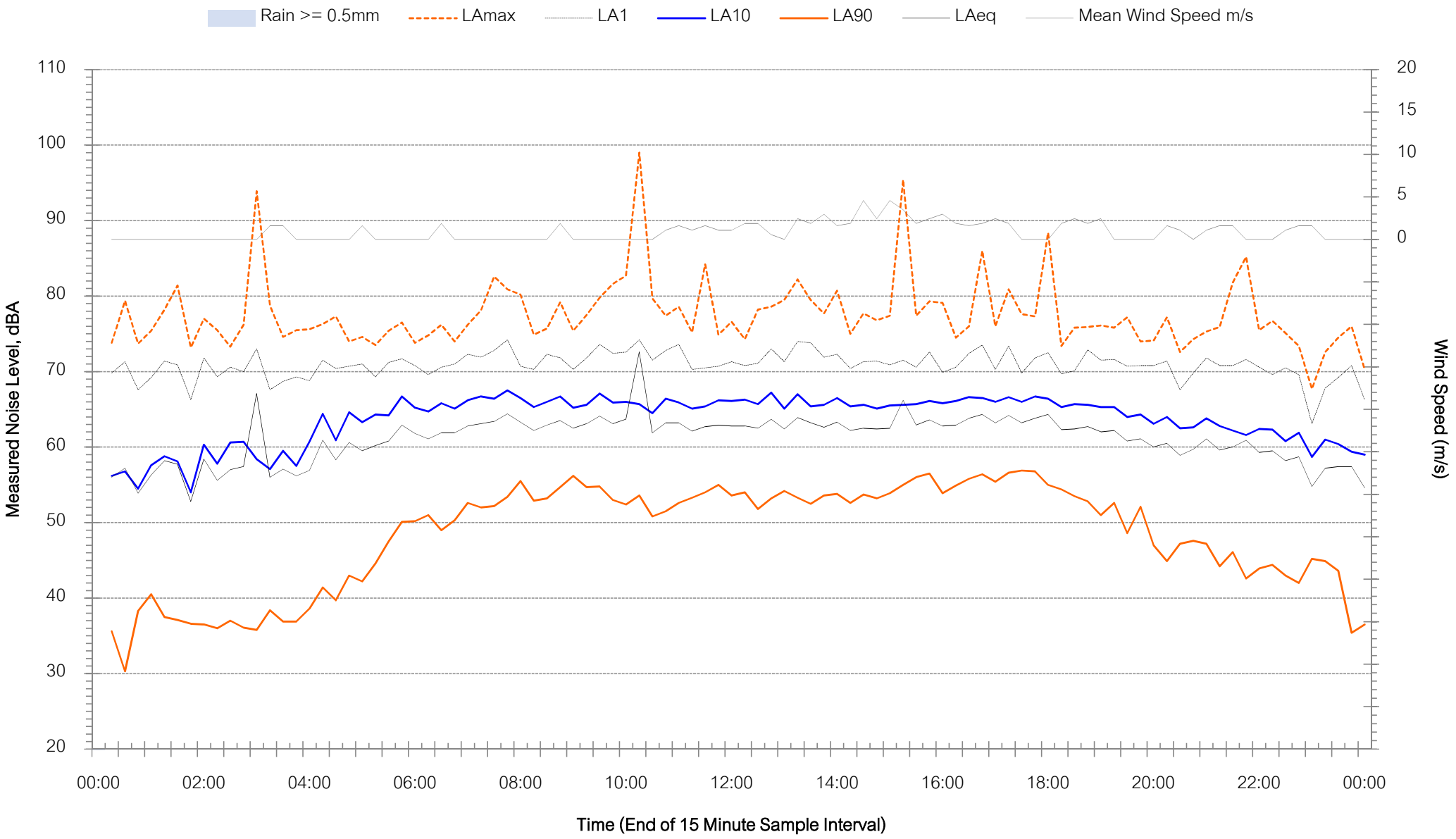
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Thursday 23 May 2019



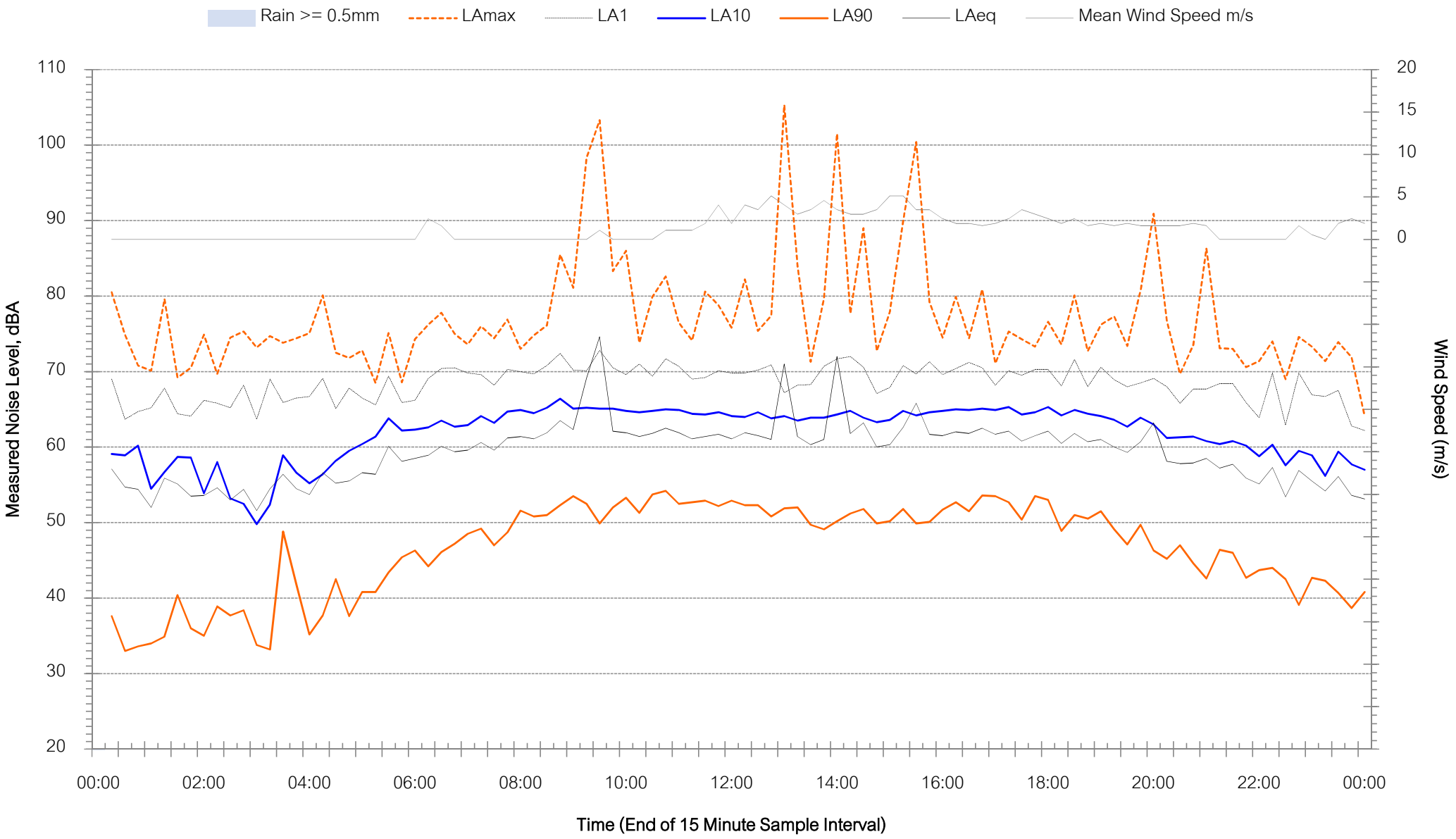
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Friday 24 May 2019



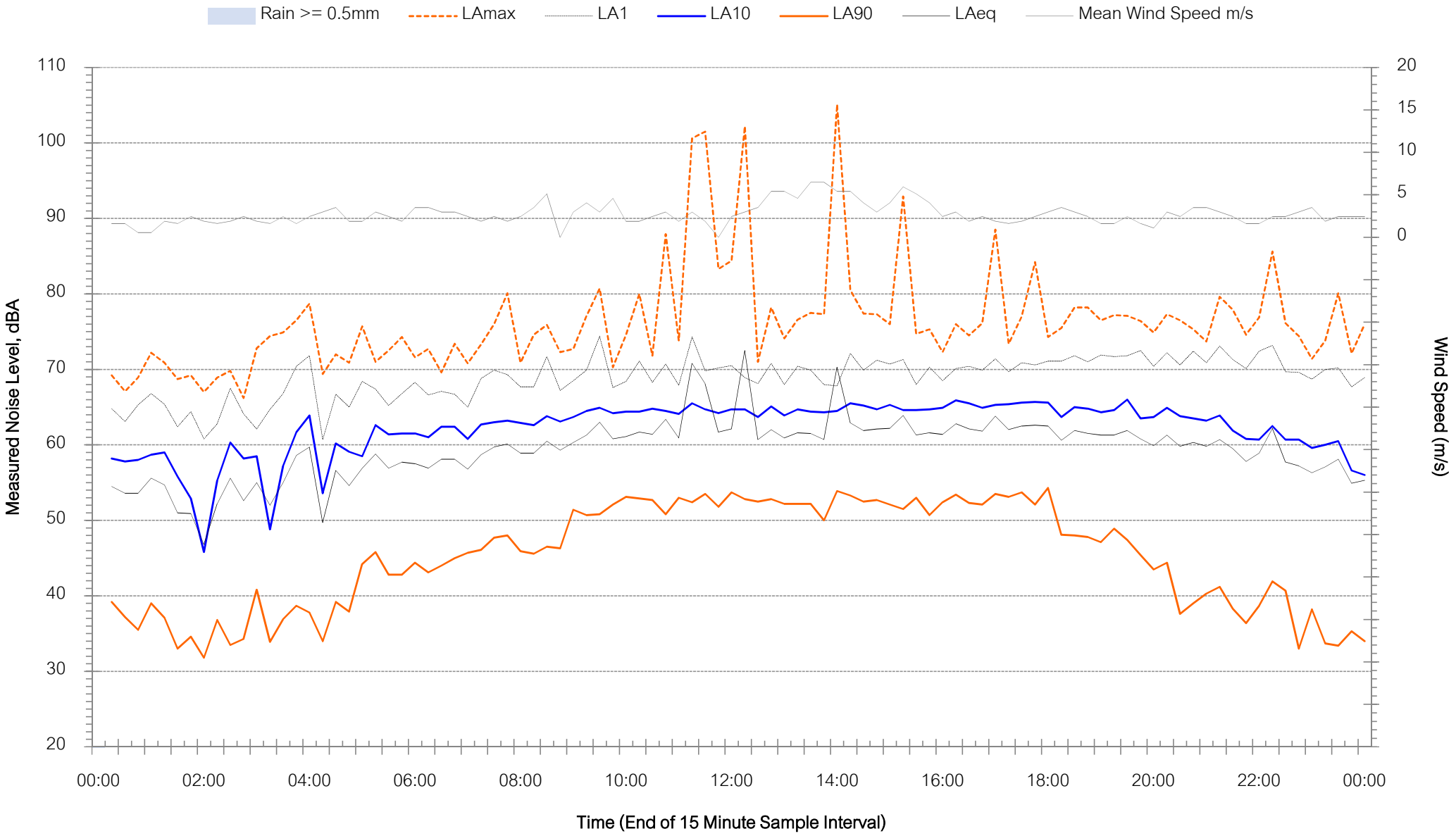
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Saturday 25 May 2019



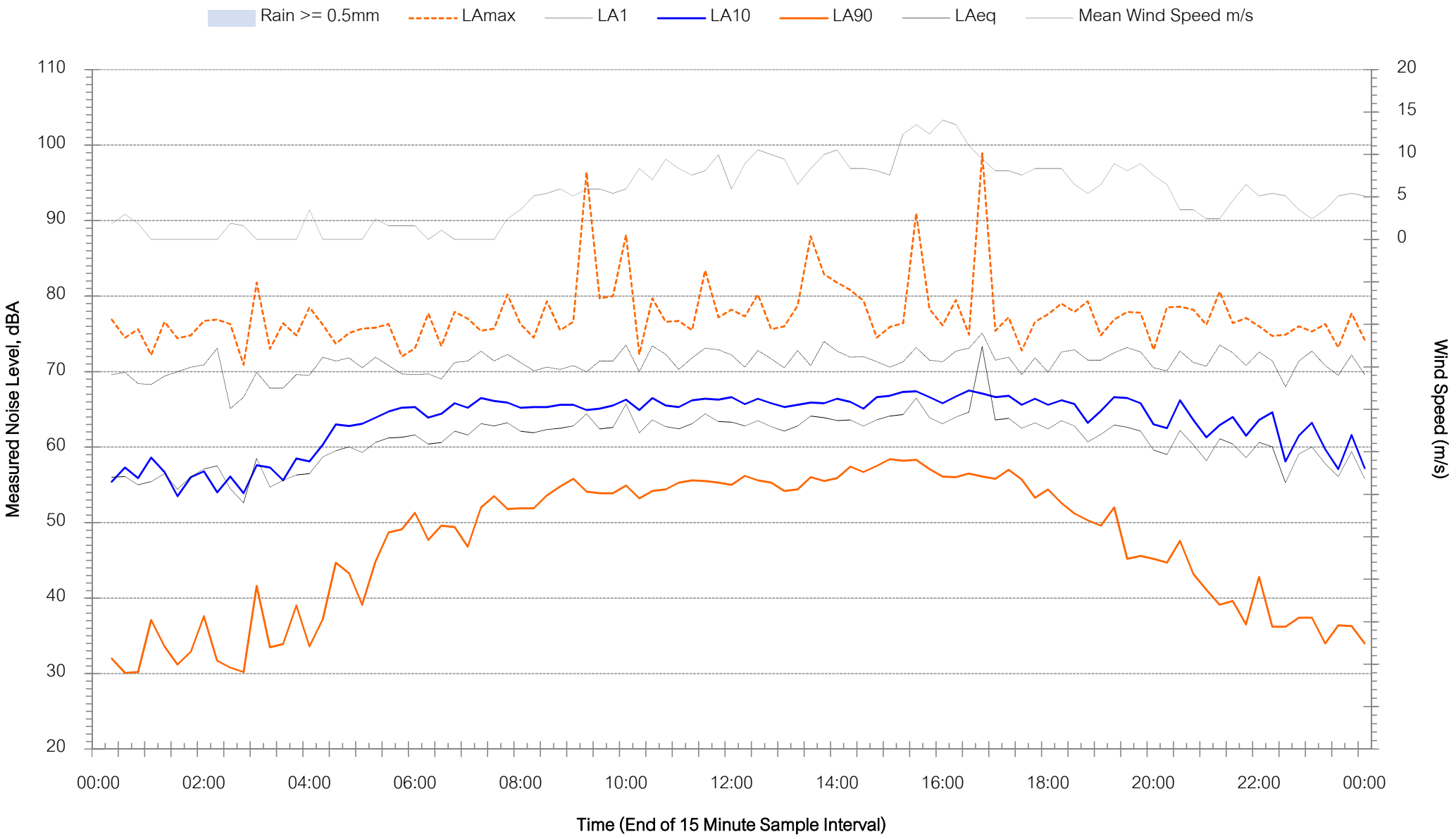
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Sunday 26 May 2019



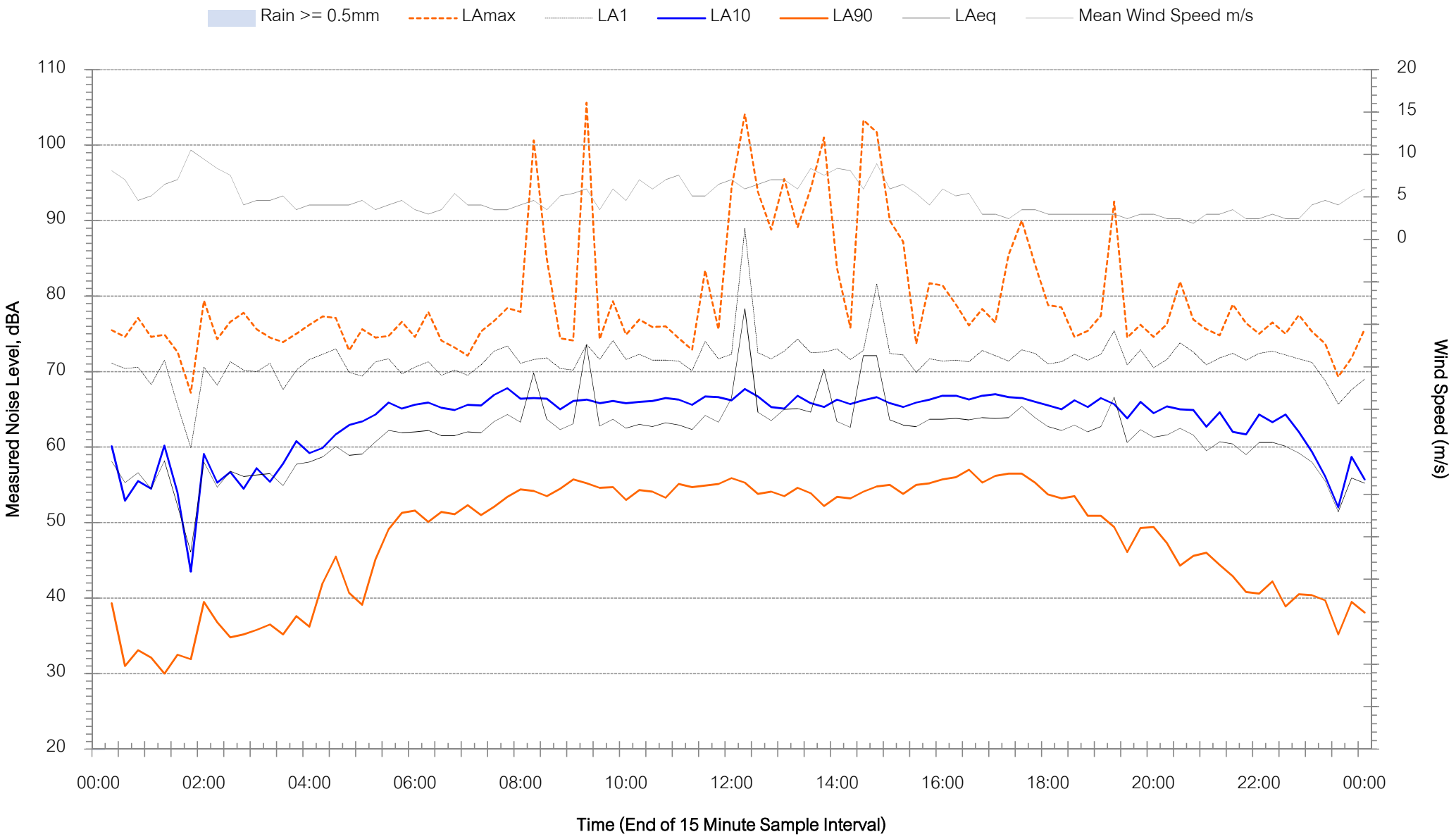
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Monday 27 May 2019



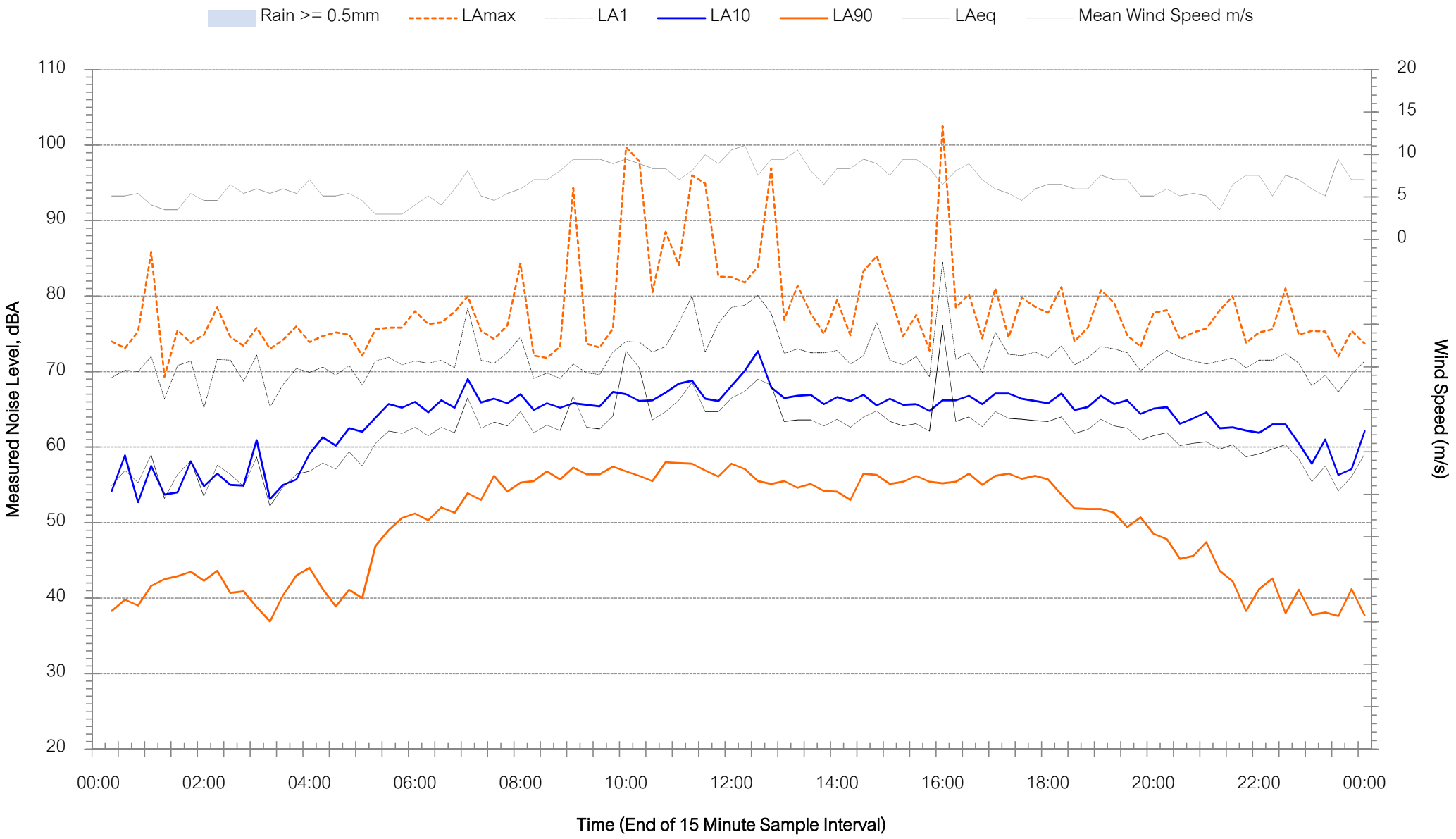
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Tuesday 28 May 2019



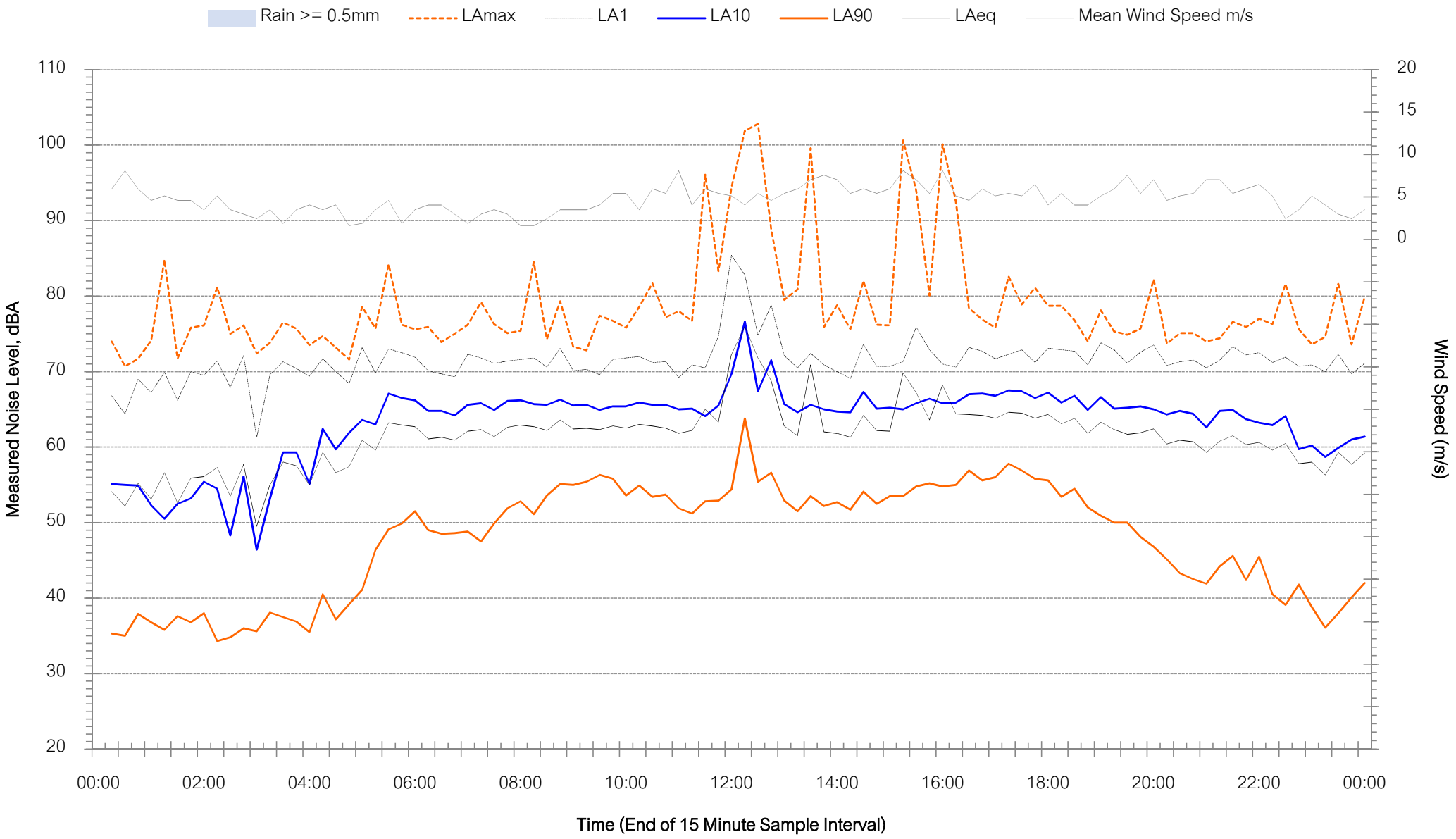
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Wednesday 29 May 2019



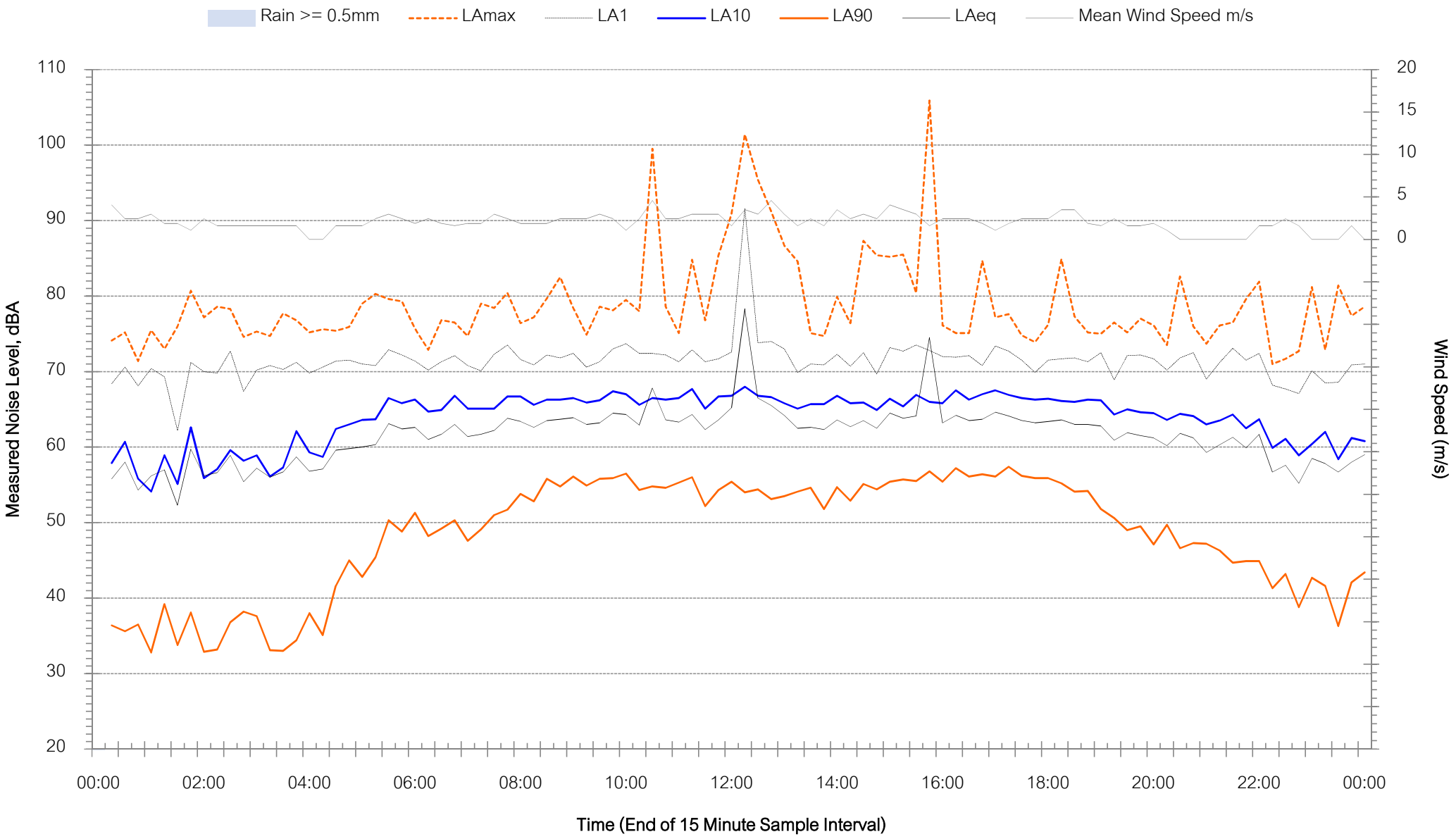
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Thursday 30 May 2019



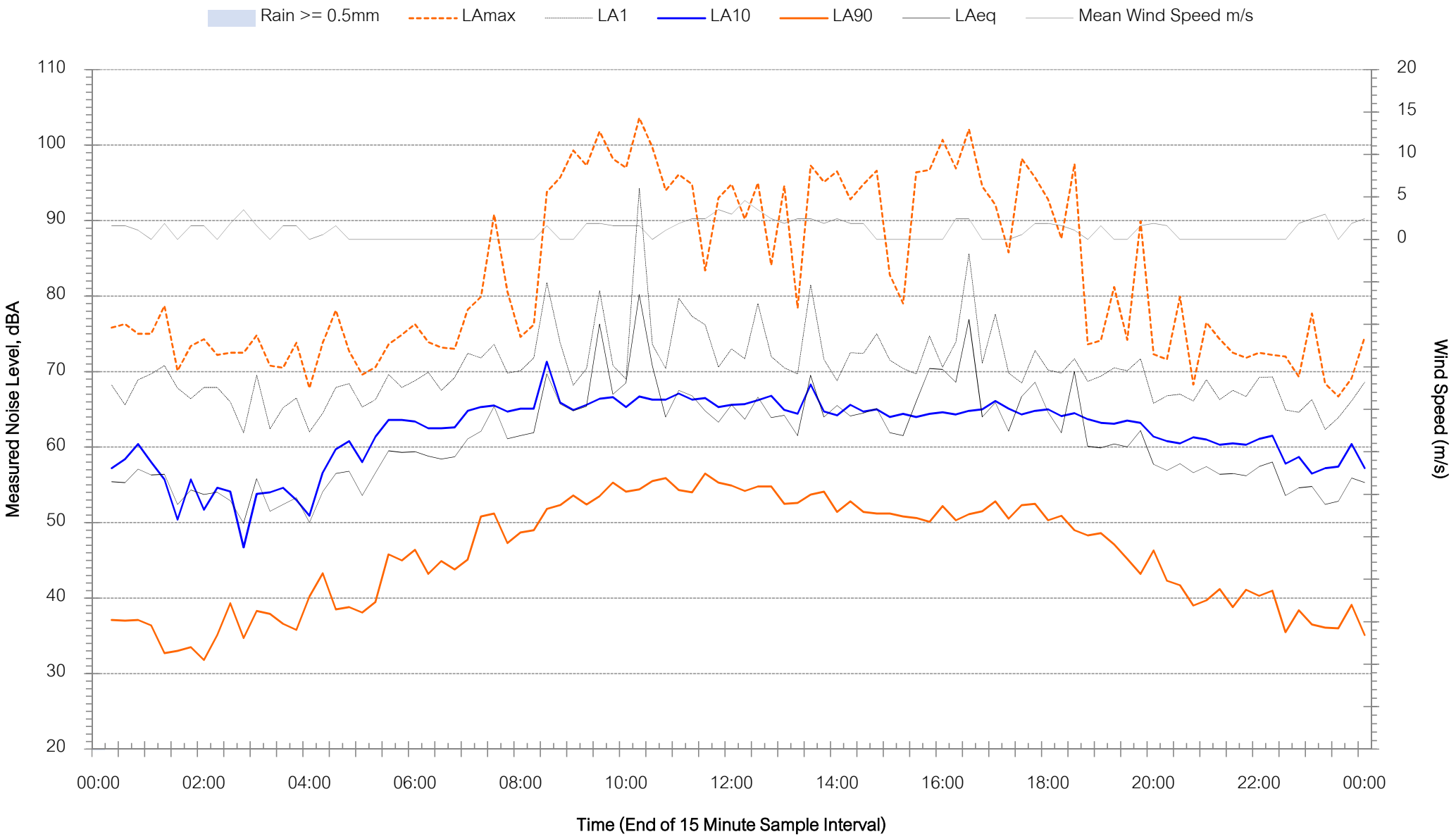
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Friday 31 May 2019



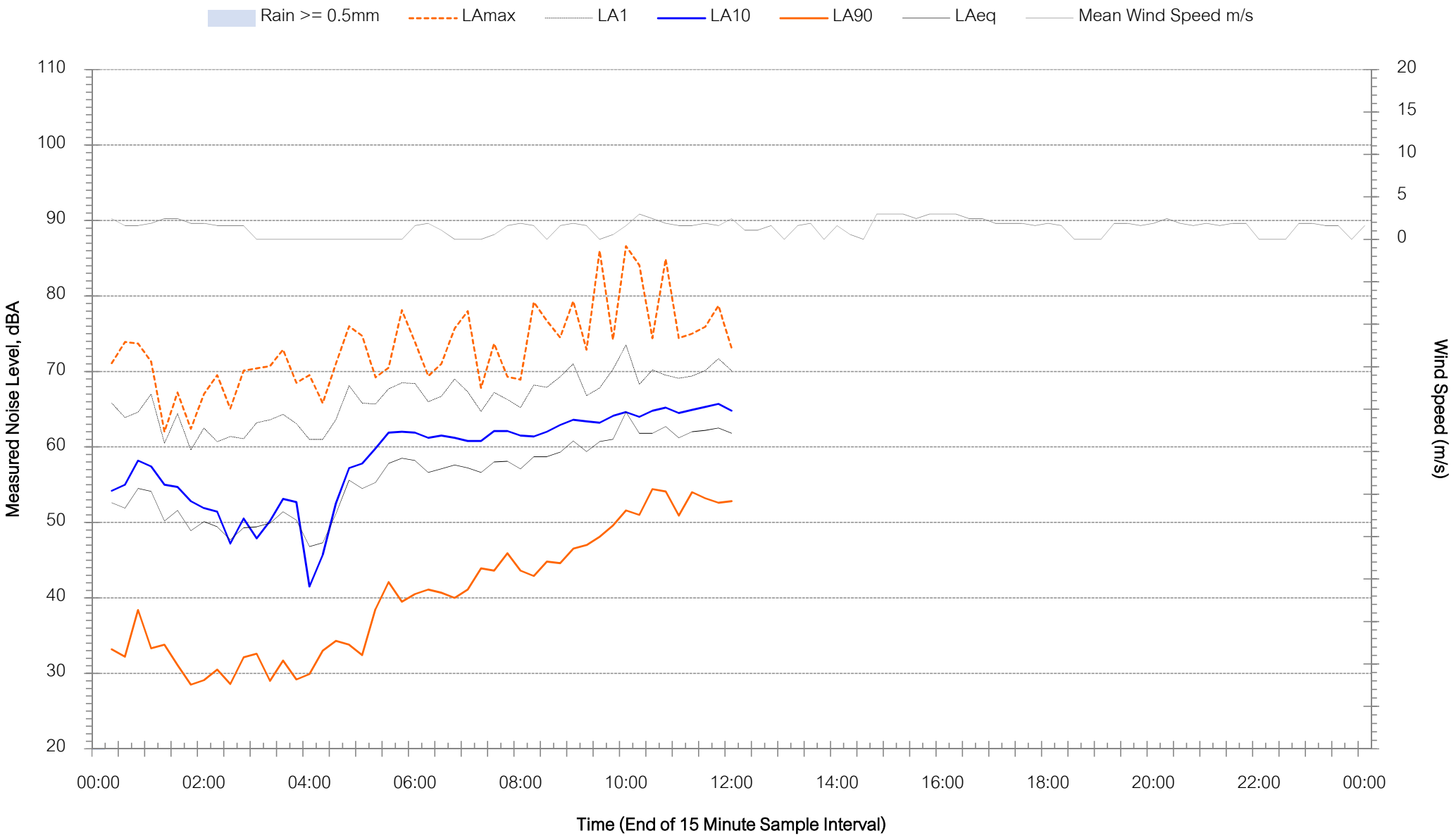
Background Noise Levels

Thompson Street, Muswellbrook, NSW - Saturday 1 June 2019



Background Noise Levels

Thompson Street, Muswellbrook, NSW - Sunday 2 June 2019



Appendix C - Single Point Calculation Sheets

Table C1 - Construction Noise Results, $L_{Aeq(15min)}$

Receivers	Predicted LAeq dBA Per Scenario				LAeq NML dBA		
	1	2	3	4	Standard	OOH1	OOH2
R1	57	65	73	55	61	47	39
R2	59	67	75	57	61	47	39
R3	60	67	75	58	61	47	39
R4	61	68	76	59	61	47	39
R5	60	68	76	58	61	47	39
R6	62	70	78	60	61	47	39
R7	56	63	71	54	61	47	39
R8	52	59	67	50	61	47	39
R9	50	57	65	48	61	47	39
R10	50	58	66	48	61	47	39
R11	50	57	65	48	61	47	39
R12	48	55	63	46	61	47	39
R13	45	51	59	43	61	47	39
R14	42	48	56	40	61	47	39
R15	42	47	55	40	61	47	39
R16	38	41	49	36	61	47	39
R17	42	46	54	40	61	47	39
R18	44	50	58	42	61	47	39
R19	46	51	59	44	61	47	39
R20	48	53	61	46	61	47	39
R21	49	55	63	47	61	47	39
R22	53	60	68	51	61	47	39
R23	60	68	76	58	61	47	39
R24	57	65	73	55	61	47	39
R25	57	64	72	55	61	47	39
R26	52	59	67	50	61	47	39
R27	52	60	68	50	61	47	39
R28	50	58	66	48	61	47	39
C1	57	65	73	55		70	
M1	47	54	62	45	61	47	39
AR1	54	62	70	52		65	

Note: Levels above the highly noise affected noise management level of 75dBA are shaded. It is noted that the highly noise affected management level. The highly noise affected level represents the point above which there may be strong community reaction to noise.

Appendix D - Additional Mitigation Measures Matrix and Triggers

Additional mitigation measures as outlined in Section 11.2.2 of the CNVG (Roads and Maritime, 2015) are summarised below. Many of these measures require communication with the community.

Specific notifications (SN)

Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures (Tables C1 to C3). This form of communication is used to support periodic notifications, or to advertise unscheduled work.

Phone calls (PC)

Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.

Individual briefings (IB)

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the proposal.

Respite Offer (RO)

Respite Offers should be made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.

Respite Period 1 (R1)

Out of hours construction noise in out of hours period 1 shall be limited to no more than three consecutive evenings per week except where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and no more than 6 evenings per month

Respite Period 2 (R2)

Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month.

Negotiated Respite (NR)

Respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration proposals. In this instance and where it can be strongly justified it may be beneficial to increase the number of evenings or nights worked through Negotiated Respite so that the proposal can be completed more quickly.

Pre-purchased movie tickets or a similar offer may also provide respite for the community while providing provision for additional out of hours work. This measure is determined on a proposal-by-proposal basis, and may not be applicable to all RMS proposals.

The receivers that should be liaised with to gain community support for Negotiated Respite include those where out of hours work exceed the NML.

Where there are few receivers above the NML each of these receivers should be visited to discuss the proposal to gain support for Negotiated Respite.

In instances where there are many receivers above the NML it may not be practical discuss the proposal with every receiver. Instead the community should be proactively engaged so they have an incentive to participate in discussion supporting Negotiated Respite. Support may be demonstrated from surveys, online feedback, contact phone numbers and community events.

Alternative accommodation (AA)

Alternative accommodation options should be provided to residents living in close proximity to construction work that are likely to incur noise levels significantly above the applicable level (Tables C1-C3). The specifics of the offer will be determined on a proposal-by-proposal basis.

Verification

Please see Appendix F of the CNVG for more details about verification of Noise and Vibration levels following complaints and as part of routine checks of noise levels.

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MAC
Muller Acoustic Consulting

APPENDIX C

DATABASE SEARCHES

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : Thompson Street

Client Service ID : 419935

Cardno NSW/ACT pty ltd

205 north albany st
Gosford New South Wales 2250

Attention: Nadine Caff

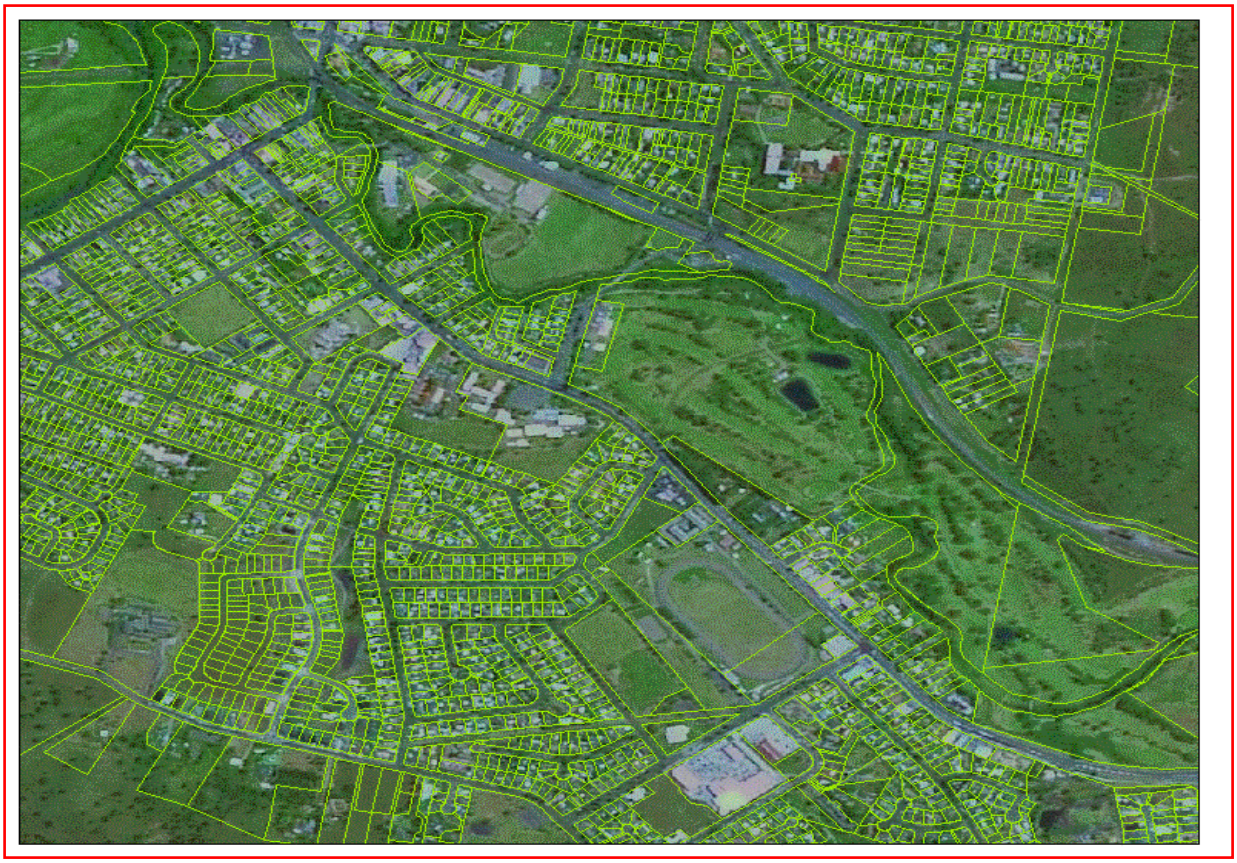
Email: nadine.caff@cardno.com.au

Date: 10 May 2019

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 1, DP:DP506830 with a Buffer of 1000 meters, conducted by Nadine Caff on 10 May 2019.

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:

1	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : Thompson Street

Client Service ID : 419940

Cardno NSW/ACT pty ltd

205 north albany st
Gosford New South Wales 2250

Attention: Nadine Caff

Email: nadine.caff@cardno.com.au

Date: 10 May 2019

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 101, DP:DP793194 with a Buffer of 200 meters, conducted by Nadine Caff on 10 May 2019.

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:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
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- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

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Locked Bag 5020 Parramatta NSW 2220
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ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : Thompson Street

Client Service ID : 419937

Cardno NSW/ACT pty ltd

Date: 10 May 2019

205 north albany st
Gosford New South Wales 2250

Attention: Nadine Caff

Email: nadine.caff@cardno.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 1, DP:DP506830 with a Buffer of 200 meters, conducted by Nadine Caff on 10 May 2019.

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:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

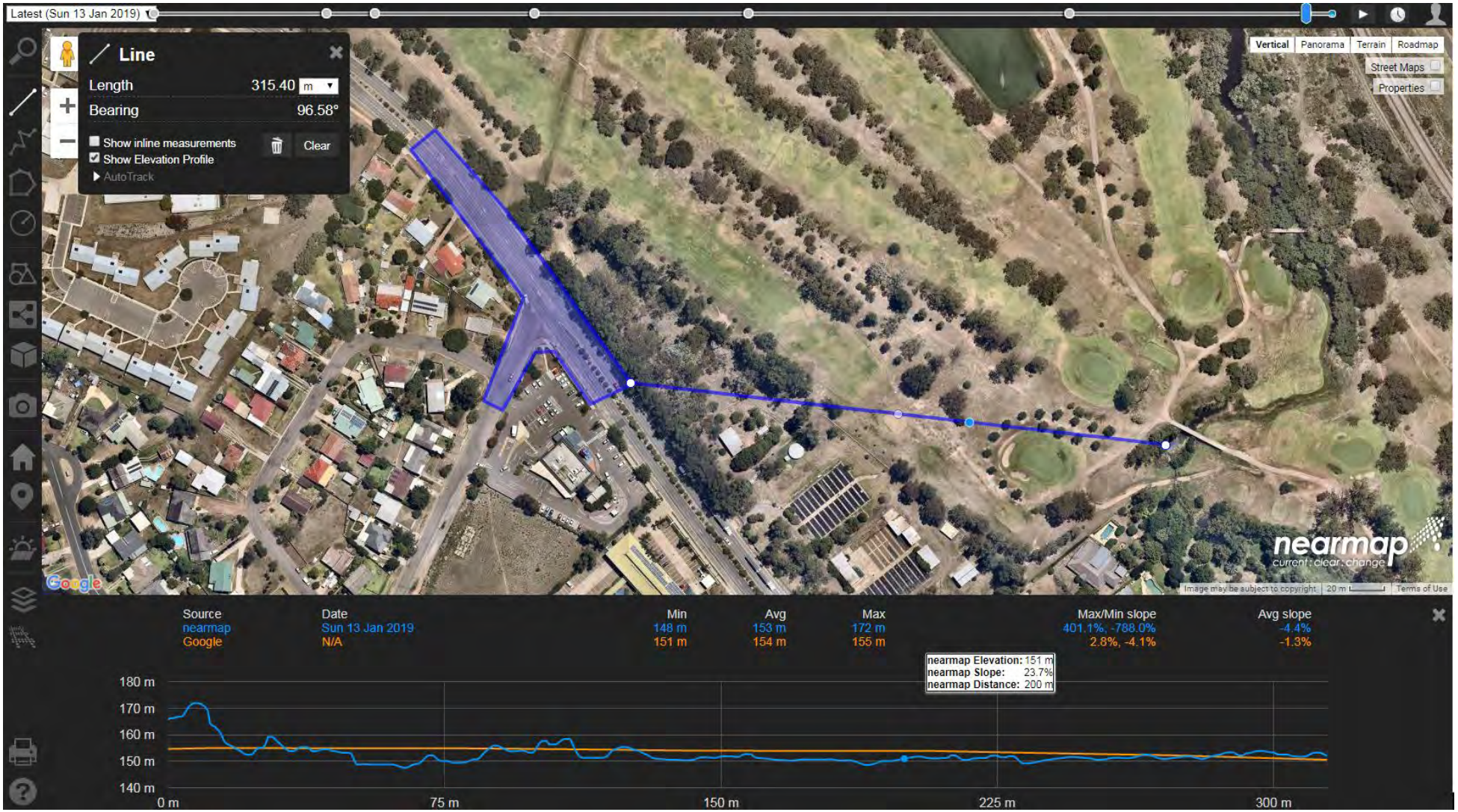
- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au


Latest (Sun 13 Jan 2019)
Line
Length 315.40 m
Bearing 96.58°
Show inline measurements
Show Elevation Profile
AutoTrack
Clear
Vertical
Panorama
Terrain
Roadmap
Street Maps
Properties
nearmap
current : clear : change
Image may be subject to copyright
20 m
Terms of Use
Source
Date
Min
Avg
Max
Max/Min slope
Avg slope
nearmap
Sun 13 Jan 2019
148 m
153 m
172 m
401.1%, -788.0%
-4.4%
Google
N/A
151 m
154 m
155 m
2.8%, -4.1%
-1.3%
nearmap Elevation: 151 m
nearmap Slope: 23.7%
nearmap Distance: 200 m
180 m
170 m
160 m
150 m
140 m
0 m
75 m
150 m
225 m
300 m

Search for NSW heritage

Return to search page where you can refine/broaden your search.

Statutory listed items

Information and items listed in the State Heritage Inventory come from a number of sources. This means that there may be several entries for the same heritage item in the database. For clarity, the search results have been divided into three sections.

- **Section 1** - contains Aboriginal Places declared by the **Minister for the Environment** under the National Parks and Wildlife Act. This information is provided by the Heritage Division.
- **Section 2** - contains heritage items listed by the **Heritage Council of NSW** under the NSW Heritage Act. This includes listing on the State Heritage Register, an Interim Heritage Order or protected under section 136 of the NSW Heritage Act. This information is provided by the Heritage Division.
- **Section 3** - contains items listed by **local councils** on Local Environmental Plans under the Environmental Planning and Assessment Act, 1979 and **State government agencies** under s.170 of the Heritage Act. This information is provided by local councils and State government agencies.

Section 1. Aboriginal Places listed under the National Parks and Wildlife Act.

Your search did not return any matching results.

Section 2. Items listed under the NSW Heritage Act.

Your search returned 8 records.

Item name	Address	Suburb	LGA	SHR
Eatons Hotel & St Vincent De Paul Group	178, 180-188 Bridge Street	Muswellbrook	Muswellbrook	00331
Edinglassie	710 Denman Road	Muswellbrook	Muswellbrook	00170
Loxton House	142-144 Bridge Street	Muswellbrook	Muswellbrook	00185
Merton	4883 Jerrys Plains Road	Denman	Muswellbrook	00159
Muswellbrook Railway Station and yard group	Main Northern railway	Muswellbrook	Muswellbrook	01208
Rous Lench	Denman Road	Edinglassie	Muswellbrook	00211
St. Alban's Anglican Church	Hunter Terrace	Muswellbrook	Muswellbrook	00458
Weidmann Cottage	132 Bridge Street	Muswellbrook	Muswellbrook	00260

Section 3. Items listed by Local Government and State Agencies.

Your search returned 205 records.

Item name	Address	Suburb	LGA	Information source
Armitage House	2 Armitage Avenue	Muswellbrook	Muswellbrook	LGOV
Army munitions base	495 Rosemount Road	Denman	Muswellbrook	LGOV
Atherstone	5 Sowerby Street	Muswellbrook	Muswellbrook	GAZ
Atherstone	5 Sowerby Street	Muswellbrook	Muswellbrook	LGOV
Baerami Creek Shale Mines and Retort	Baerami Creek Road	Baerami	Muswellbrook	LGOV
Baerami Homestead	Berami Road via Sandy Hollow	Denman	Muswellbrook	GAZ
Baerami Homestead (including pedestrian bridge)	300 Baerami Creek Road	Baerami	Muswellbrook	LGOV
Baerami School of Arts	1361 Bylong Valley Way	Baerami	Muswellbrook	LGOV
Bakery	49 Ogilvie Street	Denman	Muswellbrook	LGOV
Balmoral	310 Denman Road	Muswellbrook	Muswellbrook	LGOV
Balmoral	Denman Road	Muswellbrook	Muswellbrook	GAZ
Barber Shop	5 Sydney Street	Muswellbrook	Muswellbrook	GAZ
Beer Homestead	721 Edderton Road	Muswellbrook	Muswellbrook	LGOV
Belmont	721 Edderton Road	Muswellbrook	Muswellbrook	LGOV
Bengalla Homestead	183 Bengalla Road	Bengalla	Muswellbrook	LGOV
Billiards Building	36-40 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Birralee		Muswellbrook	Muswellbrook	LGOV

	33 Brentwood Street (Cnr Brecht Street)			
Birralee	Brecht Street	Muswellbrook	Muswellbrook	GAZ
Blunt's Butter Factory	179 Overton Road	Bengalla	Muswellbrook	LGOV
Brighton Villa	12 Hunter Street	Muswellbrook	Muswellbrook	GAZ
Brighton Villa	12 Hunter Terrace	Muswellbrook	Muswellbrook	LGOV
Brogheda	6 Yarraman Road	Manobalai	Muswellbrook	LGOV
Business Heritage Conservation Area		Muswellbrook	Muswellbrook	LGOV
Campbell & Co Store, Former	54	Muswellbrook	Muswellbrook	GAZ
Campbell's Corner	60 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Cordial Factory (Demolished)	Muswellbrook Road	Denman	Muswellbrook	LGOV
Courthouse & Police Station, Former	Palace Street	Denman	Muswellbrook	GAZ
Dalmar Stud	690 Bengalla Road	Bengalla	Muswellbrook	LGOV
Denman Bridge over Hunter River	Golden Highway	Denman	Muswellbrook	SGOV
Denman Conservation Area		Denman	Muswellbrook	GAZ
Denman Heritage Conservation Area		Denman	Muswellbrook	LGOV
Denman Hotel	1-5 Ogilvie Street (corner of Palace Street)	Denman	Muswellbrook	LGOV
Denman Masonic Lodge	18 Jerdan Street	Denman	Muswellbrook	LGOV
Denman Memorial Hall	30 Ogilvie Street	Denman	Muswellbrook	LGOV
Eatons Group	164-166,172, 174, 178, 180 and 188	Muswellbrook	Muswellbrook	GAZ

	Bridge Street			
Eatons Group - house	178 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Eatons Group - shop	172 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Eatons Group - St Vincent de Paul Society building	174-176 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Eatons Hotel	182-184 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Edderton Homestead	Edderton Road	Muswellbrook	Muswellbrook	LGOV
Edinglassie	710 Denman Road	Muswellbrook	Muswellbrook	LGOV
Edward Higgens Building	30-32 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Ellamara	1831 Merriwa Road	Sandy Hollow	Muswellbrook	LGOV
Fairview	Hebden Road	Liddell	Muswellbrook	LGOV
Farrells Auto One	5 Maitland Street	Muswellbrook	Muswellbrook	LGOV
Fitzgerald /Olympic Park Gates	Wilkinson Avenue	Muswellbrook	Muswellbrook	LGOV
Former Anglican Church Rectory	21 Palace Street	Denman	Muswellbrook	LGOV
Former barber shop	7 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Former butter factory	14-15 Aberdeen Street	Muswellbrook	Muswellbrook	LGOV
Former Campbell's and Co store	52 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Former CBC Bank	35 Ogilvie Street	Denman	Muswellbrook	LGOV
Former Court House Group - police station, residence and lockup	32 Palace Street	Denman	Muswellbrook	LGOV
Former hospital	37 Sowerby Street	Muswellbrook	Muswellbrook	LGOV
Former picture theatre	17 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Former post office	3179 Bylong Valley Way	Kerrabee	Muswellbrook	LGOV

Former Presbyterian manse	106 Hill Street	Muswellbrook	Muswellbrook	LGOV
Former private hospital	5 Crinoline Street	Denman	Muswellbrook	LGOV
Former Royal Hotel	1 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Former School and Residence	1828 Merriwa Road	Ginats Creek	Muswellbrook	LGOV
Former school residence	80 Palace Street	Denman	Muswellbrook	LGOV
Former St John's Presbyterian Church PREVIOUS/OTHER NAME St Johns Presb	Hill Street	Muswellbrook	Muswellbrook	LGOV
Gelston	409 Sandy Creek Road	Muswellbrook	Muswellbrook	LGOV
Glenmunro - slab kitchen	4372 Jerrys Plains Road	Denman	Muswellbrook	LGOV
Goulburn River National Park	Goulburn River	Baerami	Muswellbrook	LGOV
Hennor	18-20 Maitland Street	Muswellbrook	Muswellbrook	LGOV
Hennor	Maitland Road	Muswellbrook	Muswellbrook	GAZ
Hillcrest	311 Hebden Road	Liddell	Muswellbrook	LGOV
Holbrook Stud	2030 Widden Valley Road	Baerami	Muswellbrook	LGOV
Hollydeen Shop and Garage	1010 Merriwa Road (Cnr Reedy Creek Road)	Hollydeen	Muswellbrook	LGOV
Hospital, Former	37 Sowerby Street	Muswellbrook	Muswellbrook	GAZ
House	5 Midanga Avenue	Muswellbrook	Muswellbrook	LGOV
House	9-11 Hunter Terrace	Muswellbrook	Muswellbrook	LGOV
Item	15 Hunter Terrace	Muswellbrook	Muswellbrook	GAZ
Item	27 Brovic Street	Muswellbrook	Muswellbrook	GAZ
Jerrys Plains Official Residence	Doyle Street	Jerrys Plains	Muswellbrook	SGOV

Kayuga	731 Kayuga Road	Kayuga	Muswellbrook	LGOV
Kayuga Bridge	Kayuga Road	Muswellbrook	Muswellbrook	LGOV
Kayuga Bridge over Hunter River	Kayuga Road	Muswellbrook	Muswellbrook	SGOV
Kerb and Guttering - Brook Street	Brook Street (Bridge Street to railway line)	Muswellbrook	Muswellbrook	LGOV
Kerb and Guttering - Sydney Street	Sydney Street (Maitland Street to Haydon Street)	Muswellbrook	Muswellbrook	LGOV
Keys Family Private Cemetery	Bengalla Road	Bengalla	Muswellbrook	LGOV
Keys Family Private Cemetery	Bengalla Road	Bengalla	Muswellbrook	GAZ
Kildonan	208 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Koobahla Villa	Cook Street	Muswellbrook	Muswellbrook	GAZ
Koombahla Villa	23 Cook Street (Cnr Carl Street)	Muswellbrook	Muswellbrook	LGOV
Lime Kiln - E.I.E.I.O	540 Sandy Creek Road	Muswellbrook	Muswellbrook	LGOV
Loxton House	140-142 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Manobalai Nature Reserve	Yarraman Road	Manobalai	Muswellbrook	LGOV
Martindale	Martindale Road	Denman	Muswellbrook	GAZ
Martindale Homestead	1150 Martindale Road	Denman	Muswellbrook	LGOV
Masonic Hall		Muswellbrook	Muswellbrook	GAZ
Masonic Lodge	75 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Merton	4883 Jerrys Plains Road	Denman	Muswellbrook	LGOV
Merton Cemetery	5052 Jerrys Plains Road	Denman	Muswellbrook	LGOV

Merton Cemetery		Denman	Muswellbrook	GAZ
Minch's Wine Shop	18 Foley Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Ambulance	Market, William Streets	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Brick Works	Muswellbrook Common	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Bridge	Kayuga Road	Muswellbrook	Muswellbrook	GAZ
Muswellbrook Cemetery	Bowman and Brecht Streets	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Conservation Area		Muswellbrook	Muswellbrook	GAZ
Muswellbrook High School	King Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Hotel	46 Market Street (Cnr Carl Street)	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Hunter River Underbridge	Railway Locations, Ulan Line, 289.304 & 327.079 Kms		Muswellbrook	SGOV
Muswellbrook Infants School	Dolahenty Street (corner of King Street)	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Police Station	William Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Police Station, Former	26 William Street	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Post Office	7 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Railway Precinct	Market Street	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Railway Precinct	Market Street	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Railway Station	Market Street	Muswellbrook	Muswellbrook	GAZ
Muswellbrook Railway Station	Market Street	Muswellbrook	Muswellbrook	LGOV
National Australia Bank building	46-50 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Negoa Homestead	92 Wiltons Lane	Kayuga	Muswellbrook	LGOV

Negoa Homestead	Kayuga Road	Muswellbrook	Muswellbrook	GAZ
Oak Milk Factory	Hunter Street	Muswellbrook	Muswellbrook	LGOV
Old Kayuga Cemetery	Kayuga Road	Kayuga	Muswellbrook	GAZ
Old Kayuga Cemetery	30 Stair Street	Kayuga	Muswellbrook	LGOV
Old Kerrabee Homestead	3179 Bylong Valley Way	Kerrabee	Muswellbrook	LGOV
Olinda		Denman	Muswellbrook	GAZ
Olinda (Demolished)	Merriwa Road	Denman	Muswellbrook	LGOV
Original buildings	Ogilvie,virginia Streets	Denman	Muswellbrook	SGOV
Overdene	79 Bengalla Road	Muswellbrook	Muswellbrook	LGOV
Overdene	Bengalla Road	Muswellbrook	Muswellbrook	GAZ
Pickering	Mangoola Road	Denman	Muswellbrook	GAZ
Pickering	221 Mangoola Road	Denman	Muswellbrook	LGOV
Piercefield and Outbuildings	1532-1618 Denman Road	Denman	Muswellbrook	LGOV
Plashett Homestead	Edderton Road	Muswellbrook	Muswellbrook	LGOV
Police Residence, Former	Palace Street	Denman	Muswellbrook	GAZ
Police Station	William Street	Muswellbrook	Muswellbrook	GAZ
Portable Timber Lockup	Palace Street	Denman	Muswellbrook	GAZ
Post Office		Muswellbrook	Muswellbrook	GAZ
Presbyterian Manse	106 Hill Street	Muswellbrook	Muswellbrook	GAZ
Prince of Wales Tavern	28-30 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Railway Depot	Victoria Street	Muswellbrook	Muswellbrook	GAZ

Railway depot (roundhouse)	Bell Street	Muswellbrook	Muswellbrook	LGOV
Railway Hotel	10-14 Market Street	Muswellbrook	Muswellbrook	LGOV
Railway signal box	Market Street	Muswellbrook	Muswellbrook	LGOV
Railway Terminus Site	Turner Street	Denman	Muswellbrook	LGOV
Residence - Timber Cottage	12 Palace Street	Denman	Muswellbrook	LGOV
Residential Heritage Conservation Area		Muswellbrook	Muswellbrook	LGOV
Roman Catholic Church	Palace Street	Denman	Muswellbrook	GAZ
Rosemount Winery	659 Rosemount Road	Denman	Muswellbrook	LGOV
Rosevale Cottage	687 Kayuga Road	Kayuga	Muswellbrook	LGOV
Rous Lench	710 Denman Road	Muswellbrook	Muswellbrook	LGOV
Royal Hotel	10-16 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Royal Hotel	10 Ogilvie Street (corner of Palace Street)	Denman	Muswellbrook	LGOV
Royal Hotel	Palace Street	Denman	Muswellbrook	GAZ
Royal Hotel (original)	Ogilvie Street	Denman	Muswellbrook	LGOV
Royal Hotel, Former	1 Sydney Street	Muswellbrook	Muswellbrook	GAZ
Rumbo Bush School	"Mayland"	Denman	Muswellbrook	LGOV
Rural Bank Buidling (Demolished - 1991)	45 Bridge Street (Cnr Brook Street)	Muswellbrook	Muswellbrook	LGOV
School of Arts	Main Road	Baerami	Muswellbrook	GAZ
School of Arts/Town Hall	3 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Shale Oil Retort Relics	1590 Merriwa Road	Sandy Hollow	Muswellbrook	LGOV

Shamrock Hotel	30 William Street	Muswellbrook	Muswellbrook	LGOV
Shop façade	34 Bridge Street	Muswellbrook	Muswellbrook	GAZ
Shop Front		Muswellbrook	Muswellbrook	LGOV
Shop front	34 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Simpson Park and Reserve	Market Street (corner of Sydney Street)	Muswellbrook	Muswellbrook	LGOV
Skellatar - St Mary's Catholic School	17 Fitzgerald Avenue	Muswellbrook	Muswellbrook	LGOV
Slab Cottage	Main Road	Kerrabee	Muswellbrook	GAZ
St Alban's Anglican Church	20 Brook Street	Muswellbrook	Muswellbrook	LGOV
St Alban's Anglican Church Rectory	Corner Hunter Terrace and Brook Street	Muswellbrook	Muswellbrook	LGOV
St Alban's Anglican Church Sunday School	15 Hunter Terrace	Muswellbrook	Muswellbrook	LGOV
St Alban's Group	Brook Street	Muswellbrook	Muswellbrook	LGOV
St Alban's Precinct	Brook Street and Hunter Terrace	Muswellbrook	Muswellbrook	GAZ
St Alban's Precinct	Brovic Street	Muswellbrook	Muswellbrook	GAZ
St Alban's Precinct	Hunter Terrace	Muswellbrook	Muswellbrook	GAZ
St Heliers	70 St Heliers Road	Muswellbrook	Muswellbrook	LGOV
St Heliers Correctional Centre	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV
St Heliers Correctional Centre - Admin & outbuildings	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV
St Heliers Correctional Centre - Officers Accommodation	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV
St Heliers Correctional Centre - Stables	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV

St James' Roman Catholic Church	Brook Street	Muswellbrook	Muswellbrook	LGOV
St James' Roman Catholic Church Convent	Brook Street	Muswellbrook	Muswellbrook	LGOV
St James' Roman Catholic Presbytery	4 Sowerby Street	Muswellbrook	Muswellbrook	LGOV
St John's Anglican Church	1824 Merriwa Road	Giants Creek	Muswellbrook	LGOV
St John's Presbyterian Church	Hill Street	Muswellbrook	Muswellbrook	LGOV
St Joseph's Hall	80 Palace Street	Denman	Muswellbrook	LGOV
St Matthias' Anglican Church	33-35 Palace Street	Denman	Muswellbrook	LGOV
St. Heliers	McCulleys Gap Road	Muswellbrook	Muswellbrook	GAZ
St. James Roman Catholic Church including surrounds	Brook Street	Muswellbrook	Muswellbrook	GAZ
St. John's Presbyterian Church Precinct	Hill Street	Muswellbrook	Muswellbrook	GAZ
St. Mary's School Skelletar	Tindale Street	Muswellbrook	Muswellbrook	GAZ
St. Matthias Anglican Church	Palace Street	Denman	Muswellbrook	GAZ
Stone Bridge	Grass Tree Road	Muswellbrook	Muswellbrook	GAZ
Stone Bridge	Muscle Creek Road	Muswellbrook	Muswellbrook	LGOV
Taskers Pharmacy	26 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Timber Cottage	129 Hill Street	Muswellbrook	Muswellbrook	LGOV
Uniting Church		Muswellbrook	Muswellbrook	GAZ
Uniting Church - Upper Hunter Parish Trinity Uniting Church	110 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Valley Hotel/Motel	33 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Water Pumping Station (Demolished)	Palace Street	Denman	Muswellbrook	LGOV
Weatherboard Hall	50 Palace Street (Cnr Turtle Street)	Denman	Muswellbrook	LGOV

Weidmann Cottage	126 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Westpac Bank building	19 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Widden Stud	1650 Widden Valley Road	Widden	Muswellbrook	LGOV
Wollemi National Park	Wollemi	Baerami	Muswellbrook	LGOV
Woodlands Stud	Woodlands Road	Denman	Muswellbrook	GAZ
Woodlands Stud	3933 Woodlands Road	Denman	Muswellbrook	LGOV
Wybong Cemetery	Yarraman Road	Wybong	Muswellbrook	LGOV
Yammanie	307 Denman Road	Muswellbrook	Muswellbrook	LGOV
Yarrawa Bridge over Goulburn River	Yarrawa Road	Denman	Muswellbrook	SGOV
Yarrawa Bridge over Hunter River	Yarrawa Road	Denman	Muswellbrook	LGOV

There was a total of 213 records matching your search criteria.

Key:
LGA = Local Government Area
GAZ= NSW Government Gazette (statutory listings prior to 1997), HGA = Heritage Grant Application, HS = Heritage Study, LGOV = Local Government, SGOV = State Government Agency.
Note: While the Heritage Division seeks to keep the Inventory up to date, it is reliant on State agencies and local councils to provide their data. Always check with the relevant State agency or local council for the most up-to-date information.

Home Contaminated land Record of notices

Search results

Your search for:LGA: Muswellbrook Shire Council

Search Again
Refine Search

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the planning process.

Search TIP

To search for a specific site, search by LGA (local government area) and carefully review all sites listed.

... more search tips

More information about particular sites may be available from:

- The POEO public register
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.
This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register

10 May 2019

No results found

Sorry, no jobs could be found that matched that criteria.

SEED | Sharing and Enabling Environmental Data

SEED Map

1.0 0 0.50 1.0 Kilometers

Scale 1: 20,193.08

WGS_1984_Web_Mercator_Auxiliary_Sphere

Generated from SEED web map. Created 9:15 AM 18/7/2019


Legend
Labels
Boundaries
Areas
High probability of occurrence
Low probability of occurrence
No known occurrence
Not assessed

Australian Government
Department of the Environment and Energy

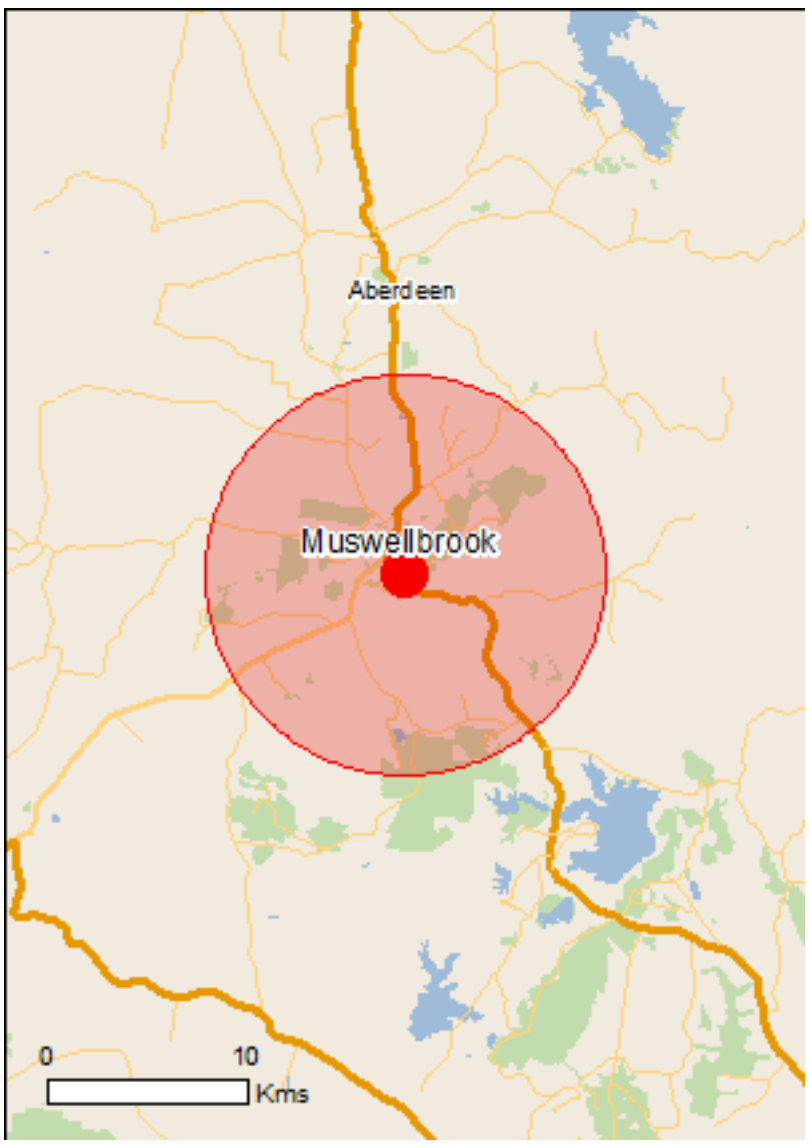
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

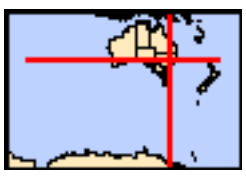
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 20/05/19 13:29:14



Coordinates
Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	29
Listed Migratory Species:	14

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	7
Commonwealth Heritage Places:	1
Listed Marine Species:	21
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	31
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Hunter estuary wetlands	50 - 100km upstream

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Listed Threatened Ecological Communities		[Resource Information]
Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community likely to occur within area
Hunter Valley Weeping Myall (Acacia pendula) Woodland	Critically Endangered	Community may occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Frogs		

Name	Status	Type of Presence
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Androcalva procumbens [87153]	Vulnerable	Species or species habitat may occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus glaucina Slaty Red Gum [5670]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Philotheca ericifolia [64942]	Vulnerable	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence within area
[Pterostylis gibbosa](#) Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
[Thesium australe](#) Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
[Delma impar](#) Striped Legless Lizard [1649]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Hirundapus caudacutus](#) White-throated Needletail [682]		Species or species habitat known to occur within area
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat known to occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat known to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority
Defence - MUSWELLBROOK GRES DEPOT

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Muswellbrook Post Office	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.27521 150.89514

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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BioNet Database search

NSW Environment & Heritage

Public Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Communities in selected area [North: -32.22 West: 150.84 East: 150.94 South: -32.32] returned 0 records for 20 entities.

Report generated on 20/05/2019 2:49 PM.

Common name	Scientific name	NSW status	Comm. status	No. of records
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	E3	CE	K
Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	E3	CE	K
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	V	P
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3		K
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	E3		K
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	E3		K
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	V2	CE	K
Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions	Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions	E3		K
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	E4B	CE	K
Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	E3		K

Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	CE	P
Lower Hunter Spotted Gum—Ironbark Forest in the Sydney Basin Bioregion	Lower Hunter Spotted Gum—Ironbark Forest in the Sydney Basin Bioregion	E3		K
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	V2		K
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	E3	CE	K
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3		K
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	E	K
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3		K
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	E3		K
Warkworth Sands Woodland in the Sydney Basin Bioregion	Warkworth Sands Woodland in the Sydney Basin Bioregion	E3	CE	K
White Box Yellow Box Blakely's Red Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland	E3	CE	K

APPENDIX D

DETAILED DESIGN

MUSWELLBROOK SHIRE COUNCIL
THOMPSON STREET & NEW ENGLAND HIGHWAY
INTERSECTION UPGRADE
100% DETAILED DESIGN
22-18812

LOCALITY PLAN
NOT TO SCALE

DRAWING LIST

DRG No.	DRAWING TITLE
22-18812-C500	COVER SHEET
22-18812-C502	GENERAL NOTES AND LEGEND
22-18812-C505	GENERAL ARRANGEMENT OVERALL PLAN
22-18812-C510	TYPICAL SECTIONS - SHEET 1 OF 1
22-18812-C515	TYPICAL DETAILS - SHEET 1 OF 3
22-18812-C516	TYPICAL DETAILS - SHEET 2 OF 3
22-18812-C517	TYPICAL DETAILS - SHEET 3 OF 3
22-18812-C520	DETAIL PLAN - SHEET 1 OF 2
22-18812-C521	DETAIL PLAN - SHEET 2 OF 2
22-18812-C530	SETOUT PLAN - SHEET 1 OF 3
22-18812-C531	SETOUT PLAN - SHEET 2 OF 3
22-18812-C532	SETOUT PLAN - SHEET 3 OF 3
22-18812-C540	LONGITUDINAL SECTIONS - SHEET 1 OF 6
22-18812-C541	LONGITUDINAL SECTIONS - SHEET 2 OF 6
22-18812-C542	LONGITUDINAL SECTIONS - SHEET 3 OF 6
22-18812-C543	LONGITUDINAL SECTIONS - SHEET 4 OF 6
22-18812-C544	LONGITUDINAL SECTIONS - SHEET 5 OF 6
22-18812-C545	LONGITUDINAL SECTIONS - SHEET 6 OF 6
22-18812-C561	DRAINAGE PLAN - SHEET 1 OF 2
22-18812-C562	DRAINAGE PLAN - SHEET 2 OF 2
22-18812-C563	DRAINAGE PIT SCHEDULE
22-18812-C564	DRAINAGE PROFILES - SHEET 1 OF 2
22-18812-C565	DRAINAGE PROFILES - SHEET 2 OF 2
22-18812-C570	SUBSURFACE DRAINAGE PLAN
22-18812-C580	PAVEMENT PLAN
22-18812-C581	CONCRETE JOINTING DETAILS - RESIDENTIAL DRIVEWAYS
22-18812-C585	PROPERTY ADJUSTMENT PLAN
22-18812-C590	SIGNAGE AND LINEMARKING PLAN

SUPPLEMENTARY DRAWING LIST

DRG No.	DRAWING TITLE	PREPARED BY
-	THOMPSON STREET INTERSECTION STREET LIGHTING UPGRADE, MUSWELLBROOK SHEET 1 OF 2	DIRECT ENGINEERING
-	THOMPSON STREET INTERSECTION STREET LIGHTING UPGRADE, MUSWELLBROOK SHEET 2 OF 2	DIRECT ENGINEERING
-	MUSWELLBROOK SHIRE COUNCIL TRAFFIC SIGNALS AT NEW ENGLAND HIGHWAY- H.W.9 AND THOMPSON STREET, MUSWELLBROOK	EXARTA CAD DESIGN

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
0	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

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Drawn C.BODE	Designer N.HINCKS	Client	MUSWELLBROOK SHIRE COUNCIL
Drafting Check	Design Check	Project	THOMPSON STREET INTERSECTION UPGRADE
Approved (Project Director)		Title	COVER SHEET
Date			
Scale AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	Original Size A1	Drawing No: 22-18812-C500 Rev: 0

Plot Date: 21 May 2018 - 4:35 PM Plotted by: Nick Hincks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C500.dwg

GENERAL

1. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH CURRENT REVISIONS OF THE RELEVANT ROADS AND MARITIME AND AUSTRALIAN STANDARDS UNLESS NOTED OTHERWISE.
2. PROVISION OF TRAFFIC CONTROL DURING CONSTRUCTION TO BE IN ACCORDANCE WITH THE CURRENT ROADS AND MARITIME SPECIFICATION G10 AND ROADS AND MARITIME PUBLICATION "TRAFFIC CONTROL AT WORK SITES" AS WELL AS AS1742.3.
3. ALL LOCATIONS, ORIENTATIONS AND LEVELS TO BE VERIFIED ON SITE BEFORE COMMENCING ANY WORK. REFER DISCREPANCIES TO THE PRINCIPAL. DO NOT OBTAIN DIMENSIONS FROM SCALING. NATURAL SURFACE LEVELS ON THE DRAWINGS ARE INDICATIVE ONLY.

TYPICAL SECTIONS

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

ALIGNMENT SETOUT CONTROL PLANS AND TABLES

1. SURVEY DATUM IS AHD.
2. SURVEY AZIMUTH IS BASED ON MGA.
3. SURVEY MARKS ARE NOT TO BE DISTURBED BEFORE ASSESSMENT BY SURVEYOR.
4. THE CONTRACTOR SHALL CHECK SUSTAINABILITY OF THE STATED COORDINATES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.
5. ANY SURVEY PMs OR SSMs THAT ARE DESTROYED ARE TO BE REPLACED WITH ANOTHER PM OR SSM TO LANDS DEPARTMENT STANDARDS. IT ALSO SHOULD BE DOCUMENTED AND CO-ORDINATED TO EQUIVALENT LANDS DEPARTMENT STANDARDS.
6. REFER ROADS AND MARITIME SPECIFICATION G71 FOR SURVEY REQUIREMENTS FOR SPATIAL TOLERANCES AND QUALITY ASSURANCE REQUIREMENTS
7. REFER ROADS AND MARITIME STANDARD DRAWINGS R0400-01 AND R0400-02 FOR SETTING OUT DIAGRAMS FOR ROADS

TYPICAL DETAILS

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

UTILITIES

1. LOCATION AND LEVEL OF ALL SERVICES CROSSING NEW DRAINAGE MUST BE OBTAINED PRIOR TO CONSTRUCTION. ALL LEVELS MUST BE CHECKED FOR CONFLICT WITH ANY SERVICES, AND ANY CONFLICTS TO BE RAISED WITH THE PRINCIPAL.

DRAINAGE

1. ALL PIPES ARE TO BE SPIGOT AND SOCKET WITH RUBBER RING JOINTS UNLESS NOTED OTHERWISE.
2. ALL CONCRETE PIPES TO HAVE HS3 TYPE INSTALLATION AS PER ROADS AND MARITIME R0240-01
3. PIPE INSTALLATION IS DESIGNED IN ACCORDANCE WITH CONCRETE PIPE ASSOCIATION OF AUSTRALIA PUBLICATION "CONCRETE PIPE SELECTION AND INSTALLATION" AND AUSTRALIAN STANDARD AS/NZ 3725.
4. CONCRETE FOR DRAINAGE ELEMENTS IS TO COMPLY WITH THE RELEVANT ROADS AND MARITIME SPECIFICATIONS AND AUSTRALIAN STANDARDS.
5. CONCRETE PIPE CLASSES HAVE BEEN DETERMINED BASED ON TYPE HS3 SUPPORT AND TRENCH OR EMBANKMENT INSTALLATION CONDITION IN ACCORDANCE WITH AS3725 UNLESS NOTED OTHERWISE.
6. REFER TO ROADS AND MARITIME ROADWORK SPECIFICATION R11 STANDARD DRAWINGS FOR PIT SETOUT POINTS. THE REFERENCE POINT FOR SUBSURFACE INLET PITS AND HEADWALLS ARE INDICATED ON THE STANDARD DRAWINGS.
7. AT GULLY PITS A 100mm DIAMETER SUBSURFACE DRAINAGE PIPE WITH FILTER SOCK TO BE LAID AT THE BOTTOM OF NEW STORM WATER TRENCHES FOR A DISTANCE OF 3m UPSTREAM WITH THE UPSTREAM END SEALED.
8. FOR DRAINAGE PIT SCHEDULE REFER TO SHEET C563.
9. FOR DESIGN DRAINAGE DRAWINGS REFER TO SHEETS C561 TO C562.
10. THE DOCUMENTED DRAINAGE DESIGNS ARE DETAILED ONLY FOR THE PERMANENT ROAD CONFIGURATION UNLESS NOTED OTHERWISE. CONSTRUCTION REQUIREMENTS TO BE THE CONTRACTOR'S RESPONSIBILITY.
11. THE CONTRACTOR IS RESPONSIBLE FOR THE PREPARATION AND IMPLEMENTATION OF AN EROSION AND SEDIMENT MANAGEMENT PLAN DURING CONSTRUCTION.
12. ANY PERMITS FOR DIVERSION WORKS REQUIRED DURING CONSTRUCTION TO BE OBTAINED BY THE CONTRACTOR.
13. EXISTING STORM WATER PIPES AND MANHOLES WITHIN THE LIMITS OF WORK TO BE REMOVED OR MODIFIED AS SPECIFIED.
14. EXISTING STORM WATER PIPES OR CULVERTS THAT ARE IDENTIFIED TO BE DECOMMISSIONED ARE TO BE BACKFILLED AND CAPPED OFF AT ENDS AND MAY REMAIN INSITU UNLESS DAMAGED, STRUCTURALLY UNSOUND OR CONFLICT WITH DESIGN ELEMENTS.
15. CONNECTION BETWEEN PIPES AND STRUCTURES TO BE UNDERTAKEN IN ACCORDANCE WITH ROADS AND MARITIME SPECIFICATION R11 AND DRAWINGS UNLESS NOTED OTHERWISE.
16. IN ROCK FILL EMBANKMENTS AND/OR NOMINATED STEEP SLOPE INSTALLATIONS, ENCLOSE ZONE OF COMPACTED FILL AROUND PIPES WITH GEOTEXTILE IN ACCORDANCE WITH ROADS AND MARITIME SPECIFICATION.
17. PIPE LENGTHS PROVIDED IN DRAINAGE SCHEDULES AND LONGITUDINAL SECTIONS ARE CALCULATED FROM PIT REFERENCE POINT TO PIT REFERENCE POINT.

PAVEMENT

1. REFER TO SHEET C515 FOR PAVEMENT DETAILS.
2. LONGITUDINAL PAVEMENT JOINTS ON LANE LINE ARE TO BE CLEAR OF WHEEL PATHS.
3. LOCATIONS AND AREAS OF CORRECTIVE COURSE ASPHALT ARE INDICATIVE ONLY. FINAL LOCATIONS AND VOLUMES ARE TO BE DETERMINED ON SITE DURING CONSTRUCTION BY THE CONTRACTOR WITH AGREEMENT FROM THE PRINCIPAL.

DRAINAGE STRUCTURES

1. EQUIVALENT PRECAST HEADWALLS / PITS MAY BE USED. PRECAST HEADWALL TO BE PLACED IN ACCORDANCE WITH R11.
2. INADEQUATE FOUNDING MATERIAL FOR PIPES AND STRUCTURES TO BE REMOVED OR IMPROVED FOLLOWING CONSULTATION WITH THE PRINCIPAL.
3. ROADS AND MARITIME STANDARD DETAILS TO BE ADOPTED WHERE REFERENCED.
4. SA PIT LINTELS TO BE IN ACCORDANCE WITH ROADS AND MARITIME STANDARD DRAWING R0220-03
5. STEEL GRATES AND FRAMES ARE TO BE FABRICATED FROM MILD STEEL AND HOT DIP GALVANISED. ALL GRATES ARE TO BE CLASS D (UNLESS NOTED OTHERWISE). GRATES AND FRAMES WITHIN THE PAVEMENT SURFACE (INCLUDES ADJOINING SO GUTTER) ARE TO BE BICYCLE SAFE IN ACCORDANCE WITH AS 3996 U.N.O.
6. GRATE SUPPORT TO BE CONSTRUCTED LEVEL TO ENSURE THAT THE GRATE DOES NOT ROCK AFTER INSTALLATION.
7. ALL WELDS TO COMPLY WITH AUSTRALIAN STANDARD AS 1554. FILLET WELDS TO BE NOT LESS THAN 6mm U.N.O.
8. ALL REINFORCEMENT TO COMPLY WITH AS/NZS 4671 GRADE D500L (FITMENTS) AND D500N (TYPICAL).
9. ALL GALVANISING TO BE IN ACCORDANCE WITH AS/NZS 2312 AND AS/NZS 4680. GALVANISING OF THREADED FASTENERS TO BE IN ACCORDANCE WITH AS 1214. MINIMUM GALVANISING 600g/sqm OTHER THAN ON FASTENERS.
10. DRAINAGE PITS BETWEEN 1.2m AND 3.5m DEPTH TO HAVE STEP IRONS IN ACCORDANCE WITH ROADS AND MARITIME STANDARD DRAWING R0220-45
11. DRAINAGE PITS DEEPER THAN 3.5m TO HAVE STEP IRONS AND TO HAVE LOCKABLE SURFACE GRATES.
12. PIPE CONNECTIONS TO PRECAST BOX CULVERTS TO BE IN ACCORDANCE WITH ROADS AND MARITIME STANDARD DRAWING R0220-44
13. PIPE TO PIT CONNECTIONS TO BE IN ACCORDANCE WITH ROADS AND MARITIME STANDARD DRAWING R0220-43

SUBSURFACE DRAINAGE

1. FOR SUB-PAVEMENT DRAINAGE DETAILS REFER TO SHEET C570
2. TRENCH DRAINS TO HAVE AGGREGATE FILTER OR NO FINES CONCRETE MATERIAL WRAPPED IN GEOTEXTILE AND 100mm DIAMETER, TYPE 1 CLASS SN20 CORRUGATED PERFORATED PLASTIC DRAINAGE PIPE WITH FILTER SOCK. REFER ROADS AND MARITIME STANDARD (PAVEMENT) DRAWINGS
3. FOR CONSTRUCTION OF TRENCH DRAINS REFER TO ROADS AND MARITIME STANDARD DRAWING STANDARD (PAVEMENT) DRAWINGS
4. DEPTH OF TRENCH AND PAVEMENT INTERFACE DRAINS TO BE CONFIRMED ONSITE BY THE CONTRACTOR WITH AGREEMENT FROM THE PRINCIPAL AND TO BE MEASURED FROM LOWEST POINT OF THE EXISTING OR NEW PAVEMENT SMZ.
5. GEOTEXTILE FOR TRENCH AND PAVEMENT INTERFACE DRAINS TO BE LAPPED ON THE TOP FACE.
6. WHERE POSSIBLE OUTLET TRENCH DRAINS AND PAVEMENT INTERFACE DRAINS INTO EXISTING OR NEW STORM WATER PITS.
7. WHERE OUTLET HEADWALLS ARE REQUIRED THESE ARE TO BE IN ACCORDANCE WITH ROADS AND MARITIME STANDARD (PAVEMENT) DRAWINGS. WHERE A CONNECTION IS MADE TO AN EXISTING DRAINAGE PIPE OR PIT, THE LEVEL OF THAT ELEMENT MUST BE SURVEYED PRIOR TO CONSTRUCTION OF ANY PART OF THE NEW DRAINAGE LINE SO THAT THE NEW INVERT LEVELS CAN BE CONFIRMED.
8. MINIMUM GRADE OF SUBSURFACE DRAINAGE TO BE 0.5%.

ROADSIDE FURNITURE AND DELINIATION

1. PAVEMENT MARKING AND SIGNAGE TO BE IN ACCORDANCE WITH ROADS AND MARITIME SPECIFICATIONS, GUIDELINES AND STANDARDS.
2. SIGNAGE TO BE LOCATED IN ACCORDANCE WITH AS1742.
3. MOUNTED HEIGHT FOR SIGNS TO BE 2.5m MIN.
4. THE CONTRACTOR IS TO ENSURE THAT SIGN FOOTINGS DO NOT CLASH WITH UNDERGROUND UTILITIES. SHOULD SIGN LOCATIONS NEED TO BE MOVED, APPROVAL IS REQUIRED FROM THE PRINCIPAL.
5. ALL SIGN SUPPORT STRUCTURES ARE TO BE GRADE C320LO IN ACCORDANCE WITH ROADS AND MARITIME SPECIFICATION R143 UNLESS NOTED OTHERWISE.
6. RAISED REFLECTIVE PAVEMENT MARKERS TO BE INSTALLED IN ACCORDANCE WITH THE SPACING SPECIFIED IN THE ROADS AND MARITIME DELINEATION GUIDELINES.
7. REUSE OF ANY EXISTING SIGN FACES AND SUPPORT STRUCTURES REQUIRE APPROVAL FROM THE PRINCIPAL.

CONCRETE JOINTING

1. FOR CONCRETE MEDIAN JOINTING DETAILS, REFER TO ROADS AND MARITIME STANDARD DRAWINGS, RIGID PAVEMENT, BICYCLE PATH DESIGN (DS2012/000293).
2. FOR CONCRETE MEDIANS, PROVIDE CONTRACTION JOINTS AT TYPICALLY 3m SPACING AND EXPANSION JOINTS AT TYPICALLY 15m SPACING.
3. CONCRETE MEDIUM MINIMUM SLAB WIDTH OF 0.6m, SLAB SHAPE FACTOR OF 0.54 AND MINIMUM SLAB CORNER ANGLE OF 75 DEGREES SHALL BE ADOPTED AS PER ROADS AND MARITIME STANDARD DRAWINGS, RIGID PAVEMENT, PLAIN CONCRETE PAVEMENT (DS2012/001191).

SURVEY

1. SURVEY FILE 217118DT.DWG SUPPLIED BY MSC ON 19/04/2017

LEGEND:

SURVEY

- 149.00 — EXISTING CONTOURS
- EXISTING TOP OF BANK
- EXISTING BOTTOM OF BANK
- E — EXISTING ELECTRICITY WITH LIGHTPOLE
- T — EXISTING TELSTRA WITH PIT
- E — EXISTING ELECTRICITY WITH LIGHTPOLE
- S — EXISTING SEWER WITH ACCESS CHAMBER
- RM — EXISTING SEWER RISING MAIN
- W — EXISTING WATERMAIN
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING RETAINING WALL
- EXISTING LINEMARKING
- EXISTING BOUNDARY
- EXISTING TREE; TREE TO BE REMOVED
- EXISTING BENCHMARK
- EXISTING SIGNPOST
- EXISTING EXTENT OF PAVEMENT

PAVEMEMT

- TYPE 1 - HEAVILY BOUND PAVEMENT WITH AC
- TYPE 4 - MEDIAN
- TYPE 5 - FOOTPATH
- TYPE 6 - DRIVEWAY
- TYPE 7 - MILL AND RESHEET

DRAINAGE

- 5.0 — DESIGN CONTOURS (1.0m MAJOR)
- DESIGN CONTOURS (0.2m MINOR)
- 5.0 — EXISTING CONTOURS
- EXISTING STORMWATER PIPE
- NEW STORMWATER PIPE AND RCBC
- EXISTING STORMWATER TO BE REMOVED
- NEW STORMWATER PIT; KERB INLET PIT
- Ø375 — PIPE SIZE AND FLOW DIRECTION
- 1\1 — STORMWATER PIT I.D AND TYPE

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

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Drawn	R. COCKS	Designer	N.HINCKS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client: MUSWELLBROOK SHIRE COUNCIL
Project: THOMPSON STREET INTERSECTION UPGRADE
Title: GENERAL NOTES AND LEGEND

Original Size A1 | Drawing No: 22-18812-C502 | Rev: 0

Plot Date: 21 May 2018 - 2:54 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C502.dwg

PLAN

SCALE 1:500

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UTILITY INFORMATION SHOWN ON THESE PLANS DOES NOT DEPICT ANY MORE THAN THE PRESENCE OF A SERVICE, BASED ON AVAILABLE DOCUMENTARY EVIDENCE. THE PRESENCE OF A UTILITY SERVICE, IT'S SIZE AND LOCATION SHOULD BE CONFIRMED BY FIELD INSPECTION, PRIOR TO THE COMMENCEMENT OF ROADWORKS AND THE RELEVANT UTILITY PLANS OBTAINED BY DIALLING DIAL BEFORE YOU DIG '1100'. CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES.

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 5 10 15 20 25m

SCALE 1:500 AT ORIGINAL SIZE

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Drawn	R. COCKS	Designer	N.HINCKS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client **MUSWELLBROOK SHIRE COUNCIL**

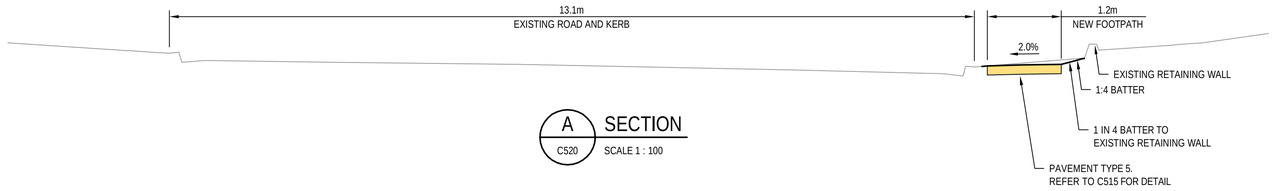
Project **THOMPSON STREET INTERSECTION UPGRADE**

Title **GENERAL ARRANGMENT OVERALL PLAN**

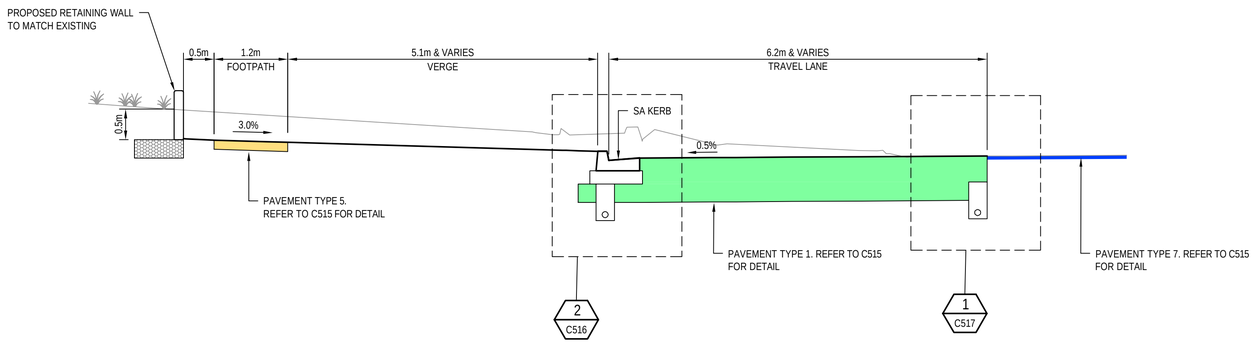
Original Size **A1**

Drawing No: 22-18812-C505 **Rev: 0**

Plot Date: 21 May 2018 - 2:55 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C505.dwg



A SECTION
C520 SCALE 1 : 100



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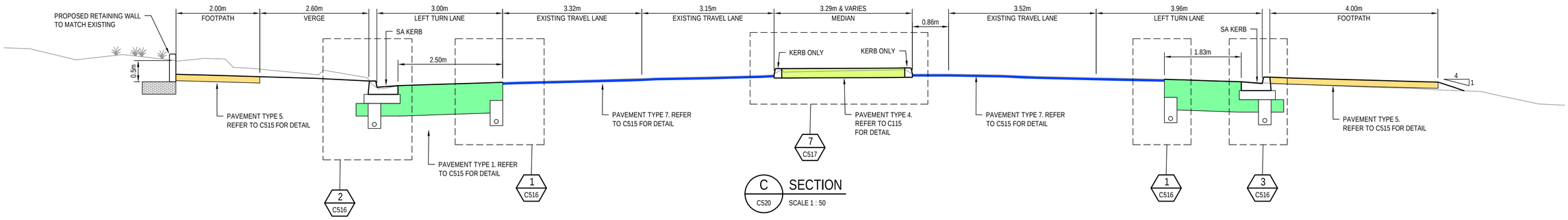

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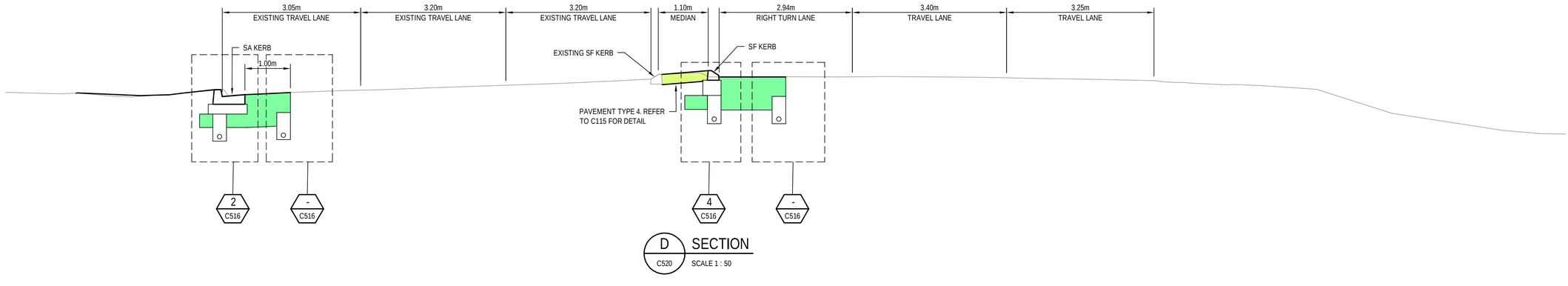

D SECTION
C520 SCALE 1 : 50

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

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0 0.5 1.0 1.5 2.0 2.5m
SCALE 1:50 AT ORIGINAL SIZE

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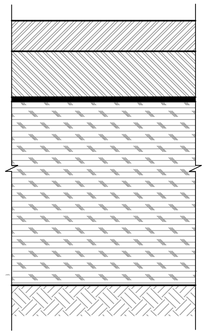
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **TYPICAL SECTIONS SHEET 1 OF 1**

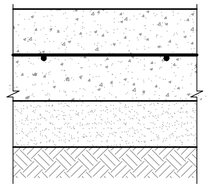
Original Size **A1** Drawing No: **22-18812-C510** Rev: **0**

Plot Date: 21 May 2018 - 2:55 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C510.dwg

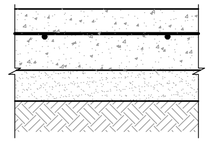


PAVEMENT TYPE 1
HEAVILY BOUND PAVEMENT WITH AC

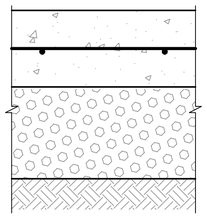
PAVEMENT TYPE 2
MILL AND RESHEET



PAVEMENT TYPE 4
MEDIAN



PAVEMENT TYPE 5
FOOTPATH



PAVEMENT TYPE 6
RESIDENTIAL DRIVEWAY

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

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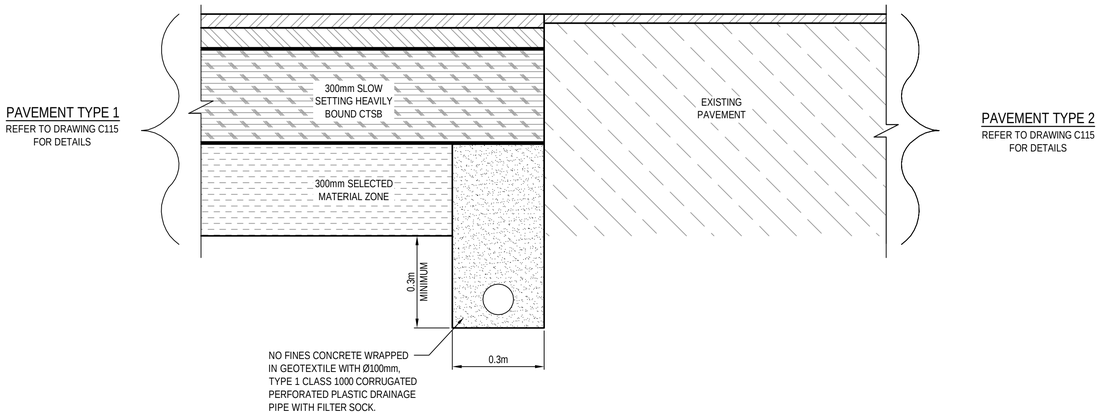
Drawn R. COCKS | Designer N.HINCKS
Drafting Check | Design Check
Approved (Project Director)
Date
Scale NOT TO SCALE
This Drawing must not be used for Construction unless signed as Approved

Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **TYPICAL DETAILS SHEET 1 OF 3**

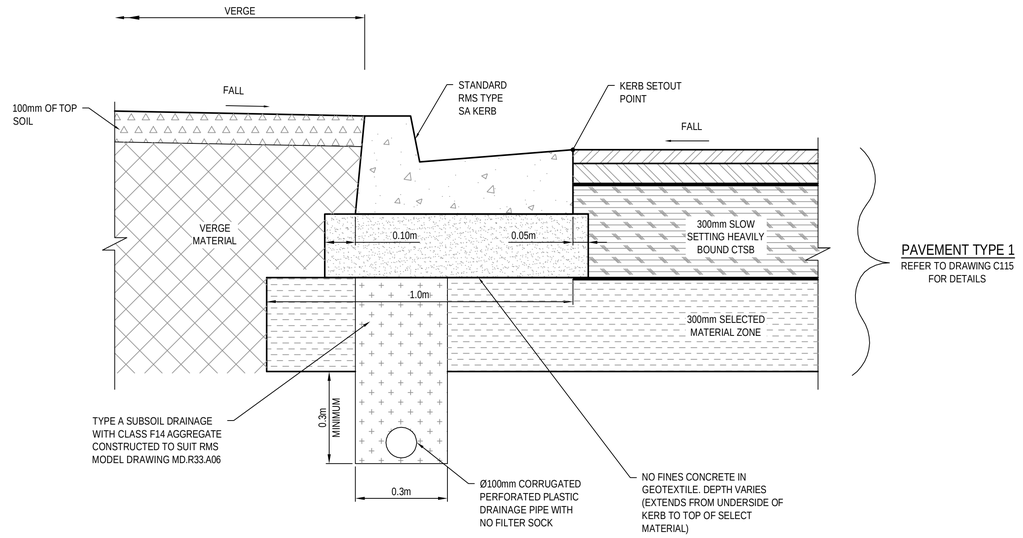
Original Size **A1** Drawing No: **22-18812-C515** Rev: **0**

Plot Date: 21 May 2018 - 2:56 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C515.dwg



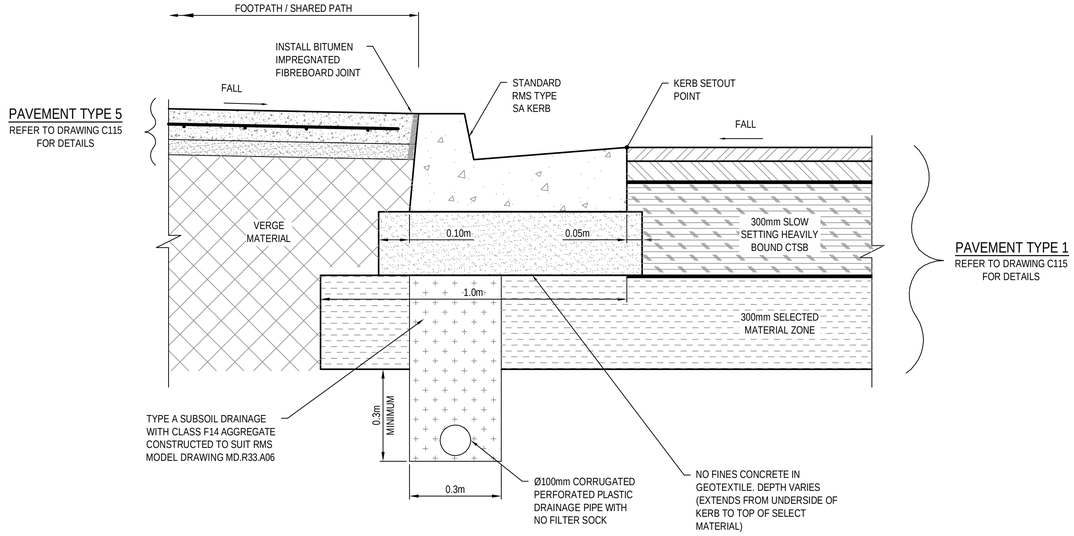
INTERFACE BETWEEN NEW HEAVILY BOUND PAVEMENT AND MILL AND RESHEET

1 - DETAIL
SCALE 1 : 10



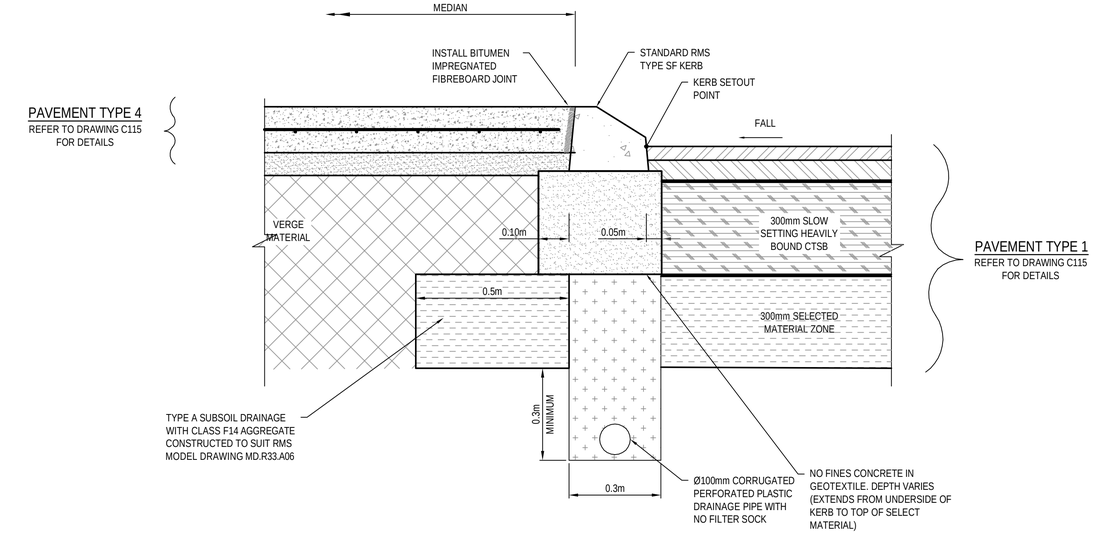
'SA' KERB AND GUTTER ON HEAVILY BOUND PAVEMENT WITH VERGE

2 - DETAIL
SCALE 1 : 10



'SA' KERB AND GUTTER ON HEAVILY BOUND PAVEMENT WITH FOOTPATH

3 - DETAIL
SCALE 1 : 10



'SF' KERB ON HEAVILY BOUND PAVEMENT WITH MEDIAN

4 - DETAIL
SCALE 1 : 10

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 0.1 0.2 0.3 0.4 0.5m
SCALE 1:10 AT ORIGINAL SIZE

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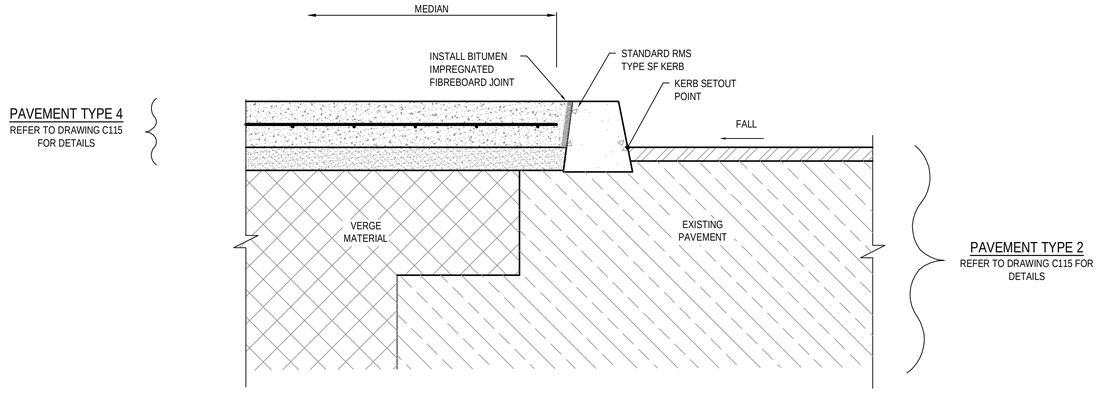
DO NOT SCALE

Drawn R. COCKS | Designer N.HINCKS
Drafting Check | Design Check
Approved (Project Director)
Date
Scale AS SHOWN
This Drawing must not be used for Construction unless signed as Approved

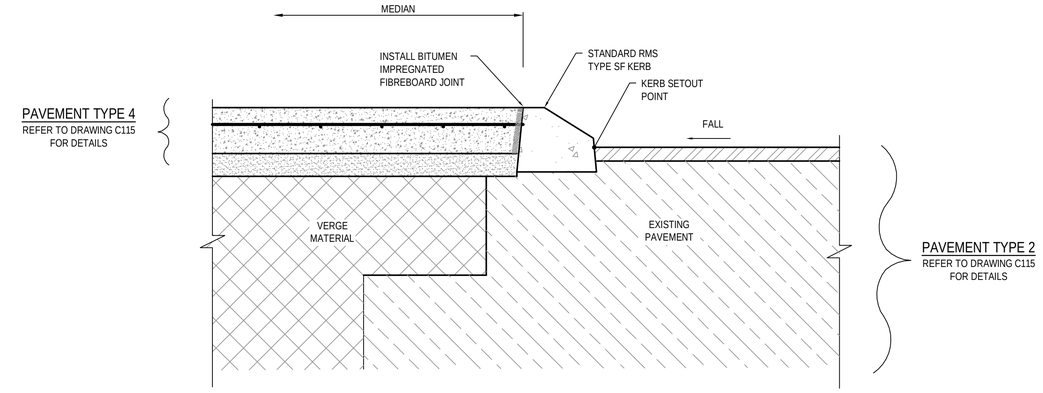
Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **TYPICAL DETAILS SHEET 2 OF 3**
Original Size **A1**
Drawing No: 22-18812-C516 **Rev: 0**

Plot Date: 21 May 2018 - 2:56 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C515.dwg



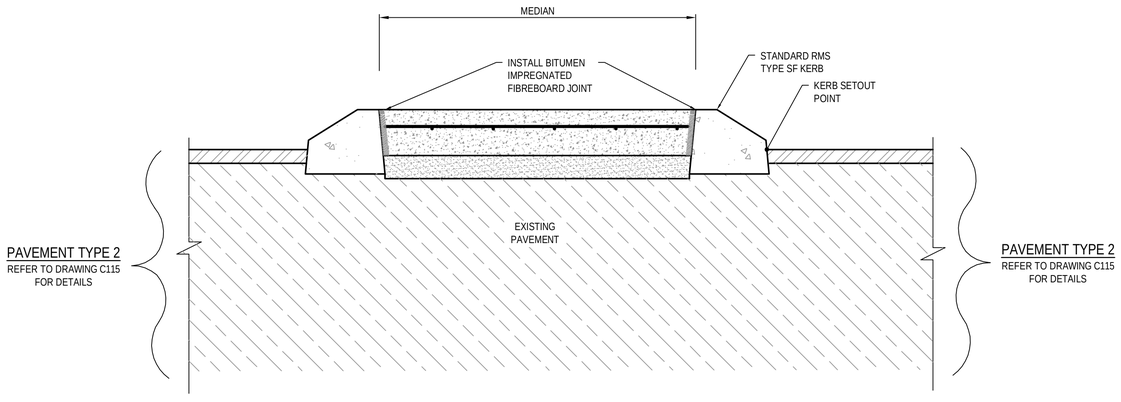
'SM' KERB ON MILL AND RESHEET WITH WIDE MEDIAN

5 DETAIL
- SCALE 1 : 10



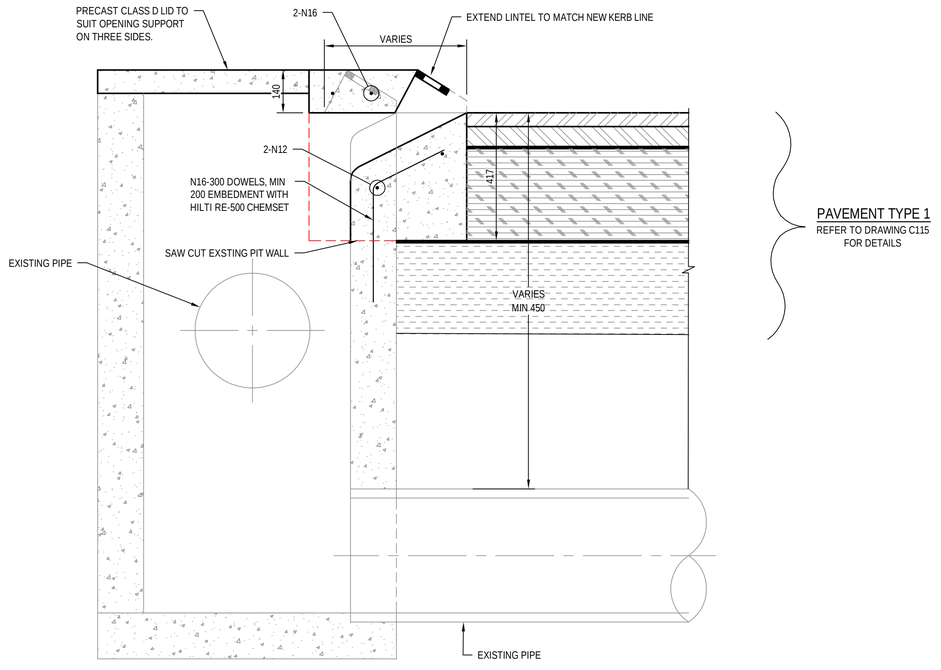
'SF' KERB ON MILL AND RESHEET WITH WIDE MEDIAN

6 DETAIL
- SCALE 1 : 10



'SF' KERB ON MILL AND RESHEET WITH NARROW MEDIAN

7 DETAIL
- SCALE 1 : 10



DETAIL
EXTENDED KERB LINTEL
SCALE 1:10

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 0.1 0.2 0.3 0.4 0.5m
SCALE 1:10 AT ORIGINAL SIZE

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Drawn	R. COCKS	Designer	N.HINCKS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title TYPICAL DETAILS SHEET 3 OF 3

Original Size A1 **Drawing No: 22-18812-C517** **Rev: 0**

Plot Date: 21 May 2018 - 4:03 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C515.dwg

JOINS DRG 22-18812-C521

SHAW CRESCENT

THOMPSON STREET

KEEP CLEAR

TO SCONE

FROM SINGLETON

NEW ENGLAND HIGHWAY

TIE INTO EXISTING FOOTPATH

PROVIDE NEW FOOTPATH

LOCALLY FILL ADJACENT TO NEW DRIVEWAY

PROVIDE RMS TYPE SA KERB AND GUTTER

PROVIDE TURNING PAD WITHIN PRIVATE PROPERTY. REFER TO DRG C581

TELSTRA SERVICE MAY REQUIRE RELOCATION. PRINCIPAL TO COMPLETE UTILITY INVESTIGATION PRIOR TO UNDERTAKING ROADWORKS. PRINCIPAL TO ENGAGE TELSTRA TO UNDERTAKE RELOCATION DESIGN IF REQUIRED PRIOR TO CONSTRUCTION.

REPLACE EXISTING DRIVEWAY

CENTRAL MEDIAN WITH RMS TYPE SF KERB

D 510

A 510

SA K&G

SF K&G

3.2m

3.2m

4.0m

4.0m

3.0m

3.0m

6.0m

2.95m

3.4m

3.4m

RETAIN EXISTING MEDIAN STORMWATER PITS AND EXTEND INLET TO NEW KERB LINTEL. REFER TO DRG C517 FOR DETAIL

PROVIDE RMS TYPE 5 PEDESTRIAN FENCE ALONG CENTRAL MEDIAN. REFER TO STD DRG R0800-10-24

RETAIN EXISTING MEDIAN STORMWATER PITS AND EXTEND INLET TO NEW KERB LINTEL. REFER TO DRG C517 FOR DETAIL

WIDEN EXISTING MEDIAN TO 1.5m TO ACCOMMODATE PEDESTRIAN FENCE AND TRAFFIC LIGHTS

REMOVE EXISTING MEDIAN TO EXTENT SHOWN

EXISTING TREE TO BE REMOVED

PROVIDE 4m WIDE CONCRETE PATH BETWEEN PEDESTRIAN CROSSINGS

TRANSITION OVER 3m TO MATCH EXISTING SF KERB

PROVIDE RMS TYPE SM KERB FOR PEDESTRIAN CROSSING

PROVIDE RMS TYPE SA KERB AND GUTTER

MODIFY EXISTING MEDIAN TO ACCOMMODATE PEDESTRIAN CROSSING

TRANSITION OVER 3m TO MATCH EXISTING SF KERB

EXISTING PIT TO BE EXTENDED TO NEW ROAD SURFACE, WITH CLASS D LID. PRINCIPAL TO ENGAGE QUALIFIED STRUCTURAL ENGINEER TO DESIGN EXTENSION PRIOR TO CONSTRUCTION

PROVIDE NEW RMS TYPE SA KERB AND GUTTER

PROVIDE NEW RETAINING WALL ON PROPERTY BOUNDARY. RETAINING WALL TO MATCH EXISTING

REMOVE EXISTING KERB TO EXTENT SHOWN

RECONSTRUCT McDONALDS PEDESTRIAN ACCESS.

PROVIDE NEW RETAINING WALL ON PROPERTY BOUNDARY. RETAINING WALL TO MATCH EXISTING

WATER SERVICE MAY REQUIRE RELOCATION. PRINCIPAL TO COMPLETE UTILITY INVESTIGATION PRIOR TO UNDERTAKING ROADWORKS

RECONSTRUCT FOOTPATH AND RETAINING WALL TO EXTENT SHOWN

B 510

C 510

1.2m

1.2m

1.3m

SF KERB

SM K.O.

SF KERB

SM K.O.

SF KERB

SF KERB (EX)

2.9m

3.3m

3.15m

3.5m

4.0m

PLAN

SCALE 1:200

PRELIMINARY

DIAL BEFORE YOU DIG www.1100.com.au

UTILITY INFORMATION SHOWN ON THESE PLANS DOES NOT DEPICT ANY MORE THAN THE PRESENCE OF A SERVICE, BASED ON AVAILABLE DOCUMENTARY EVIDENCE. THE PRESENCE OF A UTILITY SERVICE, IT'S SIZE AND LOCATION SHOULD BE CONFIRMED BY FIELD INSPECTION, PRIOR TO THE COMMENCEMENT OF ROADWORKS AND THE RELEVANT UTILITY PLANS OBTAINED BY DIALLING DIAL BEFORE YOU DIG '1100'. CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES.

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

0 2 4 6 8 10m

SCALE 1:200 AT ORIGINAL SIZE

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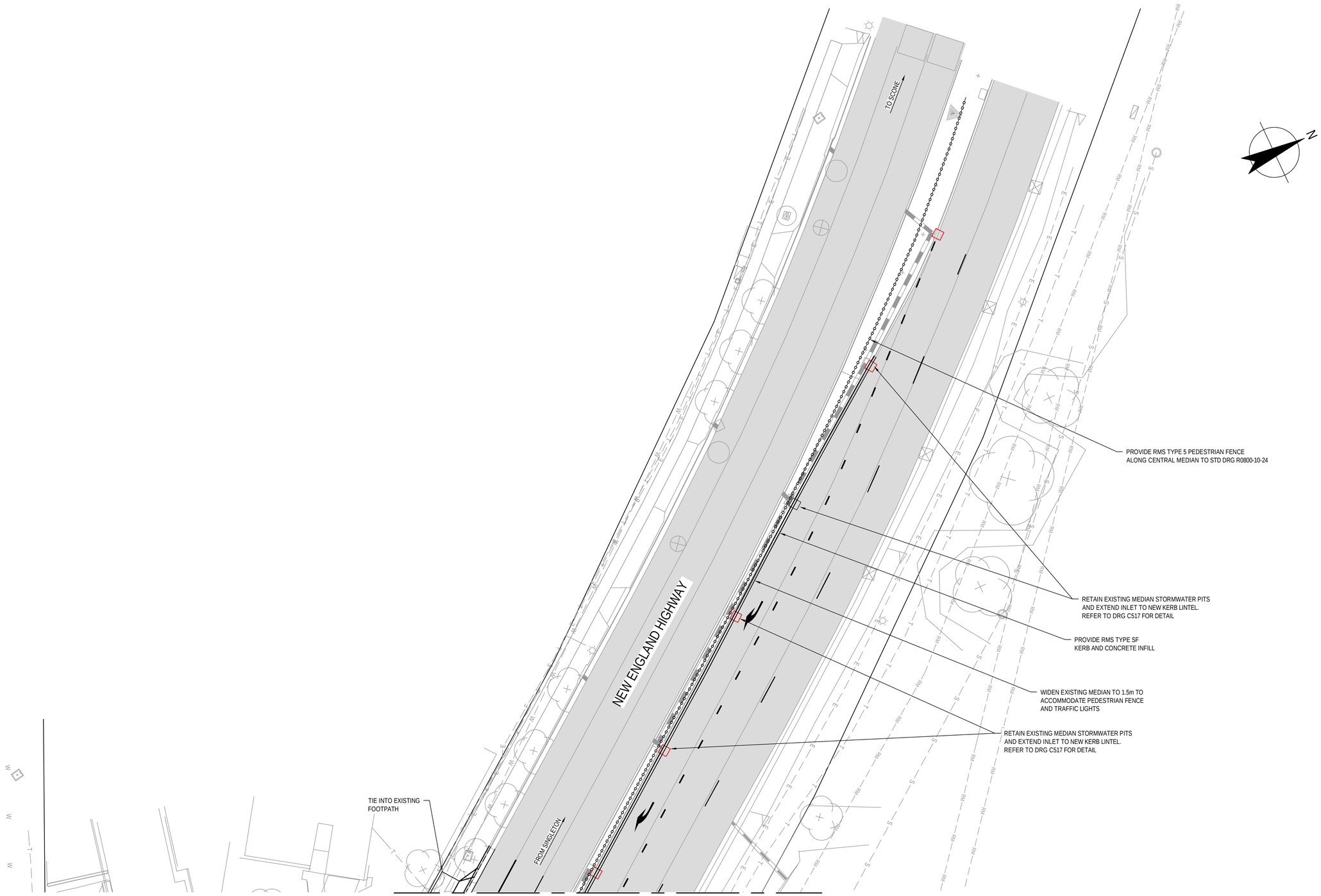
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title DETAIL PLAN SHEET 1 OF 2

Original Size A1 Drawing No: 22-18812-C520 Rev: 0

Plot Date: 21 May 2018 - 2:56 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C520.dwg



PLAN

SCALE 1:200

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PRELIMINARY

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A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

0 2 4 6 8 10m

SCALE 1:200 AT ORIGINAL SIZE

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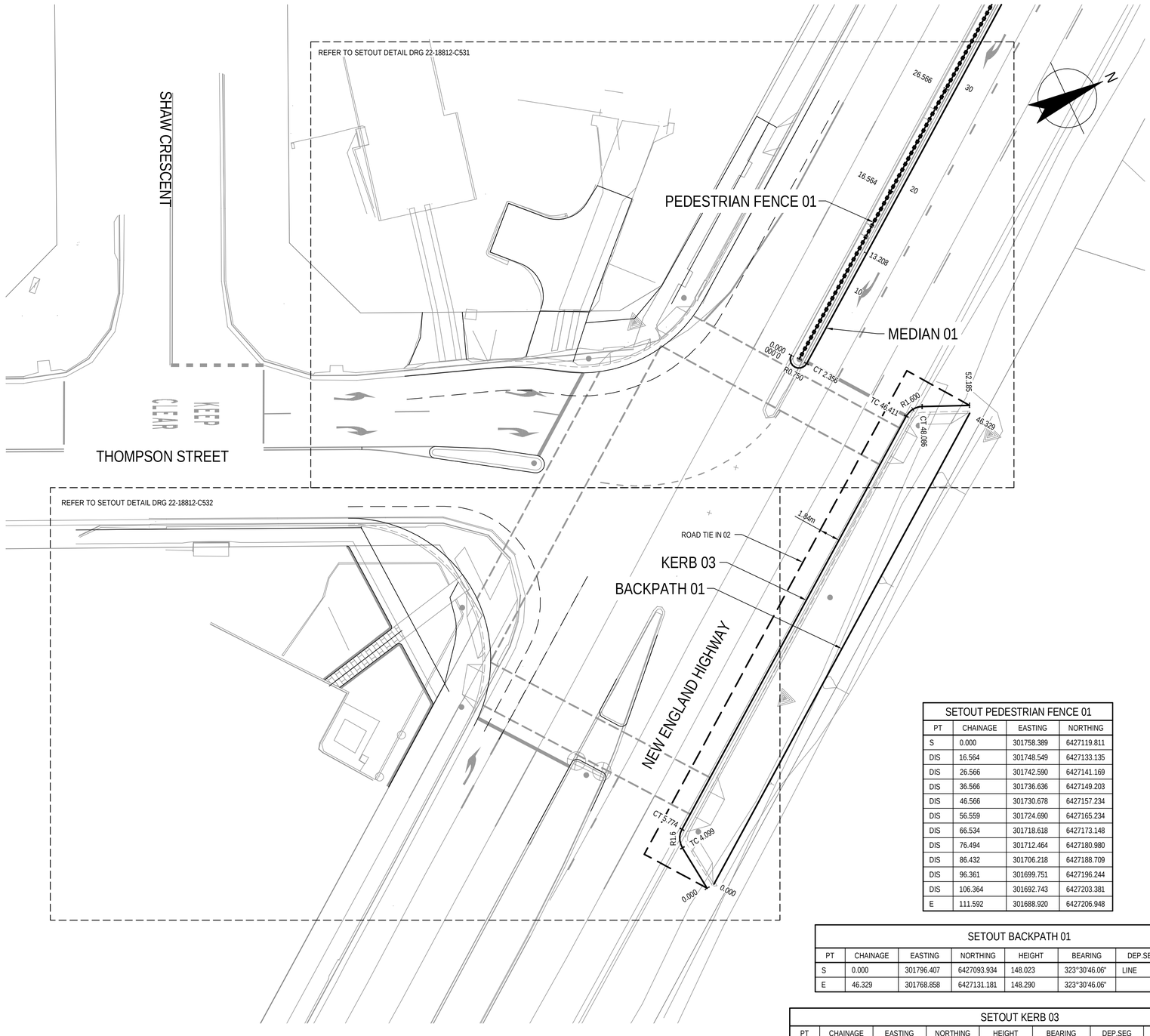
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

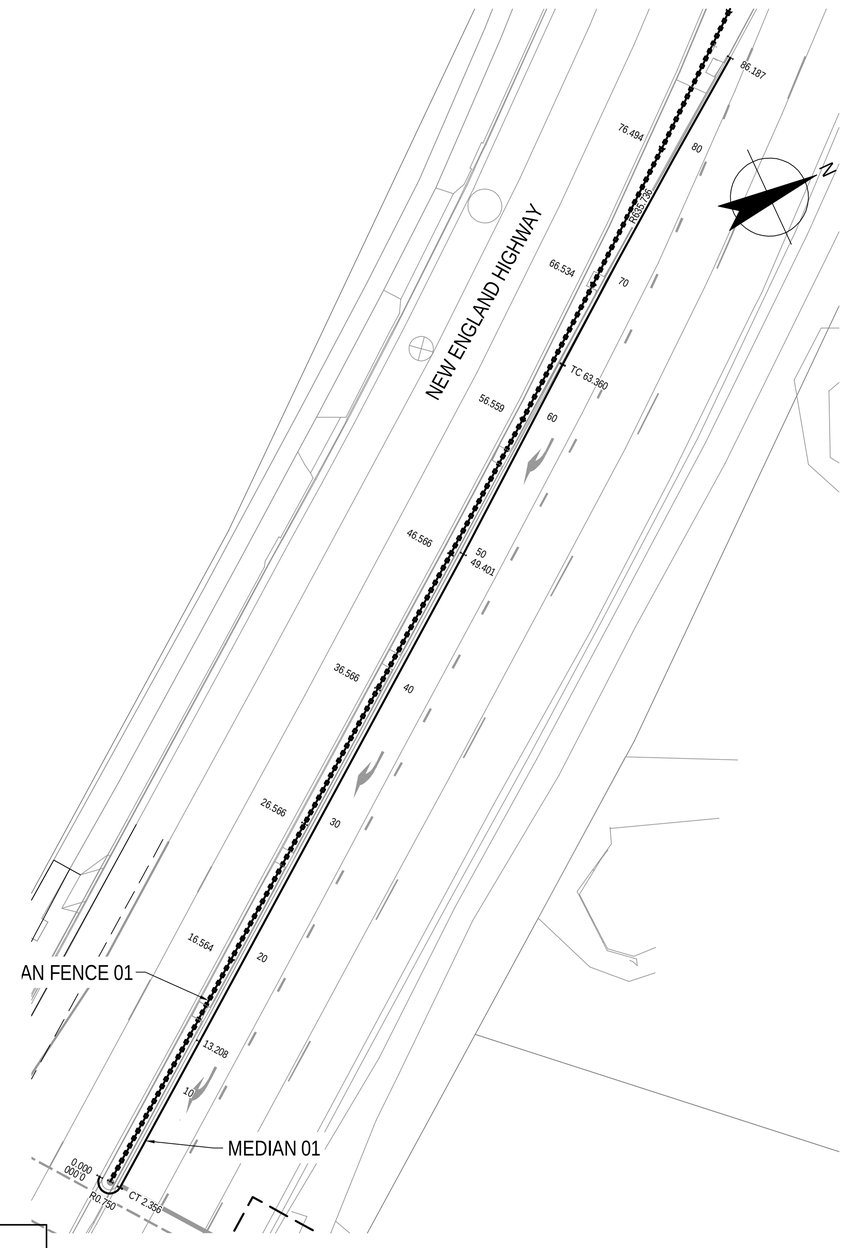
Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title **DETAIL PLAN SHEET 2 OF 2**

Original Size **A1** Drawing No: **22-18812-C521** Rev: **0**

Plot Date: 21 May 2018 - 2:56 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C521.dwg



PLAN
SCALE 1:200



PLAN
SCALE 1:200

SETOUT PEDESTRIAN FENCE 01			
PT	CHAINAGE	EASTING	NORTHING
S	0.000	301758.389	6427119.811
DIS	16.564	301748.549	6427133.135
DIS	26.566	301742.590	6427141.169
DIS	36.566	301736.636	6427149.203
DIS	46.566	301730.678	6427157.234
DIS	56.559	301724.690	6427165.234
DIS	66.534	301718.618	6427173.148
DIS	76.494	301712.464	6427180.980
DIS	86.432	301706.218	6427188.709
DIS	96.361	301699.751	6427196.244
DIS	106.364	301692.743	6427203.381
E	111.592	301688.920	6427206.948

SETOUT BACKPATH 01							
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.LEN
S	0.000	301796.407	6427093.934	148.023	323°30'46.06"	LINE	46.329
E	46.329	301768.858	6427131.181	148.290	323°30'46.06"		

SETOUT KERB 03								
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301796.484	6427093.258	147.913	263°30'45.71"	LINE		4.099
TC	4.099	301792.411	6427092.795	148.016	263°30'45.71"	ARC	1.600	1.676
CT	5.774	301790.944	6427093.433	148.045	323°30'46.01"	LINE		40.636
TC	46.411	301766.780	6427126.105	148.287	323°30'46.01"	ARC	1.600	1.676
CT	48.086	301766.599	6427127.694	148.258	23°30'48.81"	LINE		4.099
E	52.185	301768.235	6427131.453	148.180	23°30'48.81"			

SETOUT MEDIAN 01								
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301757.806	6427119.318	148.370	323°35'50.94"	ARC	-0.750	2.356
CT	2.356	301759.013	6427120.208	148.415	323°35'50.94"	LINE		10.852
DIS	13.208	301752.573	6427128.942	148.442	323°26'34.29"	LINE		36.193
DIS	49.401	301731.016	6427158.015	148.563	322°37'35.67"	LINE		13.960
TC	63.360	301722.543	6427169.109	148.599	322°37'35.67"	ARC	635.736	22.826
E	86.187	301709.015	6427187.493	148.730	324°41'01.72"			

NOTE

REFER TO DRG 22-18812-C540 TO C547 FOR PROFILES

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

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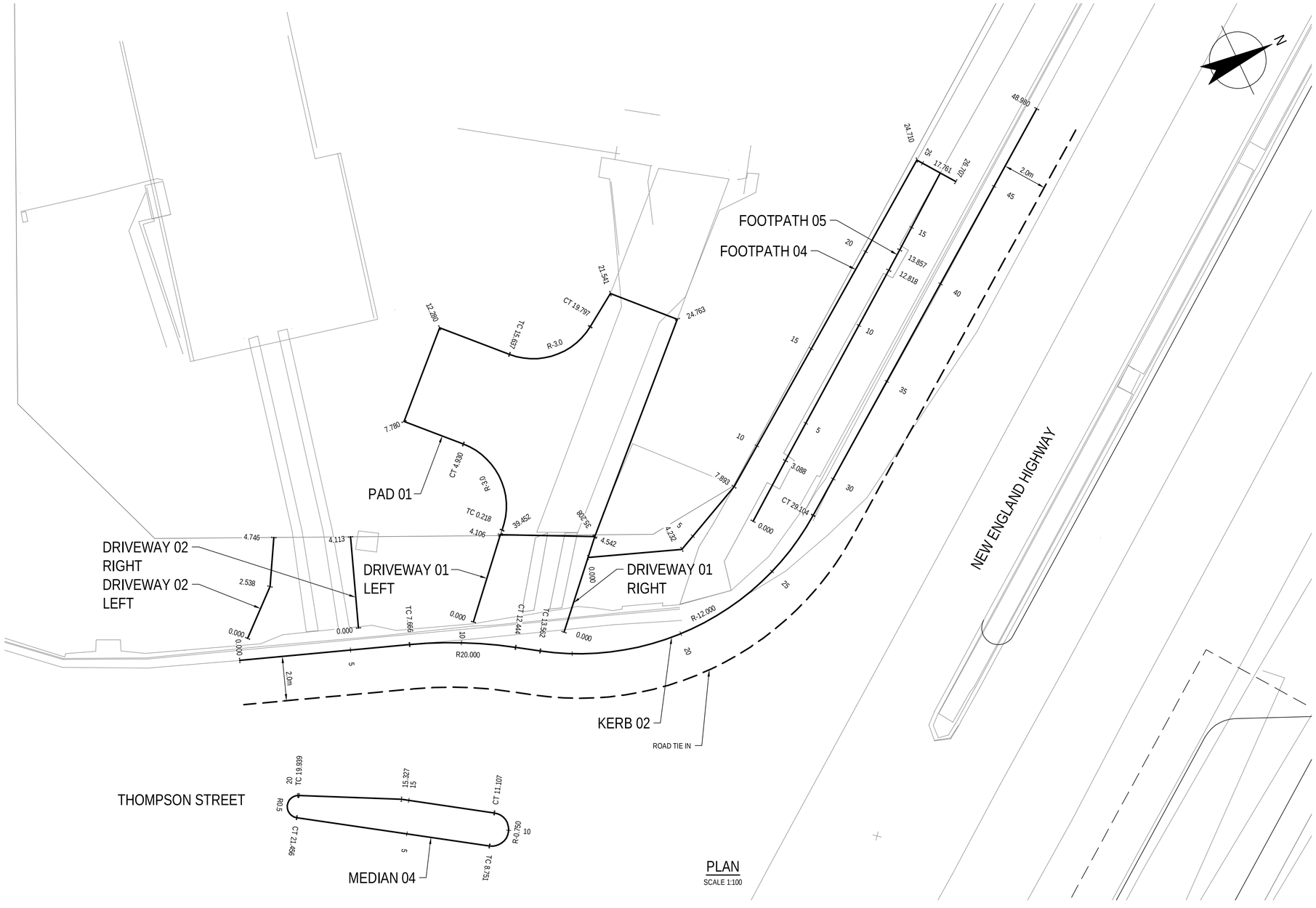
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title SETOUT PLAN
SHEET 1 OF 3

Original Size A1 Drawing No: 22-18812-C530 Rev: 0

Plot Date: 21 May 2018 - 2:56 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C530.dwg



PLAN
SCALE 1:100

SETOUT MEDIAN 04								
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301752.814	6427087.598	148.162	33°21'44.90"	LINE		8.751
DIS	8.751	301757.626	6427094.907	148.050	33°34'43.26"	ARC	-0.750	2.362
	10.000	301757.355	6427095.983	148.052	298°07'59.39"		-0.750	
DIS	11.112	301756.373	6427095.731	148.071	213°21'42.19"	LINE		4.220
DIS	15.333	301754.052	6427092.207	148.128	207°06'10.00"	LINE		4.612
TC	19.945	301751.951	6427088.101	148.183	207°06'10.00"	ARC	-0.500	1.516
	20.000	301751.929	6427088.051	148.184	200°48'48.00"		-0.500	
E	21.461	301752.814	6427087.598	148.162	33°21'44.90"			

SETOUT KERB 02								
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301745.326	6427088.259	148.306	19°40'10.96"	LINE		7.666
TC	7.666	301747.907	6427095.477	148.089	19°40'10.96"	ARC	20.000	4.778
	10.000	301748.819	6427097.625	148.017	26°21'22.23"		20.000	
CT	12.444	301750.035	6427099.743	147.941	33°21'29.54"	LINE		1.118
TC	13.562	301750.649	6427100.677	147.915	33°21'29.54"	ARC	-12.000	14.570
	20.000	301752.614	6427106.727	147.908	2°37'08.60"		-12.000	
CT	28.132	301750.309	6427114.363	147.979	323°47'37.91"	LINE		20.849
	30.000	301749.205	6427115.871	147.996	323°47'37.91"			
	40.000	301743.299	6427123.940	148.077	323°47'37.91"			
E	48.980	301737.994	6427131.186	148.136	323°47'37.91"			

SETOUT PAD 01								
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301745.155	6427101.259	148.178	315°48'04.17"	LINE		0.218
TC	0.218	301745.004	6427101.415	148.188	315°48'04.17"	ARC	-3.000	4.712
CT	4.930	301740.762	6427101.475	148.410	225°48'36.76"	LINE		2.850
DIS	7.780	301738.718	6427099.488	148.544	315°48'40.37"	LINE		4.500
	10.000	301737.171	6427101.080	148.648	315°48'40.37"			
DIS	12.280	301735.581	6427102.715	148.661	45°48'35.10"	LINE		3.357
TC	15.637	301737.989	6427105.055	148.425	45°48'35.10"	ARC	-3.000	4.160
CT	19.797	301738.395	6427108.868	148.381	326°21'36.18"	LINE		1.744
	20.000	301738.283	6427109.037	148.380	326°21'36.18"			
DIS	21.541	301737.429	6427110.320	148.372	46°01'07.55"	LINE		3.221
DIS	24.763	301739.747	6427112.557	148.275	135°48'37.10"	LINE		10.445
	30.000	301743.398	6427108.802	148.200	135°48'37.10"			
DIS	35.208	301747.028	6427105.067	148.125	206°10'36.51"	LINE		4.244
E	39.452	301745.155	6427101.259	148.178	206°10'36.51"			

SETOUT FOOTPATH 04								
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301747.753	6427104.395	148.114	19°59'30.83"	LINE	4.232	0.218
DIS	4.232	301749.200	6427108.371	148.042	334°48'57.43"	LINE	3.661	
DIS	7.893	301747.642	6427111.685	148.044	324°13'40.71"	LINE	16.817	
	10.000	301746.410	6427113.394	148.055	324°13'40.71"			
	20.000	301740.564	6427121.508	148.107	324°13'40.71"			
DIS	24.710	301737.811	6427125.329	148.131	53°57'56.39"	LINE	1.997	
E	26.707	301739.426	6427126.504	148.177	53°57'56.39"			

SETOUT FOOTPATH 05								
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301749.408	6427111.804	148.093	323°10'54.06"	LINE	3.088	0.218
DIS	3.088	301747.558	6427114.276	148.003	323°28'07.29"	LINE	9.730	
	10.000	301743.443	6427119.830	148.031	323°28'07.29"			
DIS	12.818	301741.765	6427122.094	148.048	323°15'25.01"	LINE	1.039	
DIS	13.857	301741.144	6427122.927	148.068	322°47'00.39"	LINE	3.904	
E	17.761	301738.783	6427126.036	148.115	322°47'00.39"			

SETOUT DRIVEWAY 01 RIGHT							
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.LEN
S	0.031	301750.334	6427101.999	148.057	312°51'30.34"	LINE	4.511
E	4.542	301747.028	6427105.067	148.125	312°51'30.34"		

SETOUT DRIVEWAY 01 LEFT							
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.LEN
S	0.000	301748.201	6427098.506	148.150	312°06'51.79"	LINE	4.106
E	4.106	301745.155	6427101.259	148.178	312°06'51.79"		

SETOUT DRIVEWAY 02 RIGHT							
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.LEN
S	0.000	301746.265	6427093.711	148.266	289°59'36.03"	LINE	4.113
E	4.113	301742.400	6427095.117	148.437	289°59'36.03"		

SETOUT DRIVEWAY 02 LEFT							
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.LEN
S	0.000	301744.582	6427089.003	148.381	318°17'36.05"	LINE	2.538
DIS	2.538	301742.894	6427090.897	148.469	299°28'14.46"	LINE	2.208
E	4.746	301740.971	6427091.984	148.546	299°28'14.46"		

NOTE

REFER TO DRG 22-18812-C540 TO C546 FOR PROFILES

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

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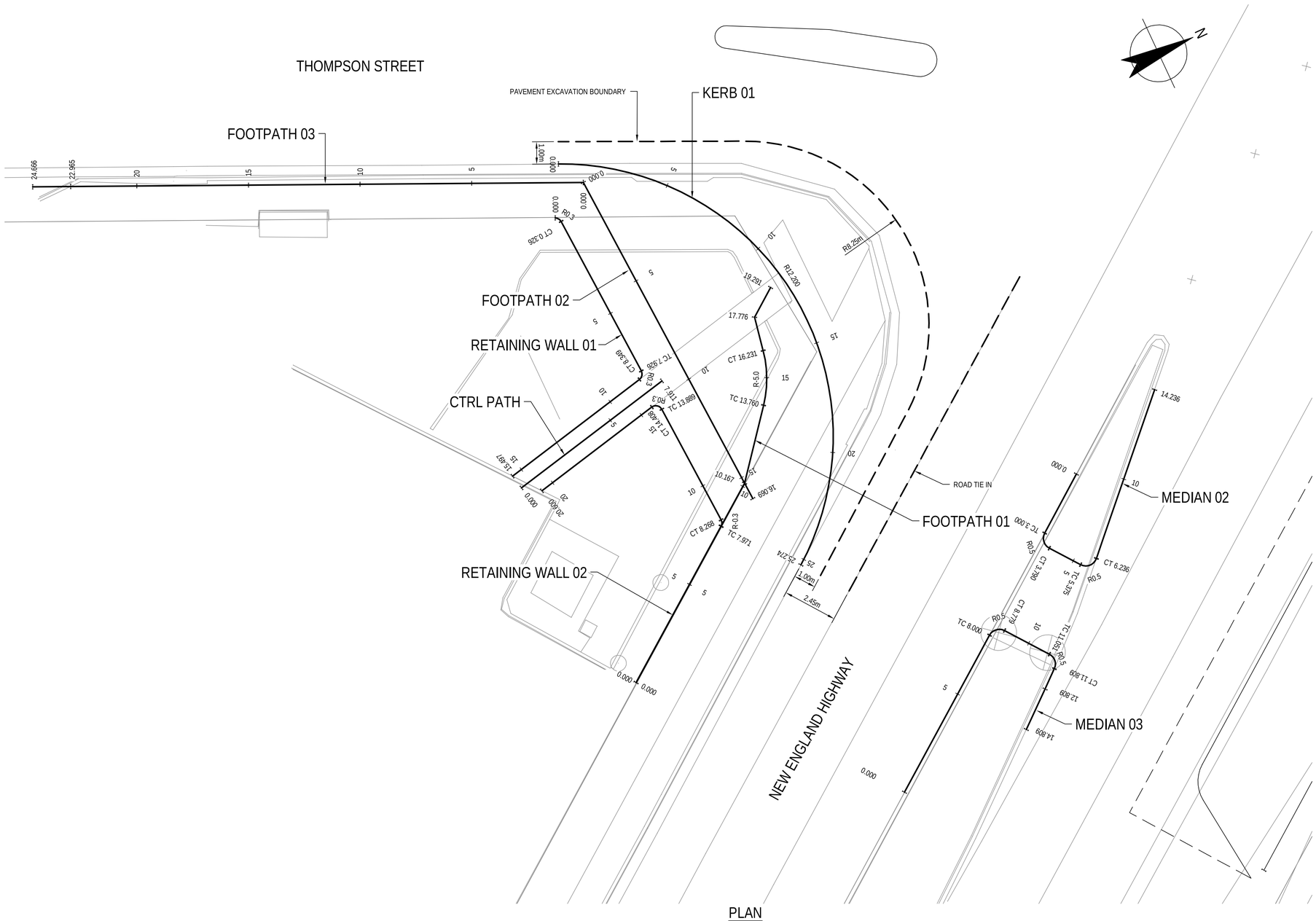
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title SETOUT PLAN
SHEET 2 OF 3

Original Size A1
Drawing No: 22-18812-C531
Rev: 0

Plot Date: 21 May 2018 - 2:56 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C531.dwg



PLAN

SCALE 1:100

SETOUT KERB 01

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301754.379	6427078.662	148.182	143°10'40.63"	ARC	12.200	25.274
	10.000	301761.600	6427085.172	148.008	71°26'40.78"		12.200	
	20.000	301771.286	6427084.337	147.966	118°24'30.29"		12.200	
E	25.274	301775.248	6427080.918	147.955	143°10'40.63"			

SETOUT FOOTPATH 01

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301776.903	6427072.001	148.419	323°31'34.11"	LINE		7.971
TT	7.971	301772.164	6427078.411	148.200	323°31'32.69"	LINE		2.195
	10.000	301770.958	6427080.042	148.179	323°31'32.69"			
DIS	10.167	301770.859	6427080.177	148.178	308°44'57.20"	LINE		3.593
TC	13.760	301768.057	6427082.425	148.141	308°44'57.20"	ARC	-5.000	2.471
CT	16.231	301765.833	6427083.443	148.133	280°25'51.08"	LINE		1.546
DIS	17.776	301764.313	6427083.723	148.135	323°21'55.51"	LINE		1.514
E	19.291	301763.409	6427084.938	148.105	323°21'55.51"			

SETOUT FOOTPATH 02

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301755.601	6427079.324	148.281	86°48'11.81"	LINE	16.069	
	10.000	301765.585	6427079.882	148.250	86°48'11.81"			
E	16.069	301771.645	6427080.220	148.165	86°48'11.81"			

SETOUT FOOTPATH 03

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301755.601	6427079.324	148.281	204°32'59.91"	LINE	24.666	
	5.000	301753.523	6427074.776	148.403	204°32'59.91"			
	10.000	301751.446	6427070.228	148.502	204°32'59.91"			
	15.000	301749.369	6427065.680	148.581	204°32'59.91"			
	20.000	301747.291	6427061.132	148.659	204°32'59.91"			
E	24.666	301745.352	6427056.888	148.811	204°32'59.91"			

SETOUT MEDIAN 02

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301776.771	6427093.821	148.206	143°13'58.26"	LINE		2.000
TT	2.000	301777.968	6427092.219	148.204	143°13'58.26"	LINE		1.000
TC	3.000	301778.567	6427091.418	148.204	143°13'58.26"	ARC	-0.500	0.790
CT	3.790	301779.270	6427091.319	148.206	52°43'54.42"	LINE		1.585
TC	5.375	301780.532	6427092.279	148.229	52°43'54.42"	ARC	-0.500	0.861
CT	6.236	301780.577	6427093.036	148.236	314°01'43.50"	LINE		1.000
TT	7.236	301779.858	6427093.731	148.240	314°01'43.50"	LINE		7.000
	10.000	301777.871	6427095.652	148.252	314°01'43.50"			
E	14.236	301774.825	6427098.596	148.269	314°01'43.50"			

SETOUT MEDIAN 03

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301786.434	6427080.820	148.235	323°26'29.30"	LINE		7.000
TT	7.000	301782.264	6427086.442	148.215	323°26'29.30"	LINE		1.000
TC	8.000	301781.668	6427087.246	148.212	323°26'29.30"	ARC	0.500	0.779
CT	8.779	301781.767	6427087.941	148.212	52°44'01.58"	LINE		2.272
	10.000	301782.739	6427088.681	148.218	52°44'01.58"			
TC	11.051	301783.576	6427089.317	148.226	52°44'01.58"	ARC	0.500	0.758
CT	11.809	301784.259	6427089.243	148.229	139°36'00.01"	LINE		1.000
DIS	12.809	301784.907	6427088.482	148.233	139°54'15.42"	LINE		2.000
E	14.809	301786.195	6427086.952	148.242	139°54'15.42"			

SETOUT CTRL PATH

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301766.830	6427071.032	148.915	347°41'42.26"	LINE	7.911	
E	7.911	301765.144	6427078.762	148.286	347°41'42.26"			

SETOUT RETAINING WALL 01

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301756.507	6427077.512	148.435	86°48'13.24"	ARC	0.300	0.326
CT	0.326	301756.763	6427077.687	148.429	86°48'13.24"	LINE		7.600
TC	7.926	301764.351	6427078.110	148.300	86°48'13.24"	ARC	0.300	0.424
CT	8.349	301764.661	6427077.875	148.304	167°41'11.40"	LINE		7.148
	10.000	301765.013	6427076.262	148.463	167°41'11.40"			
E	15.497	301766.185	6427070.891	148.928	167°41'11.40"			

SETOUT RETAINING WALL 02

PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	DEP.SEG	DEP.RAD	DEP.LEN
S	0.000	301776.903	6427072.001	148.419	323°31'33.11"	LINE		7.971
TC	7.971	301772.164	6427078.411	148.200	323°31'33.11"	ARC	-0.300	0.297
CT	8.268	301771.906	6427078.532	148.200	266°48'14.79"	LINE		5.621
	10.000	301770.177	6427078.436	148.231	266°48'14.79"			
TC	13.889	301766.294	6427078.219	148.300	266°48'14.79"	ARC	-0.300	0.519
CT	14.408	301766.018	6427077.856	148.333	167°41'43.52"	LINE		6.192
	20.000	301767.209	6427072.392	148.854	167°41'43.52"			
E	20.600	301767.337	6427071.806	148.910	167°41'43.52"			

NOTE

REFER TO DRG 22-18812-C540 TO C546 FOR PROFILES

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

0 1 2 3 4 5m

SCALE 1:100 AT ORIGINAL SIZE

GHD Tower, Level 3
24 Honeysuckle Drive, Newcastle NSW 2300 Australia
PO Box 5403 Hunter Rgn Mail Cent. NSW 2310
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E ntlmail@ghd.com W www.ghd.com

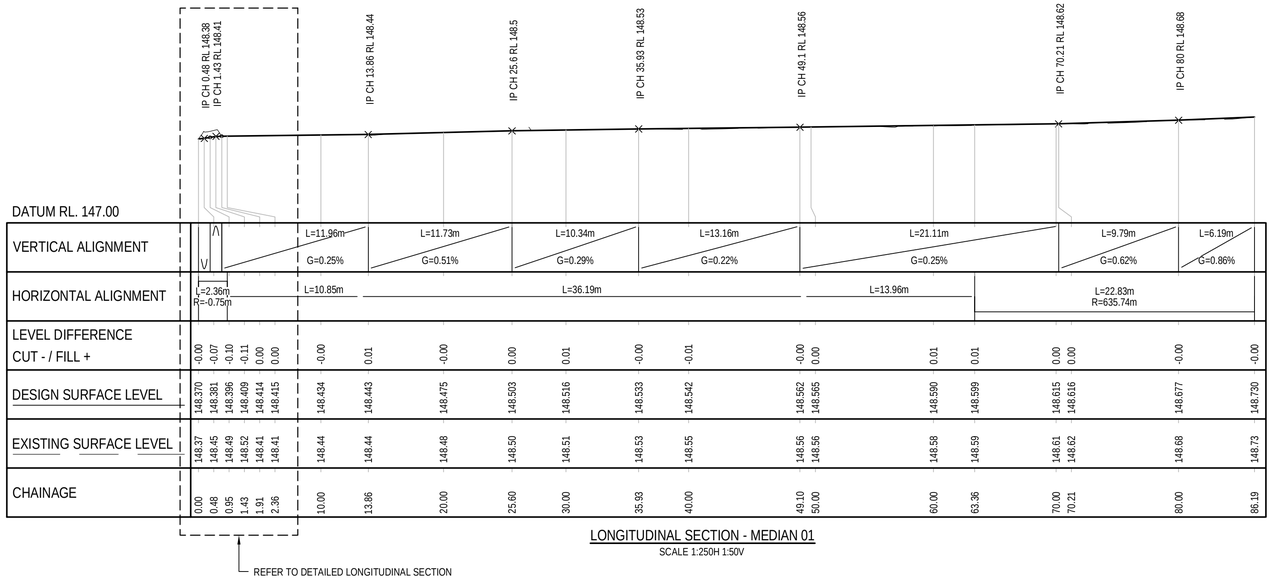
DO NOT SCALE

Drawn	R. COCKS	Designer	N.HINCKS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title SETOUT PLAN
SHEET 3 OF 3

Original Size A1 Drawing No: 22-18812-C532 Rev: 0

Plot Date: 21 May 2018 - 2:56 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C532.dwg



DATUM RL. 147.00

VERTICAL ALIGNMENT					L=11.96m G=0.25%			L=11.73m G=0.51%		L=10.34m G=0.29%		L=13.16m G=0.22%		L=21.11m G=0.25%				L=9.79m G=0.62%	L=6.19m G=0.86%		
HORIZONTAL ALIGNMENT	L=2.36m R=-0.75m					L=10.85m		L=36.19m							L=13.96m		L=22.83m R=635.74m				
LEVEL DIFFERENCE CUT - / FILL +	-0.00	-0.07	-0.10	-0.11	0.00	0.00	-0.00	0.01	-0.00	0.00	0.01	-0.00	-0.01	-0.00	0.00	0.01	0.01	0.00	0.00	-0.00	-0.00
DESIGN SURFACE LEVEL	148.370	148.381	148.396	148.409	148.414	148.415	148.434	148.443	148.475	148.503	148.516	148.533	148.542	148.562	148.565	148.590	148.599	148.615	148.616	148.677	148.730
EXISTING SURFACE LEVEL	148.37	148.45	148.49	148.52	148.41	148.41	148.44	148.44	148.48	148.50	148.51	148.53	148.55	148.56	148.56	148.58	148.59	148.61	148.62	148.68	148.73
CHAINAGE	0.00	0.48	0.95	1.43	1.91	2.36	10.00	13.86	20.00	25.60	30.00	35.93	40.00	49.10	50.00	60.00	63.36	70.00	70.21	80.00	86.19

REFER TO DETAILED LONGITUDINAL SECTION

LONGITUDINAL SECTION - MEDIAN 01
SCALE 1:250H 1:50V

DATUM RL. 148.00

VERTICAL ALIGNMENT	G=2.03%	K=0.65 L=0.95m	G=3.5%	K=0.29 L=0.95m	L=11.96m G=0.25%		
HORIZONTAL ALIGNMENT	L=2.36m R=-0.75m					L=10.85m	
LEVEL DIFFERENCE CUT - / FILL +	-0.00	-0.07	-0.10	-0.11	0.00	0.00	-0.00
DESIGN SURFACE LEVEL	148.370	148.381	148.396	148.409	148.414	148.415	148.417
EXISTING SURFACE LEVEL	148.37	148.45	148.49	148.52	148.41	148.41	148.42
CHAINAGE	0.00	0.48	0.95	1.43	1.91	2.36	3.00

DETAIL
MEDIAN 01 CH0 -CH3
SCALE 1:50H 1:10V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=4.09m G=2.5%					L=40.64m G=0.59%							L=4.1m G=-1.89%				
HORIZONTAL ALIGNMENT	L=4.10m	L=1.68m R=1.60m		L=40.64m							L=1.68m R=1.60m		L=4.10m				
LEVEL DIFFERENCE CUT - / FILL +	0.06	0.01	0.01	-0.00	-0.00	0.00	0.02	0.02	0.03	0.01	-0.00	0.00	0.01	0.01	0.00	0.03	0.26
DESIGN SURFACE LEVEL	147.913	148.015	148.025	148.034	148.041	148.045	148.070	148.130	148.189	148.249	148.287	148.286	148.278	148.267	148.258	148.222	148.180
EXISTING SURFACE LEVEL	147.86	148.01	148.02	148.03	148.04	148.05	148.06	148.11	148.16	148.24	148.29	148.28	148.27	148.25	148.26	148.19	147.92
CHAINAGE	0.00	4.09	4.51	4.93	5.35	5.77	10.00	20.00	30.00	40.00	46.41	46.83	47.25	47.67	48.09	50.00	52.18

LONGITUDINAL SECTION - KERB 03
SCALE 1:250H 1:50V

DATUM RL. 146.00

VERTICAL ALIGNMENT	L=46.33m G=0.58%					
HORIZONTAL ALIGNMENT	L=46.33m					
LEVEL DIFFERENCE CUT - / FILL +	0.18	0.18	0.17	0.40	0.52	0.48
DESIGN SURFACE LEVEL	148.023	148.081	148.138	148.196	148.254	148.290
EXISTING SURFACE LEVEL	147.85	147.90	147.97	147.79	147.74	147.81
CHAINAGE	0.00	10.00	20.00	30.00	40.00	46.33

LONGITUDINAL SECTION - BACKPATH
SCALE 1:250H 1:50V

PRELIMINARY

A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18
No	Revision Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

VERTICAL 1:50
AT ORIGINAL SIZE
0 0.5 1 1.5 2 2.5m

HORIZONTAL 1:250
AT ORIGINAL SIZE
0 2.5 5 7.5 10 12.5m

GHD Tower, Level 3
24 Honeysuckle Drive, Newcastle NSW 2300 Australia
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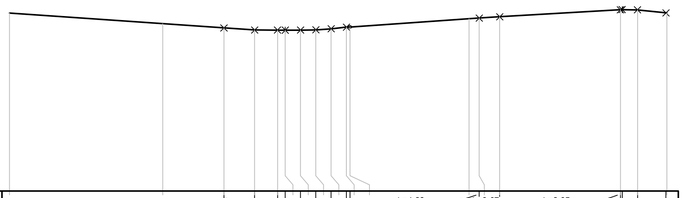
Drawn R. COCKS
Designer N.HINCKS
Drafting Check
Design Check
Approved (Project Director)
Date
Scale AS SHOWN
This Drawing must not be used for Construction unless signed as Approved

Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **LONGITUDINAL SECTIONS**
SHEET 1 OF 6

Original Size **A1**
Drawing No: 22-18812-C540
Rev: 0

Plot Date: 21 May 2018 - 2:57 PM
Plotted by: Bec Cocks
Cad File No: G:\22\18812\CADD\Drawings\22-18812-C540.dwg



DATUM RL. 147.00

VERTICAL ALIGNMENT												L=4.22m G=1.37%		L=0.67m G=1.35%	L=3.95m G=1.16%			
HORIZONTAL ALIGNMENT	L=8.75m				L=2.36m R=-0.75m							L=4.22m		L=4.61m			L=1.52m R=-0.50m		
LEVEL DIFFERENCE CUT - / FILL +	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DESIGN SURFACE LEVEL	148.162	148.092	148.065	148.051	148.050	148.050	148.050	148.052	148.059	148.069	148.071	148.124	148.128	148.137	148.183	148.182	148.162
EXISTING SURFACE LEVEL	148.16	148.09	148.06	148.05	148.05	148.05	148.05	148.05	148.06	148.07	148.07	148.12	148.13	148.14	148.18	148.18	148.16
CHAINAGE	0.00	5.00	7.00	8.00	8.75	9.00	9.50	10.00	10.50	11.00	11.11	15.00	15.33	16.00	19.95	20.50	21.46

LONGITUDINAL SECTION - MEDIAN 04
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=3.52m G=1.62%	L=1m G=1.15%	
HORIZONTAL ALIGNMENT	L=4.51m		
LEVEL DIFFERENCE CUT - / FILL +	0.08	0.03	-0.02
DESIGN SURFACE LEVEL	148.057	148.114	148.125
EXISTING SURFACE LEVEL	147.98	148.08	148.14
CHAINAGE	0.03	3.55	4.54

LONGITUDINAL SECTION - DRIVEWAY 01 R
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=4.12m G=0.69%	
HORIZONTAL ALIGNMENT	L=4.11m	
LEVEL DIFFERENCE CUT - / FILL +	-0.01	0.00
DESIGN SURFACE LEVEL	148.150	148.178
EXISTING SURFACE LEVEL	148.16	148.18
CHAINAGE	0.00	4.11

LONGITUDINAL SECTION - DRIVEWAY 01 L
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=4.11m G=4.15%	
HORIZONTAL ALIGNMENT	L=4.11m	
LEVEL DIFFERENCE CUT - / FILL +	0.04	0.00
DESIGN SURFACE LEVEL	148.266	148.437
EXISTING SURFACE LEVEL	148.23	148.44
CHAINAGE	0.00	4.11

LONGITUDINAL SECTION - DRIVEWAY 02 R
SCALE 1:100H 1:20V

DATUM RL. 148.00

VERTICAL ALIGNMENT	L=4.75m G=3.48%	
HORIZONTAL ALIGNMENT	L=2.54m	L=2.21m
LEVEL DIFFERENCE CUT - / FILL +	-0.02	-0.00
DESIGN SURFACE LEVEL	148.381	148.546
EXISTING SURFACE LEVEL	148.41	148.55
CHAINAGE	0.00	4.75

LONGITUDINAL SECTION - DRIVEWAY 02 L
SCALE 1:100H 1:20V

PRELIMINARY

No	Revision Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

VERTICAL 1:50
AT ORIGINAL SIZE
0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:100
AT ORIGINAL SIZE
0 1 2 3 4 5m

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24 Honeysuckle Drive, Newcastle NSW 2300 Australia
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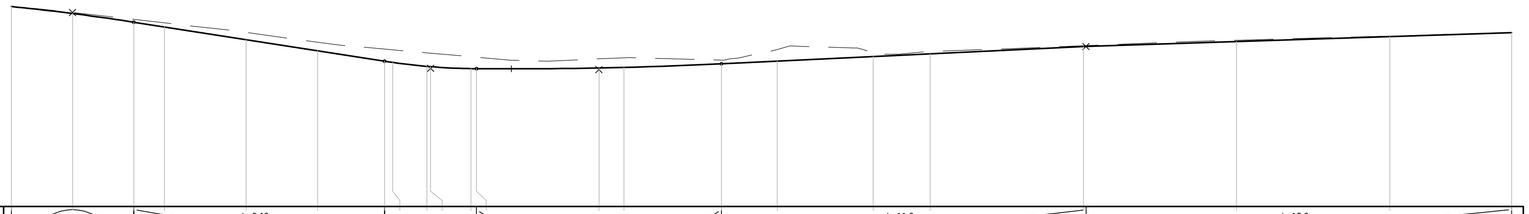
E ntlmail@ghd.com **W** www.ghd.com

DO NOT SCALE

Drawn R. COCKS
Designer N.HINCKS
Drafting Check
Design Check
Approved (Project Director)
Date
Scale AS SHOWN
This Drawing must not be used for Construction unless signed as Approved

Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **LONGITUDINAL SECTIONS**
SHEET 2 OF 6
Original Size **A1**
Drawing No: 22-18812-C541
Rev: 0

Plot Date: 21 May 2018 - 2:57 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C541.dwg



DATUM RL. 147.00

VERTICAL ALIGNMENT: G=-2% | K=3.6 L=4m | L=8.19m G=-3.11% | K=1.02 L=3m | G=-0.16% | K=7.23 L=8m | L=11.9m G=0.95% | L=13.9m G=0.66%

HORIZONTAL ALIGNMENT: L=7.67m | L=4.78m R=20.00m | L=1.12m | L=14.57m R=-12.00m | L=20.85m

LEVEL DIFFERENCE CUT - / FILL +	0.00	-0.01	-0.02	-0.03	-0.05	-0.06	-0.08	-0.08	-0.09	-0.09	-0.08	-0.08	-0.06	-0.06	-0.02	-0.08	-0.01	-0.01	-0.01	-0.01	-0.00	-0.00
DESIGN SURFACE LEVEL	148.306	148.260	148.203	148.172	148.089	148.017	147.949	147.941	147.915	147.913	147.900	147.900	147.905	147.908	147.932	147.949	147.979	147.996	148.044	148.077	148.110	148.136
EXISTING SURFACE LEVEL	148.31	148.27	148.22	148.20	148.14	148.07	148.03	148.02	148.00	148.00	147.98	147.98	147.96	147.97	147.96	148.02	147.99	148.01	148.05	148.09	148.11	148.14
CHAINAGE	0.00	2.00	4.00	5.00	7.67	10.00	12.18	12.44	13.56	13.68	15.00	15.18	19.18	20.00	23.18	25.00	28.13	30.00	35.00	40.00	45.00	48.98

LONGITUDINAL SECTION - KERB 02

SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT: L=10.28m G=4.7% | L=2m G=0% | L=3.72m G=-7.02% | L=5.54m G=-0.51% | L=2.71m G=-3.29% | L=10.96m G=-1.44%

HORIZONTAL ALIGNMENT: L=0.22m | L=4.71m R=-3.00m | L=2.85m | L=4.50m | L=3.36m | L=4.16m R=-3.00m | L=1.74m | L=3.22m | L=10.45m | L=4.24m

LEVEL DIFFERENCE CUT - / FILL +	-0.00	0.01	0.02	-0.07	-0.07	-0.15	-0.11	-0.10	-0.09	0.02	0.02	-0.03	-0.00	0.02	0.03	-0.04	-0.02	-0.00
DESIGN SURFACE LEVEL	148.178	148.188	148.410	148.648	148.661	148.661	148.470	148.425	148.400	148.381	148.380	148.372	148.283	148.272	148.200	148.128	148.125	148.178
EXISTING SURFACE LEVEL	148.18	148.18	148.39	148.72	148.73	148.81	148.58	148.52	148.49	148.36	148.36	148.40	148.28	148.25	148.17	148.17	148.14	148.18
CHAINAGE	0.00	0.22	4.93	10.00	10.28	12.28	15.00	15.64	16.00	19.80	20.00	21.54	24.25	25.00	30.00	35.00	35.21	39.45

LONGITUDINAL SECTION - PAD 01

SCALE 1:100H 1:20V

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:100 AT ORIGINAL SIZE 0 1 2 3 4 5m

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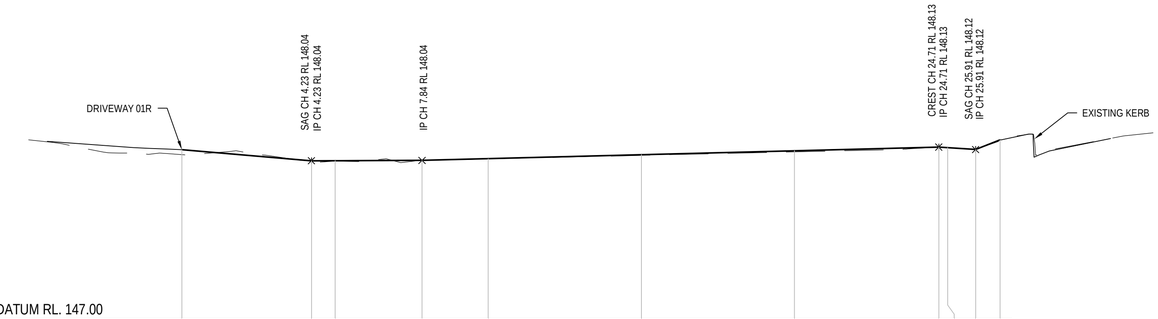
24 Honeysuckle Drive, Newcastle NSW 2300 Australia
PO Box 5403 Hunter Rgn Mail Cent. NSW 2310
T 61 2 4979 9999 F 61 2 4979 9988
E ntlmail@ghd.com W www.ghd.com

DO NOT SCALE

Drawn R. COCKS
Designer N.HINCKS
Drafting Check
Design Check
Approved (Project Director)
Date
Scale AS SHOWN
This Drawing must not be used for Construction unless signed as Approved

Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **LONGITUDINAL SECTIONS**
SHEET 3 OF 6
Original Size A1
Drawing No: 22-18812-C542
Rev: 0

Plot Date: 21 May 2018 - 2:57 PM
Plotted by: Bec Cocks
Cad File No: G:\22\18812\CADD\Drawings\22-18812-C542.dwg

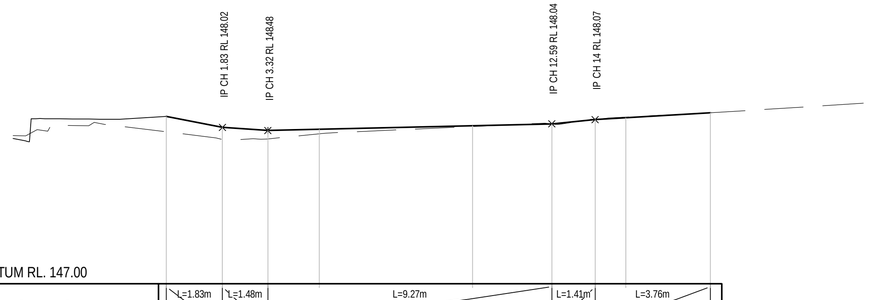


DATUM RL. 147.00

VERTICAL ALIGNMENT	L=4.23m G=-1.7%		L=3.61m G=0.07%		L=16.87m G=0.51%							L=1.2m G=-1.29%	L=0.79m G=7.82%	
HORIZONTAL ALIGNMENT	L=4.23m		L=3.66m		L=16.82m							L=2.00m		
LEVEL DIFFERENCE CUT - / FILL +	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01
DESIGN SURFACE LEVEL	148.114	148.042	148.042	148.044	148.055	148.081	148.107	148.131	148.127	148.115	148.177			
EXISTING SURFACE LEVEL	148.08	148.03	148.04	148.04	148.05	148.08	148.10	148.13	148.13	148.12	148.17			
CHAINAGE	0.00	4.23	5.00	7.84	10.00	15.00	20.00	24.71	25.00	25.91	26.71			

LONGITUDINAL SECTION - FOOTPATH 04

SCALE 1:100H 1:20V



DATUM RL. 147.00

VERTICAL ALIGNMENT	L=1.83m G=-3.95%	L=1.48m G=-1.35%	L=9.27m G=0.46%				L=1.41m G=2%	L=3.76m G=1.17%		
HORIZONTAL ALIGNMENT	L=3.09m		L=9.73m				L=1.04m	L=3.90m		
LEVEL DIFFERENCE CUT - / FILL +	0.10	0.08	0.05	0.03	0.00	0.00	-0.00	-0.00	-0.00	
DESIGN SURFACE LEVEL	148.093	148.020	148.000	148.008	148.031	148.043	148.071	148.083	148.115	
EXISTING SURFACE LEVEL	147.99	147.94	147.95	147.98	148.03	148.04	148.07	148.09	148.12	
CHAINAGE	0.00	1.83	3.32	5.00	10.00	12.59	14.00	15.00	17.76	

LONGITUDINAL SECTION - FOOTPATH 05

SCALE 1:100H 1:20V

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

VERTICAL 1:50 AT ORIGINAL SIZE — 0 0.5 1 1.5 2 2.5m

HORIZONTAL 1:100 AT ORIGINAL SIZE — 0 1 2 3 4 5m

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Drafting Check | Design Check
Approved (Project Director)
Date
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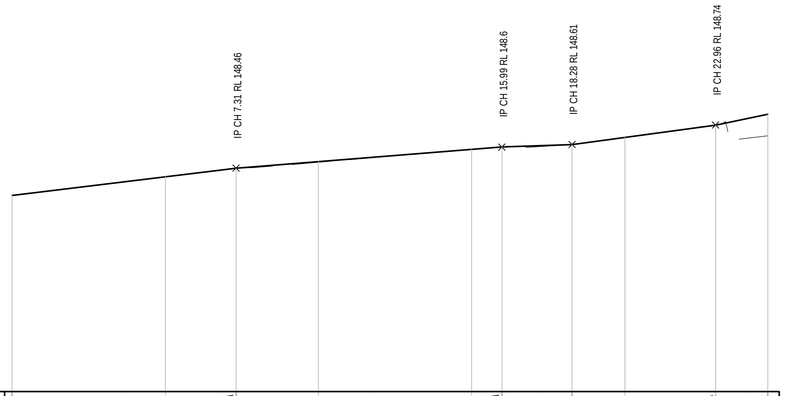
Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title LONGITUDINAL SECTIONS SHEET 4 OF 6

Original Size A1 **Drawing No: 22-18812-C543** **Rev: 0**

Plot Date: 21 May 2018 - 2:57 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C543.dwg

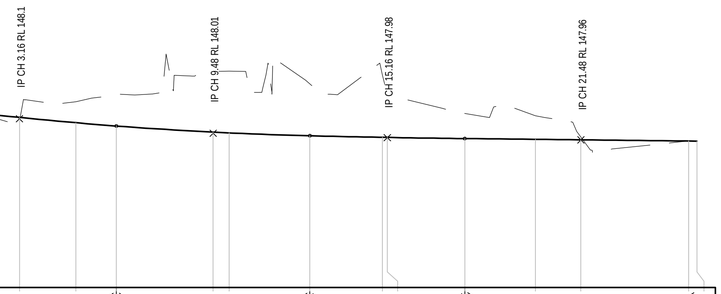


DATUM RL. 147.00

VERTICAL ALIGNMENT	L=7.31m G=2.44%		L=8.68m G=1.59%			L=2.29m G=0.69%	L=4.69m G=2.71%		L=1.7m G=4.19%		
HORIZONTAL ALIGNMENT	L=24.67m											
LEVEL DIFFERENCE CUT - / FILL +	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00	0.14		
DESIGN SURFACE LEVEL	148.281	148.403	148.459	148.502	148.581	148.597	148.613	148.659	148.740	148.811		
EXISTING SURFACE LEVEL	148.28	148.40	148.46	148.50	148.58	148.60	148.61	148.66	148.74	148.67		
CHAINAGE	0.00	5.00	7.31	10.00	15.00	15.99	18.28	20.00	22.96	24.67		

LONGITUDINAL SECTION - FOOTPATH 03

SCALE 1:100H 1:20V



DATUM RL. 147.00

VERTICAL ALIGNMENT	L=5m G=-2.59%	K=5.86 L=6.32m		G=-1.51%	K=6.26 L=6.32m		G=-0.5%	K=18.52 L=5.05m		G=-0.23%	K=441.13 L=7.58m											
HORIZONTAL ALIGNMENT	L=25.27m R=12.20m																					
LEVEL DIFFERENCE CUT - / FILL +	0.00	0.05	-0.14	-0.21	-0.40	-0.40	-0.34	-0.41	-0.27	-0.16	-0.15	0.03	0.00	-0.00								
DESIGN SURFACE LEVEL	148.182	148.109	148.074	148.053	148.013	148.008	147.990	147.979	147.979	147.971	147.966	147.963	147.955	147.955								
EXISTING SURFACE LEVEL	148.18	148.06	148.21	148.26	148.41	148.41	148.33	148.39	148.25	148.13	148.12	147.93	147.95	147.95								
CHAINAGE	0.00	3.16	5.00	6.22	9.48	10.00	12.64	15.00	15.16	17.69	20.00	21.48	25.00	25.27								

LONGITUDINAL SECTION - KERB 01

SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=8.52m G=-0.36%					L=2.09m G=0%	L=5.45m G=-1.56%															
HORIZONTAL ALIGNMENT	L=16.07m																					
LEVEL DIFFERENCE CUT - / FILL +	0.00	-0.37			-0.43	-0.47	-0.44					-0.40	-0.17									
DESIGN SURFACE LEVEL	148.281	148.253			148.250	148.250	148.250					148.182	148.165									
EXISTING SURFACE LEVEL	148.28	148.63			148.68	148.72	148.69					148.58	148.33									
CHAINAGE	0.00	5.00			8.52	10.00	10.61					15.00	16.07									

LONGITUDINAL SECTION - FOOTPATH 02

SCALE 1:100H 1:20V

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

VERTICAL 1:50 AT ORIGINAL SIZE — 0 0.5 1 1.5 2 2.5m

HORIZONTAL 1:100 AT ORIGINAL SIZE — 0 1 2 3 4 5m

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Drafting Check | Design Check
Approved (Project Director)
Date
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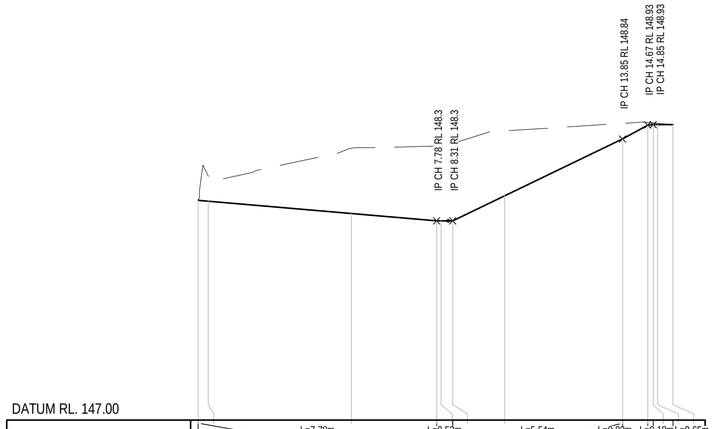
Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title LONGITUDINAL SECTIONS SHEET 5 OF 6

Original Size A1 **Drawing No: 22-18812-C544** **Rev: 0**

Plot Date: 21 May 2018 - 2:57 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C544.dwg



DATUM RL. 147.00

VERTICAL ALIGNMENT	L=7.78m G=-1.73%			L=0.53m G=0%		L=5.54m G=9.65%		L=0.82m G=10.98%	L=0.18m G=1.31%	L=0.65m G=0%		
HORIZONTAL ALIGNMENT	L=0.33m R=0.30m	L=7.60m			L=0.42m R=0.30m	L=7.15m						
LEVEL DIFFERENCE CUT - / FILL +	-0.00	-0.16	-0.43	-0.49	-0.49	-0.50	-0.42	-0.10	-0.02	-0.01	-0.01	0.00
DESIGN SURFACE LEVEL	148.435	148.429	148.348	148.300	148.300	148.300	148.463	148.835	148.926	148.928	148.928	148.928
EXISTING SURFACE LEVEL	148.44	148.59	148.77	148.79	148.79	148.80	148.89	148.94	148.94	148.94	148.94	148.93
CHAINAGE	0.00	0.33	5.00	7.78	7.93	8.31	10.00	13.85	14.67	14.85	15.00	15.50

LONGITUDINAL SECTION - RETAINING WALL 01
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=7.97m G=-2.75%		L=0.3m G=0%	L=5.62m G=1.78%		L=0.44m G=5.76%	L=6.27m G=9.32%			
HORIZONTAL ALIGNMENT	L=7.97m		L=0.30m R=-0.30m	L=5.62m		L=0.52m R=-0.30m	L=6.19m			
LEVEL DIFFERENCE CUT - / FILL +	-0.00	-0.12	-0.19	-0.34	-0.35	-0.48	-0.49	-0.46	-0.04	0.01
DESIGN SURFACE LEVEL	148.419	148.282	148.200	148.200	148.231	148.300	148.326	148.388	148.854	148.910
EXISTING SURFACE LEVEL	148.42	148.40	148.39	148.54	148.58	148.78	148.82	148.85	148.90	148.90
CHAINAGE	0.00	5.00	7.97	8.27	10.00	13.89	14.33	15.00	20.00	20.60

LONGITUDINAL SECTION - RETAINING WALL 02
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=3.02m G=-0.09%	K=0.83 L=1.61m		G=1.85%	K=1.13 L=1.61m		L=8m G=0.42%		
HORIZONTAL ALIGNMENT	L=2.00m L=1.00	L=0.79m R=-0.50m	L=1.59m			L=0.86m R=-0.50m	L=1.00m L=7.00m		
LEVEL DIFFERENCE CUT - / FILL +	-0.00	0.00	-0.13	-0.12	-0.12	-0.11	-0.00	-0.00	0.00
DESIGN SURFACE LEVEL	148.206	148.204	148.206	148.218	148.224	148.229	148.236	148.252	148.269
EXISTING SURFACE LEVEL	148.21	148.20	148.34	148.34	148.34	148.34	148.24	148.25	148.27
CHAINAGE	0.00	3.00	3.79	4.63	5.00	5.38	6.24	10.00	14.24

LONGITUDINAL SECTION - MEDIAN 02
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=0.82m G=0%	L=6.37m G=-9.65%		L=0.51m1m G=-2.76%%		
HORIZONTAL ALIGNMENT	L=7.91m					
LEVEL DIFFERENCE CUT - / FILL +	0.02	-0.01	-0.37	-0.50	-0.48	-0.47
DESIGN SURFACE LEVEL	148.915	148.915	148.512	148.300	148.286	148.286
EXISTING SURFACE LEVEL	148.89	148.92	148.88	148.80	148.76	148.75
CHAINAGE	0.00	0.82	5.00	7.19	7.70	7.91

LONGITUDINAL SECTION - PATH
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=7.97m G=-2.75%		L=5.79m G=-1.02%		L=2.23m G=-0.39%		L=1.79m G=0.18%		L=1.51m G=-2.04%	
HORIZONTAL ALIGNMENT	L=7.97m		L=2.20m	L=3.59m	L=2.47m R=-5.00m			L=1.55m	L=1.51m	
LEVEL DIFFERENCE CUT - / FILL +	-0.00	-0.12	-0.19	-0.20	-0.35	-0.30	-0.35	-0.36	-0.36	-0.34
DESIGN SURFACE LEVEL	148.419	148.282	148.200	148.179	148.141	148.136	148.132	148.133	148.136	148.105
EXISTING SURFACE LEVEL	148.42	148.40	148.39	148.38	148.49	148.44	148.48	148.49	148.50	148.44
CHAINAGE	0.00	5.00	7.97	10.00	13.76	15.00	15.99	16.23	17.78	19.29

LONGITUDINAL SECTION - FOOTPATH 01
SCALE 1:100H 1:20V

DATUM RL. 147.00

VERTICAL ALIGNMENT	L=7m G=-0.29%		L=1m G=-0.28%	K=1.67 L=1.9m			G=0.86% K=3.86 L=1.9m			L=1m G=0.37%	L=2m G=0.45%	
HORIZONTAL ALIGNMENT	L=7.00m		L=1.00m		L=2.27m					L=1.00m	L=2.00m	
LEVEL DIFFERENCE CUT - / FILL +	0.00	-0.00	-0.00	0.00	-0.12	-0.12	-0.12	-0.11	-0.10	0.00	0.00	0.00
DESIGN SURFACE LEVEL	148.235	148.221	148.215	148.212	148.212	148.212	148.218	148.225	148.226	148.229	148.233	148.242
EXISTING SURFACE LEVEL	148.23	148.22	148.21	148.21	148.33	148.34	148.34	148.34	148.33	148.23	148.23	148.24
CHAINAGE	0.00	5.00	7.00	8.00	8.78	8.95	9.90	10.86	11.05	11.81	12.81	14.81

LONGITUDINAL SECTION - MEDIAN 03
SCALE 1:100H 1:20V

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:100 AT ORIGINAL SIZE 0 1 2 3 4 5m

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Designer N.HINCKS
Drafting Check
Design Check
Approved (Project Director)
Date
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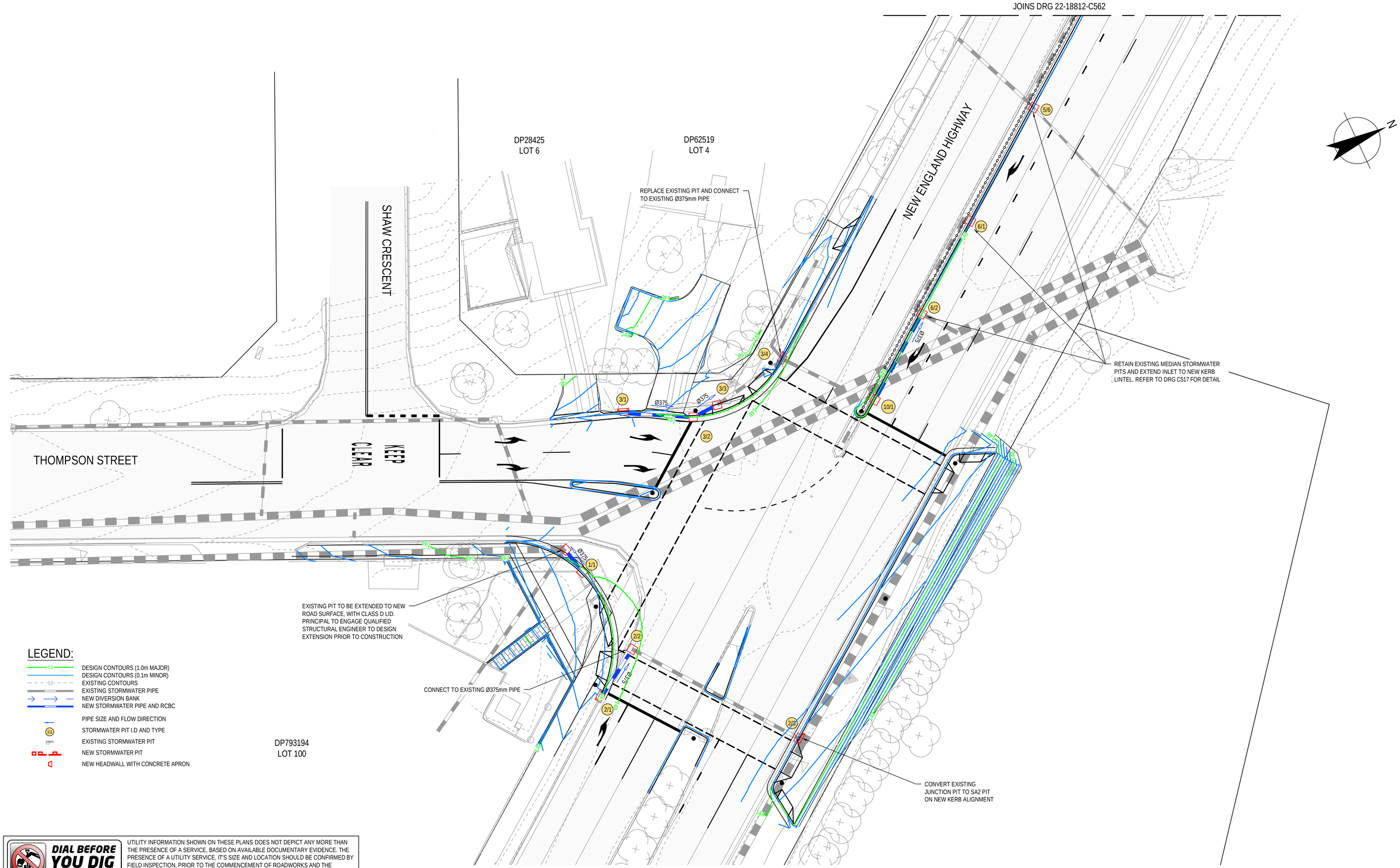
Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **LONGITUDINAL SECTIONS**
SHEET 6 OF 6
Original Size **A1**
Drawing No: 22-18812-C545
Rev: 0

Plot Date: 21 May 2018 - 2:57 PM
Plotted by: Bec Cocks
Cad File No: G:\22\18812\CADD\Drawings\22-18812-C545.dwg



PLAN
SCALE 1:200

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No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

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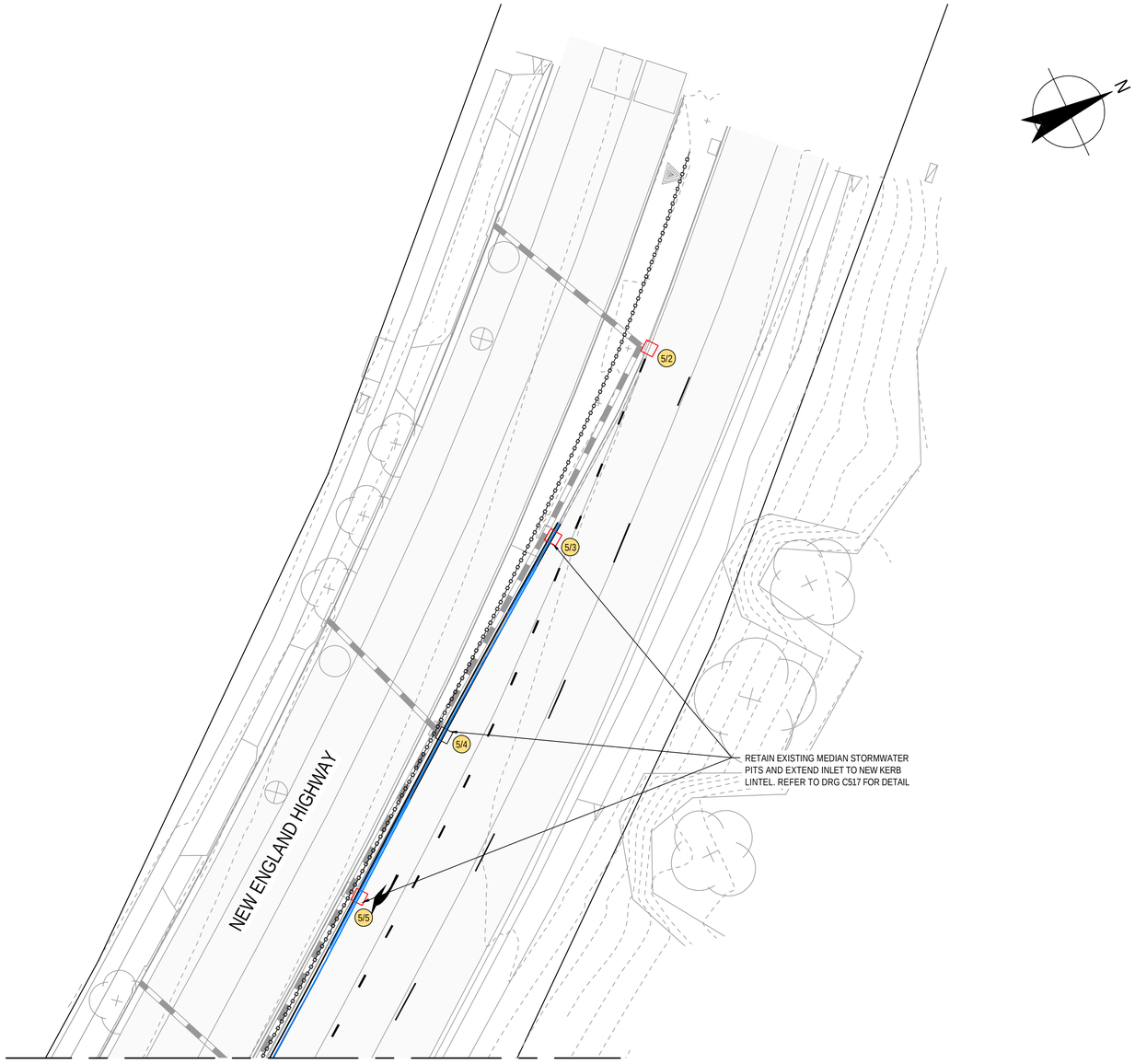
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title DRAINAGE PLAN SHEET 1 OF 2

Original Size A1
Drawing No: 22-18812-C561
Rev: 0

Plot Date: 21 May 2018 - 2:57 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C561.dwg



JOINS DRG 22-18812-C561

PLAN

SCALE 1:200

LEGEND:

- DESIGN CONTOURS (1.0m MAJOR)
- DESIGN CONTOURS (0.1m MINOR)
- EXISTING CONTOURS
- EXISTING STORMWATER PIPE
- NEW DIVERSION BANK
- NEW STORMWATER PIPE AND RCBC
- PIPE SIZE AND FLOW DIRECTION
- STORMWATER PIT I.D AND TYPE
- EXISTING STORMWATER PIT
- NEW STORMWATER PIT
- NEW HEADWALL WITH CONCRETE APRON

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PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

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Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client: **MUSWELLBROOK SHIRE COUNCIL**
Project: **THOMPSON STREET INTERSECTION UPGRADE**
Title: **DRAINAGE PLAN SHEET 2 OF 2**

Original Size **A1** Drawing No: **22-18812-C562** Rev: **0**

Plot Date: 21 May 2018 - 2:58 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C562.dwg

PIT SCHEDULE

PIT NAME	TYPE	EASTING	NORTHING	PIT SIZE		INLET		OUTLET		PIT SETOUT RL	DEPTH	REMARKS
				WIDTH (m)	LENGTH (m)	DIA	INV LEV	DIA	INV LEV			
1/1	STANDARD GULLY PIT TYPE SA1	301761.3	6427085.1	1.1	1.1			375	147	148.011	1.005	XY SETOUT TO SETOUT STRING, SETOUT LEVEL TO SETOUT STRING
1/2	RTA DRAINAGE JUNCTION BOX	301758.3	6427083.9	1.1	1.1	375	146.993			148.159	1.166	CONNECT NEW PIPE TO EXISTING JUNCTION BOX PIT
2/1	STANDARD GULLY PIT TYPE SA2	301775.2	6427080.9	1.1	1.1			375	146.9	147.955	1.009	XY SETOUT TO SETOUT STRING, SETOUT LEVEL TO SETOUT STRING
2/2	RTA DRAINAGE JUNCTION BOX	301771.5	6427086	1.1	1.1	375	146.92	375	146.9	147.989	1.089	CONVERT EXISTING PIT TO JUNCTION BOX
2/3	STANDARD GULLY PIT TYPE SA2	301787.6	6427098	1.1	1.1	375	146.82	375	146.8	148.079	1.279	CONVERT EXISTING JUNCTION BOX TO SA2 PIT
3/1	STANDARD GULLY PIT TYPE SA2	301748	6427095.8	1.1	1.1			375	147.1	148.122	0.996	XY SETOUT TO SETOUT STRING, SETOUT LEVEL TO SETOUT STRING
3/2	STANDARD GULLY PIT TYPE SA1	301751.7	6427102.6	1.1	1.1	375	146.977	375	146.7	147.954	1.262	XY SETOUT TO SETOUT STRING, SETOUT LEVEL TO SETOUT STRING
3/3	RTA DRAINAGE JUNCTION BOX	301751.1	6427105.7	1.1	1.1	375	146.665	375	146.6	148.067	1.422	CONVERT EXISTING PIT TO JUNCTION BOX
5/2	STANDARD GULLY PIT TYPE SF	301700.4	6427198.5	1.1	1.1	375	147.021	375	147	148.815	1.814	MODIFY INLET TO NEW KERB LINE. REFER DETAIL ON
5/3	STANDARD GULLY PIT TYPE SF	301709.6	6427186.6	1.1	1.1	375	146.926	375	146.9	148.721	1.815	MODIFY INLET TO NEW KERB LINE. REFER DETAIL ON
5/4	STANDARD GULLY PIT TYPE SF	301719.1	6427173.7	1.1	1.1	375	146.826	375	146.8	148.613	1.808	MODIFY INLET TO NEW KERB LINE. REFER DETAIL ON
5/5	STANDARD GULLY PIT TYPE SF	301726.9	6427163.4	1.1	1.1	375	146.754	375	146.7	148.58	1.846	MODIFY INLET TO NEW KERB LINE. REFER DETAIL ON
5/6	STANDARD GULLY PIT TYPE SF	301736.2	6427151	1.1	1.1	375	146.672	375	146.4	148.544	2.129	MODIFY INLET TO NEW KERB LINE. REFER DETAIL ON
6/1	STANDARD GULLY PIT TYPE SF	301744.7	6427139.6	1.1	1.1			375	147.5	148.506	0.977	MODIFY INLET TO NEW KERB LINE. REFER DETAIL ON
6/2	STANDARD GULLY PIT TYPE SF	301751.5	6427130.3	1.1	1.1	375	147.477	375	146.3	148.463	2.163	MODIFY INLET TO NEW KERB LINE. REFER DETAIL ON
10/1	STANDARD GULLY PIT TYPE SF	301757.9	6427121.7	1.1	1.1			375	147.4	148.423	0.976	XY SETOUT TO SETOUT STRING, SETOUT LEVEL TO SETOUT STRING

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
0	100% DETAILED DESIGN		RJC	NH*	AS*	21.05.18

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Drafting Check | Design Check
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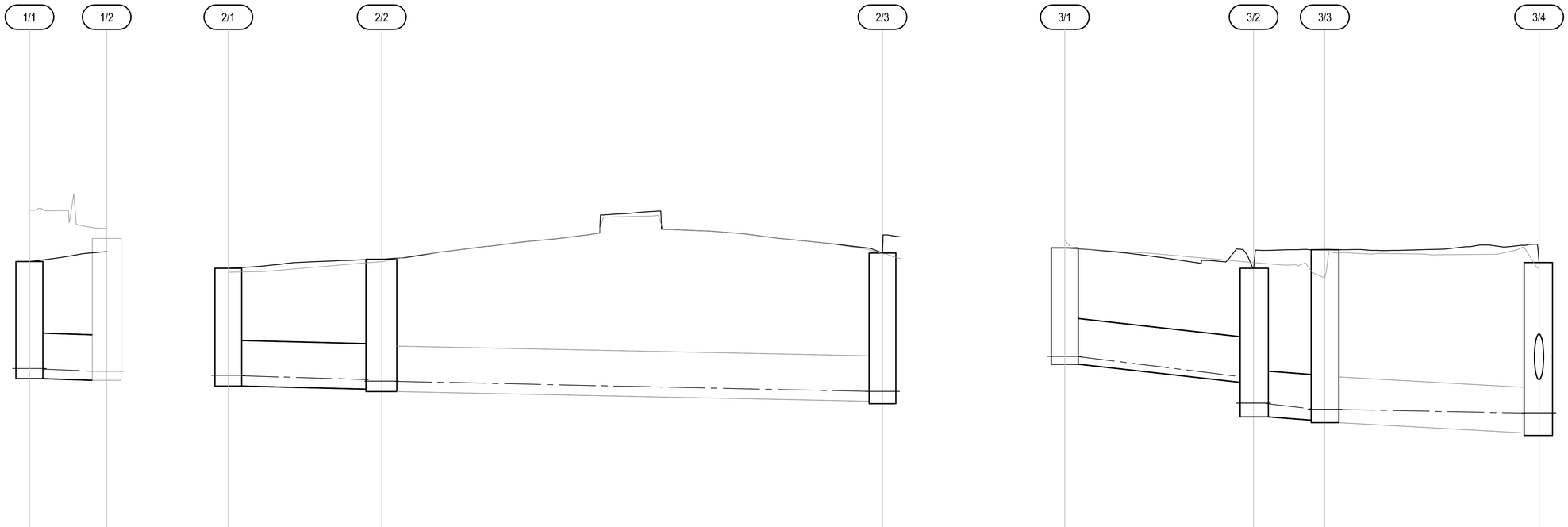
Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title DRAINAGE PIT SCHEDULE

Original Size A1
Drawing No: 22-18812-C563
Rev: 0

Plot Date: 21 May 2018 - 2:58 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C563.dwg



	1/1		1/2
ACTUAL VELOCITY (m/s)		0.64	
CAPACITY VELOCITY (m/s)		1.01	
PIPE FLOW (cu.m/s)		0.011	
PIPE CAPACITY (cu.m/s)		0.111	
PIPE GRADE (%)		0.4%	
PIPE SLOPE (1 IN X)		247.8	
PIPE SIZE (mm)		375	
PIPE CLASS		RCP 4	
DATUM R.L.	144.00		
5YR HYDRAULIC GRADE LINE	147.089 147.086		147.067
DEPTH TO INVERT FROM DESIGN SURFACE	0.965		1.166 1.166
INVERT LEVEL	147.006		146.993 146.993
DESIGN SURFACE LEVEL	147.971		148.159
EXISTING SURFACE LEVEL	148.391		148.243
CHAINAGE	0.000	3.180	3.180

LINE 1

	2/1		2/2		2/3
ACTUAL VELOCITY (m/s)		0.66		0.66	
CAPACITY VELOCITY (m/s)		1.00		0.99	
PIPE FLOW (cu.m/s)		0.012		0.012	
PIPE CAPACITY (cu.m/s)		0.111		0.110	
PIPE GRADE (%)		0.4%		0.4%	
PIPE SLOPE (1 IN X)		250.0		256.3	
PIPE SIZE (mm)		375		375	
PIPE CLASS		RCP 4		RCP 4	
DATUM R.L.	144.00				
5YR HYDRAULIC GRADE LINE	147.035 147.030		146.999 146.987 146.985		146.902 146.899
DEPTH TO INVERT FROM DESIGN SURFACE	0.969		1.069 1.089		1.219 1.239
INVERT LEVEL	146.946		146.920 146.900		146.820 146.800
DESIGN SURFACE LEVEL	147.915		147.989		148.039
EXISTING SURFACE LEVEL	147.882		147.968		148.034
CHAINAGE	0.000	6.313	6.313	20.601	26.915

LINE 2

	3/1		3/2		3/3		3/4
ACTUAL VELOCITY (m/s)		1.01		1.07		1.08	
CAPACITY VELOCITY (m/s)		2.20		1.53		1.56	
PIPE FLOW (cu.m/s)		0.008		0.023		0.023	
PIPE CAPACITY (cu.m/s)		0.243		0.169		0.172	
PIPE GRADE (%)		1.9%		0.9%		1.0%	
PIPE SLOPE (1 IN X)		52.1		107.4		103.7	
PIPE SIZE (mm)		375		375		375	
PIPE CLASS		RCP 4		RCP 4		RCP 4	
DATUM R.L.	144.00						
5YR HYDRAULIC GRADE LINE	147.190 147.188		147.023 146.805 146.800		146.758 146.755 146.753		146.724 146.725 146.703
DEPTH TO INVERT FROM DESIGN SURFACE	0.956		0.938 1.222		1.402 1.422		1.402 1.422
INVERT LEVEL	147.126		146.977 146.692		146.665 146.645		146.560 146.540
DESIGN SURFACE LEVEL	148.082		147.914		148.067		147.962
EXISTING SURFACE LEVEL	148.152		147.963		147.835		147.918
CHAINAGE	-7.543	7.767	0.223	2.932	3.155	8.814	11.969

LINE 3

DRAINAGE LONGITUDINAL SECTIONS

SCALE 1:100H 1:20V

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0	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

0 0.2 0.4 0.6 0.8 1.0m
SCALE 1:20 AT ORIGINAL SIZE

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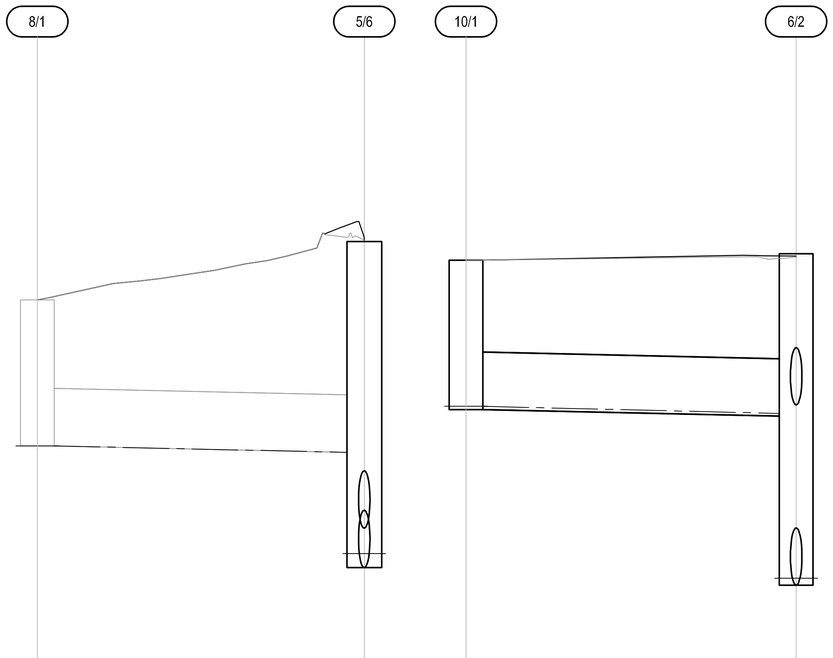
Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **DRAINAGE PROFILES**
SHEET 1 OF 2

Original Size **A1**
Drawing No: 22-18812-C564
Rev: 0

Plot Date: 21 May 2018 - 4:35 PM Plotted by: Nick Hincks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C564.dwg



	LINE 8			LINE 10		
ACTUAL VELOCITY (m/s)	0.00			0.28		
CAPACITY VELOCITY (m/s)	1.00			1.00		
PIPE FLOW (cu.m/s)	0.000			0.001		
PIPE CAPACITY (cu.m/s)	0.111			0.111		
PIPE GRADE (%)	0.4%			0.4%		
PIPE SLOPE (1 IN X)	250.0			250.0		
PIPE SIZE (mm)	375			375		
PIPE CLASS	RCP 4			RCP 4		
DATUM R.L.	144.00			144.00		
5YR HYDRAULIC GRADE LINE	147.210	147.167 146.506	146.503	147.468	147.422 146.345	
DEPTH TO INVERT FROM DESIGN SURFACE	0.953	1.377	2.129	0.976	1.060	2.163
INVERT LEVEL	147.210	147.167	146.415	147.447	147.404	146.300
DESIGN SURFACE LEVEL	148.163		148.544	148.423		148.463
EXISTING SURFACE LEVEL	148.163		148.552	148.420		148.441
CHAINAGE	0.000	10.675	10.675	0.000	10.780	10.780

DRAINAGE LONGITUDINAL SECTIONS

SCALE 1:100H 1:20V

No	Revision	Drawn	Job Manager	Project Director	Date
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SCALE 1:100 AT ORIGINAL SIZE

0 0.2 0.4 0.6 0.8 1.0m
SCALE 1:20 AT ORIGINAL SIZE

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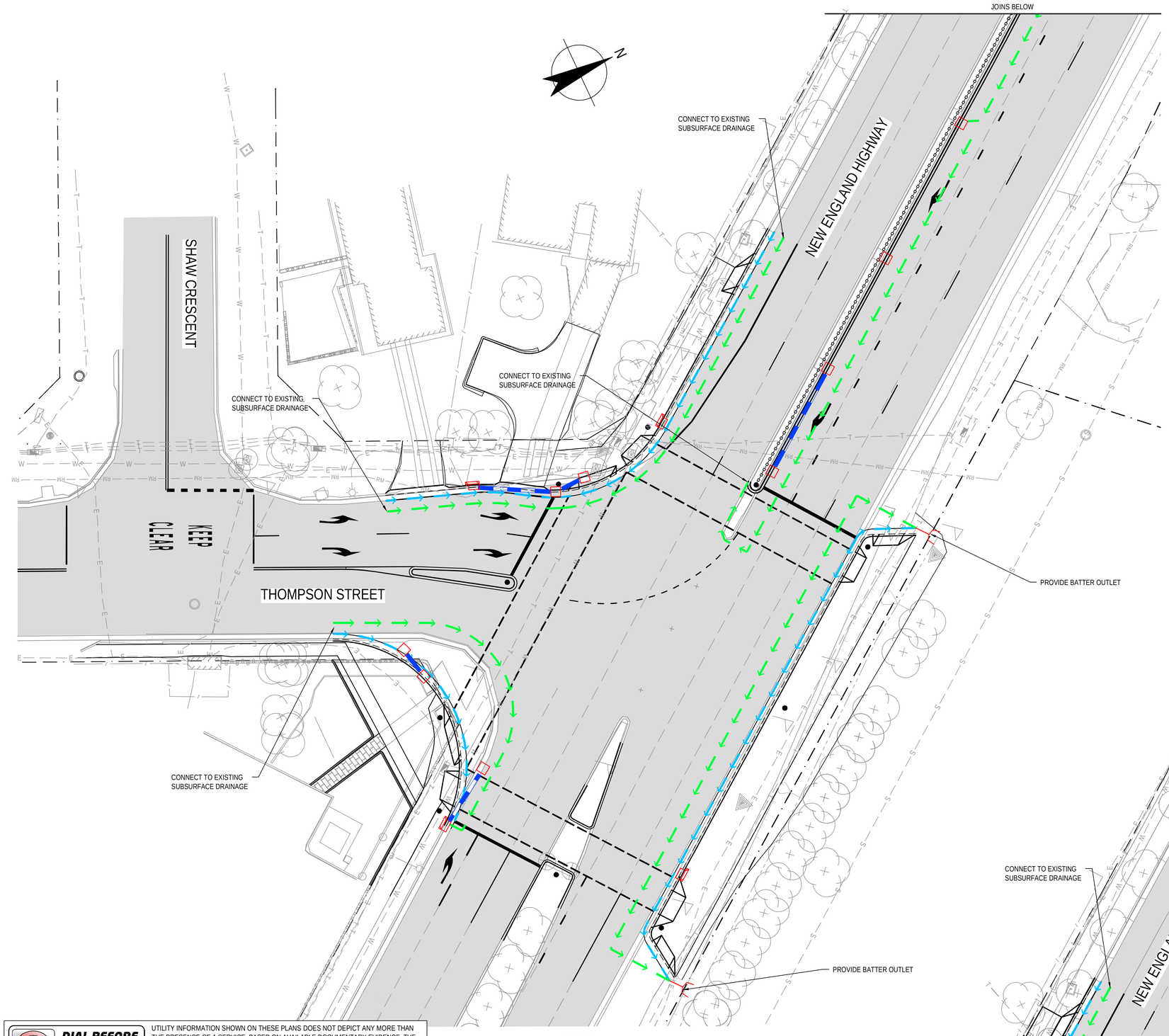
Client MUSWELLBROOK SHIRE COUNCIL
Project THOMPSON STREET INTERSECTION UPGRADE
Title DRAINAGE PROFILES SHEET 2 OF 2

Original Size A1 Drawing No: 22-18812-C565 Rev: 0

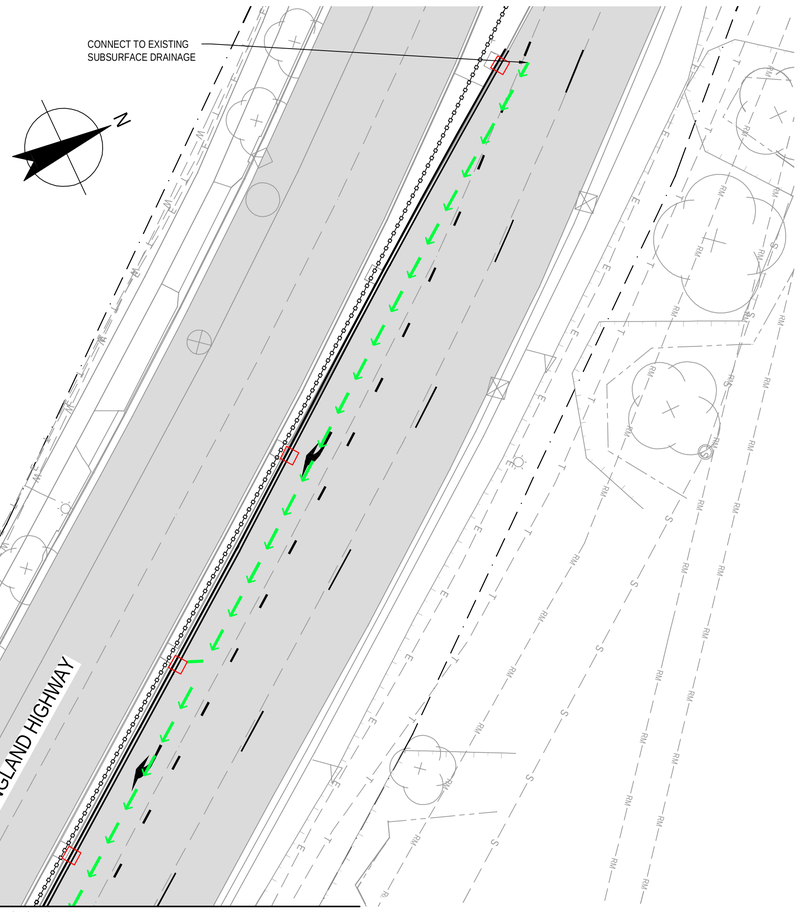
Plot Date: 21 May 2018 - 4:35 PM Plotted by: Nick Hincks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C564.dwg



PLAN
SCALE 1:200

LEGEND

- COMBINED EDGE AND TRENCH DRAIN
- TRENCH DRAIN
- UNSLOTTED PIPE
- PAVEMENT INTERFACE DRAIN
- BATTER OUTLET



PLAN
SCALE 1:200

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0 2 4 6 8 10m
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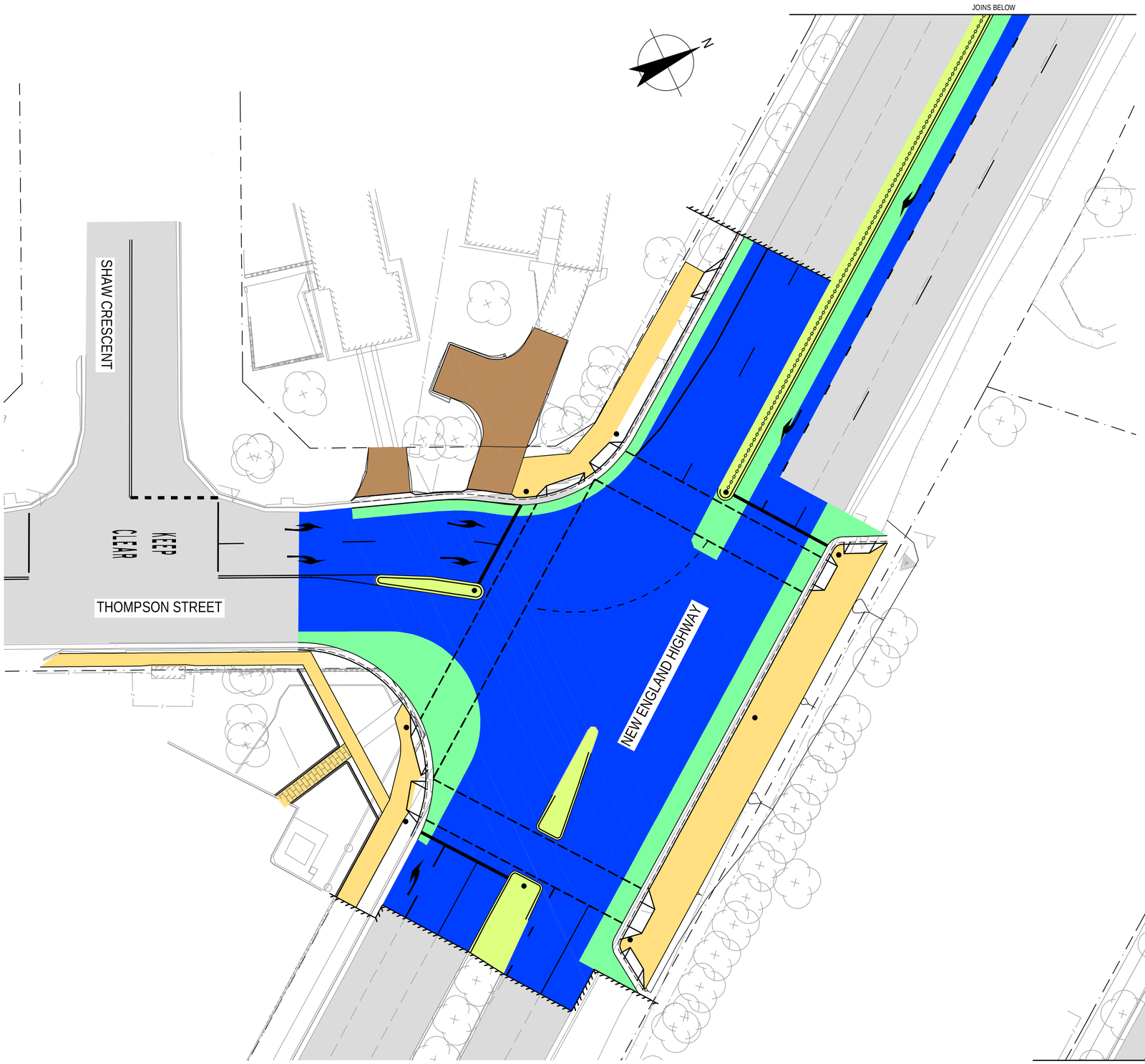
Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **SUBSURFACE DRAINAGE PLAN**

Original Size **A1** Drawing No: **22-18812-C570** Rev: **0**

Plot Date: 21 May 2018 - 2:58 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C570.dwg



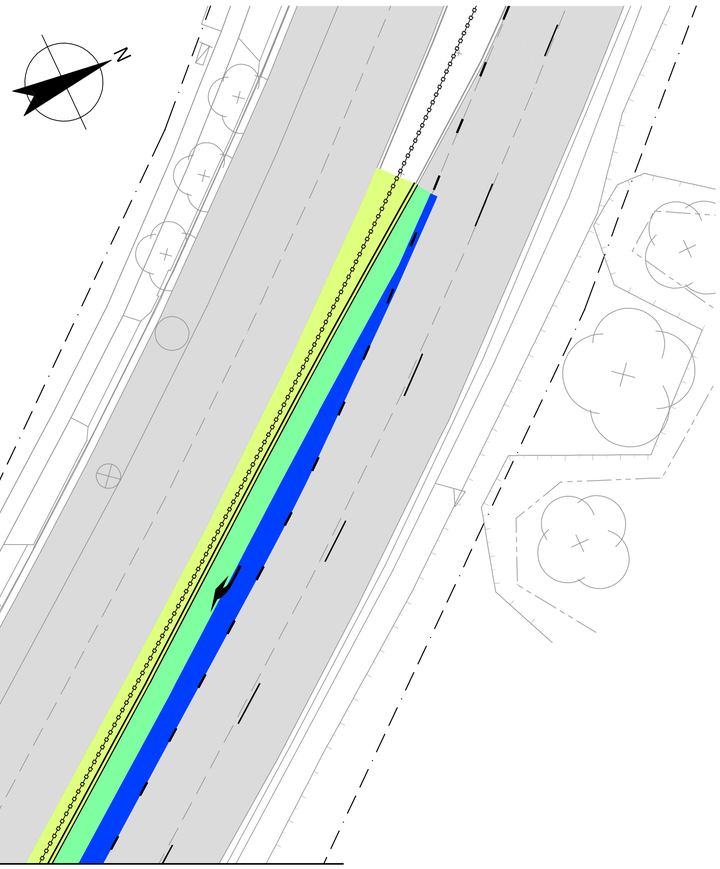
PLAN
SCALE 1:200

LEGEND:

- TYPE 1 - HEAVILY BOUND PAVEMENT WITH AC
- TYPE 4 - MEDIAN
- TYPE 5 - FOOTPATH
- TYPE 6 - DRIVEWAY
- TYPE 7 - MILL AND RESHEET

NOTE:

REFER TO SHEET C515 FOR PAVEMENT DETAILS



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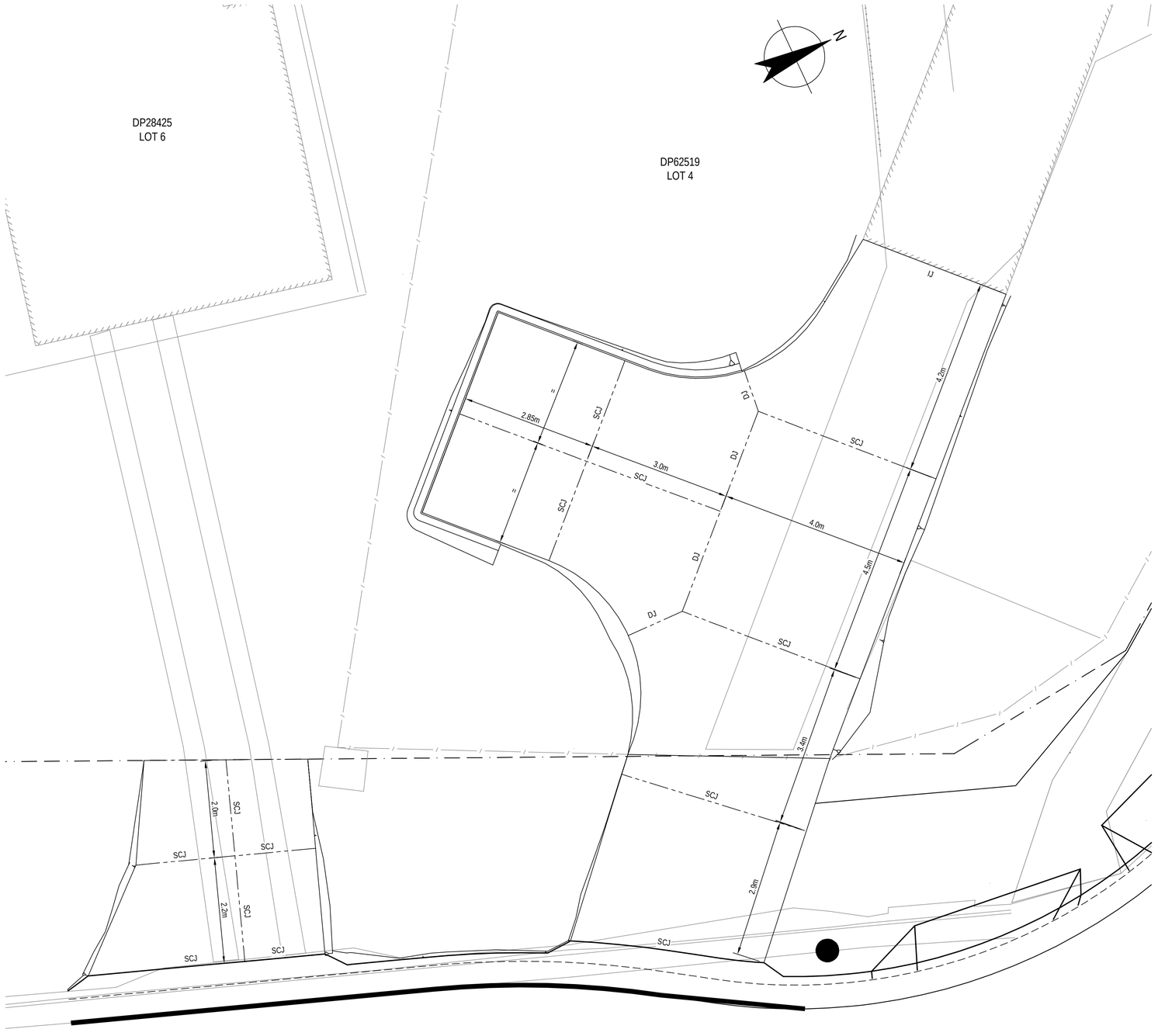
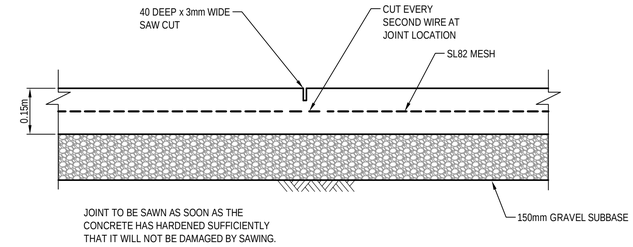
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **PAVEMENT PLAN**

Original Size **A1**
Drawing No: 22-18812-C580 **Rev: 0**

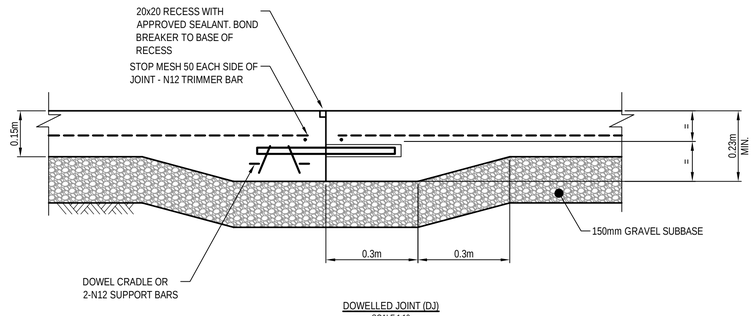
Plot Date: 21 May 2018 - 2:58 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C580.dwg



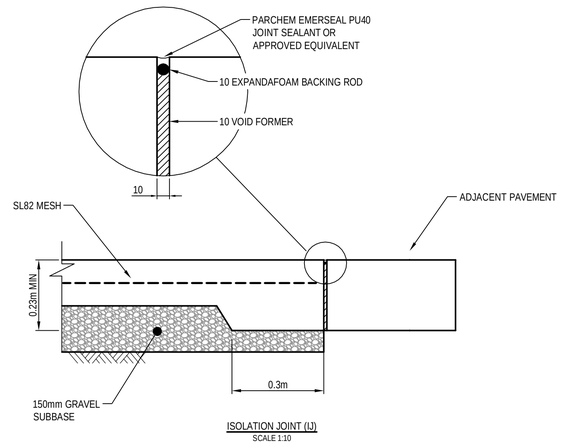
PLAN
SCALE 1:50



SAW CUT JOINT (SCJ)
SCALE 1:10



DOWELLED JOINT (DJ)
SCALE 1:10



ISOLATION JOINT (IJ)
SCALE 1:10

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SCALE 1:50 AT ORIGINAL SIZE

0 0.1 0.2 0.3 0.4 0.5m
SCALE 1:10 AT ORIGINAL SIZE

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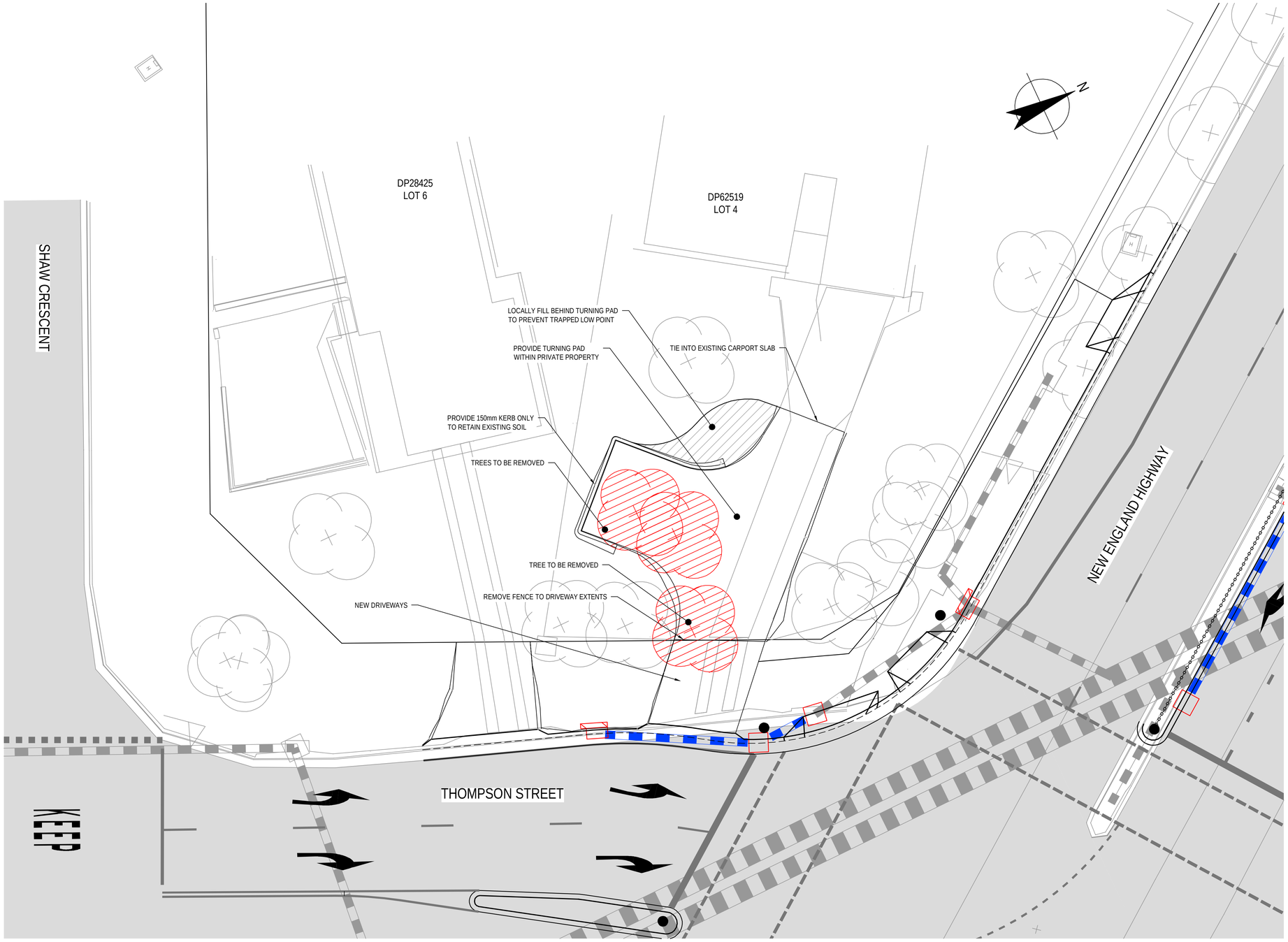
Project THOMPSON STREET INTERSECTION UPGRADE
Title CONCRETE JOINTING DETAILS RESIDENTIAL DRIVEWAYS

Original Size A1
Drawing No: 22-18812-C581
Rev: 0

Plot Date: 21 May 2018 - 2:58 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C581.dwg



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SCALE 1:100

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Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **PROPERTY ADJUSTMENT PLAN**
81 MAITLAND STREET

Original Size **A1**
Drawing No: 22-18812-C585 **Rev: 0**

Plot Date: 21 May 2018 - 2:59 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C585.dwg

PLAN
SCALE 1:200

PLAN
SCALE 1:200

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No	Revision	Drawn	Job Manager	Project Director	Date
0	100% DETAILED DESIGN	RJC	NH*	AS*	21.05.18

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

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Design Check
Approved (Project Director)
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Client **MUSWELLBROOK SHIRE COUNCIL**
Project **THOMPSON STREET INTERSECTION UPGRADE**
Title **SIGNAGE AND LINEMARKING**

Original Size A1
Drawing No: **22-18812-C590**
Rev: 0

Plot Date: 21 May 2018 - 2:59 PM Plotted by: Bec Cocks Cad File No: G:\22\18812\CADD\Drawings\22-18812-C590.dwg

APPENDIX

E

GEOTECHNICAL REPORT

Muswellbrook Shire Council

South Muswellbrook Intersection Design

Geotechnical Report

May 2017

Table of contents

Table index

Appendices

Appendix E – Laboratory Result Sheets

Appendix F – Traffic calculations

Appendix G – Pavement design calculations

1. Introduction

This report presents the results of a geotechnical investigation undertaken by GHD for the proposed intersection upgrades at Thompson Street and Woollybutt Way, Muswellbrook, NSW. The proposed upgrades will comprise a new signalised intersection including pavement widening and turning lanes at the Thompson Street and New England Highway intersection and a new roundabout with associated approach reconstructions and pavement widening at the Woollybutt Way and Rutherford Road intersection.

The purpose of the geotechnical investigation was to obtain geotechnical information to enable the preparation of geotechnical models for use in pavement design.

The report presents the factual results of the subsurface investigation, together with interpretation of the geotechnical conditions at site and discussion and recommendations relating to subgrade preparation and pavement thickness design.

This report should be read in conjunction with the attached general notes in Appendix B.

1.1 Assumptions and limitations

This report has been prepared by GHD for Muswellbrook Shire Council (MSC) and may only be used and relied on by MSC for the purpose agreed between GHD and the MSC as set out in Section 1 of this report.

GHD otherwise disclaims responsibility to any person other than MSC arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

GHD has prepared this report on the basis of information provided by MSC which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on

- Conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.
- Assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.
- Information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of roads, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Site description and regional geology

2.1 Site description

The existing three-way intersections comprise asphaltic sealed surfaces.

The Thompson Street and New England Highway intersection is bounded by residential housing to the west, a McDonalds restaurant and car parking to the south and medium dense trees followed by open grassed areas associated with a golf course to the east. Surface levels gently rise to the west of the New England Highway, with relatively flat land to the east.

The Woollybutt Way and Rutherford Road intersection is located approximately 700 m south of the Thompson Street and New England Highway intersection. The intersection is bound by an Aldi supermarket and car parking to the south, residential housing to the east and car parking and the Upper Hunter Showground to the west and north. Surface levels gently rise to the west.

2.2 Regional geology

Reference to the 1:100,000 scale Hunter Coalfield Regional Geology Map (Geological Series Sheet 9033 and part of 9133, 9032 and 9132) indicates that:

- The Woollybutt Way intersection is underlain by Permian aged Branxton Formation of the Maitland Group, comprising conglomerate, sandstone and siltstone.
- The Thompson Street intersection lies close to the geological contact between Quaternary aged alluvium, comprising silt, sand and gravel and the Permian aged Branxton Formation. The map infers that the Quaternary alluvium is located on the eastern side of the New England Highway, with the Branxton Formation located to the west.

3. Geotechnical investigation methodology

3.1 Preliminaries

A 'Dial-Before-You-Dig' buried services enquiry was made for each of the proposed test locations. To manage the risks of underground services, a qualified services locator was engaged to scan and confirm that the proposed test locations were clear of any services.

A Health, Safety and Environmental (HSE) Plan, including a Job Safety and Environment Analysis (JSEA) was prepared prior to conducting the fieldwork. All project site staff were inducted in to the HSE Plan prior to commencing fieldwork by the GHD supervisor, who also conducted a pre-work safety assessment.

3.2 Fieldwork

The subsurface investigation was carried out on 1 March 2017 and comprised the drilling of five (5) large diameter test pits (TP01 to TP05). Test pits TP01 and TP02 were located on the eastern side of the New England Highway for the proposed Thompson Street and New England Highway intersection upgrade. Test pits TP03, TP04 and TP05 were located on the northern side of Rutherford Road for the Woollybutt Way and Rutherford Road intersection.

The test pit locations are shown on the Geotechnical Test Location Plans presented as Figure 1 and Figure 2 in Appendix A.

Test pits were drilled using a 5 tonne excavator with a 450 mm diameter solid flight auger attachment. The test pits were extended to depths between 1.8 m and 1.95 m.

Dynamic Cone Penetrometer (DCP) tests (DCP01 to DCP05) were undertaken at each test location, to provide an assessment of the relative soil 'strength' and correlation with geotechnical parameters. The DCP tests were conducted to a maximum depth of 1.8 m or prior refusal.

The subsurface investigation was carried out under the full-time supervision of an experienced Geotechnical Engineer who was responsible for locating the test pits, logging the encountered subsurface conditions, conducting in-situ testing and collecting suitable representative samples for laboratory testing. The logging was generally carried out in accordance with Australian Standard, AS1726-1993. Disturbed samples of representative materials were recovered for subsequent laboratory testing.

Upon completion, the excavated spoil was returned to the excavation and compacted using the weight of the excavator.

The test locations were determined with reference to site features. Hand held GPS coordinates (typically accurate to +/-10 m) in MGA format were recorded at each test location. The test location coordinates are presented on the test pit logs provided in Appendix C and DCP report sheets are provided in Appendix D. The logs should be read in conjunction with the attached Standard Sheets included in Appendix B, which explain the terms, abbreviations and symbols used together with the interpretations and limitations of the logging procedure.

3.3 Laboratory testing

Geotechnical soil samples recovered from the site were transported to GHD's NATA accredited laboratory for testing. The following laboratory tests were undertaken:

- Five (5) moisture content tests.
- Four (4) Atterberg limit tests.
- Three (3) California Bearing Ratio (CBR) and standard compaction tests (10 day soak).

4. Subsurface conditions

4.1 Subsurface profile

Generalised descriptions of the subsurface conditions at each intersection are provided below. Reference to the test pit logs (Appendix C) should be made for a full description of the subsurface conditions encountered at each test location. Test procedures, classification methods and descriptive terms are discussed in the Standard Sheets in Appendix B.

4.1.1 Thompson Street and New England Highway intersection

In general terms, the subsurface conditions encountered at the Thompson Street and New England Highway intersection comprised alluvial soils consisting predominantly high plasticity clay of hard consistency. Low plasticity alluvial silt and low and medium plasticity sandy clay and clay fill were encountered at shallow depths less than 0.3 m.

While not encountered in the test pits (undertaken on the eastern side of the New England Highway), residual soils are expected to be encountered on the Thompson Street (western) side of the intersection.

4.1.2 Woollybutt Way and Rutherford Road intersection

In general terms, the subsurface conditions encountered at the Woollybutt Way and Rutherford Road intersection comprised well compacted fill materials to depths between 0.45 m and 0.95 m, overlying predominantly hard residual soils.

Fill material comprised low plasticity sandy clay, with the exception of a layer of clayey sand underlying a thin layer of spray sealed bitumen in TP05.

Residual soils typically comprised medium to high plasticity clay. Exceptions to the medium to high plasticity clay were encountered in TP05, with low plasticity sandy clay from 0.45 to 0.9 m and dense clayey sand from 1.5 to 1.8 m.

4.2 Groundwater

Groundwater was not encountered in any of the test pits, with soil profiles typically recording a slightly moist to moist moisture condition.

5. Laboratory test results

The geotechnical laboratory results are summarised in the following tables, whilst with the laboratory test report sheets presented in Appendix E.

Table 5-1 Atterberg limit test results

Sample Location	Sample Depth (m)	Material	Atterberg limits			
			MC (%)	LL (%)	PL (%)	PI (%)
TP01	0.2-0.5	Clay (alluvium)	15.9	48	18	30
TP02	0.4-0.6	Clay (alluvium)	18.8	53	18	35
TP04	0.6-0.9	Clay (residual)	12.2	39	15	24
TP05	0.5-0.7	Sandy Clay (residual)	9.9	23	15	8

Where: MC = Field moisture content LL = Liquid limit
PL = Plastic limit PI = Plasticity limit

The results of the Atterberg limit tests confirmed the logging of:

- Alluvial clay as medium to high plasticity, with a moisture content close to the liquid limit (i.e. moist).
- Residual clay as medium plasticity and sandy clay as low plasticity, with a moisture content less than the plastic limit (i.e. slightly moist).

Table 5-2 Standard compaction and Californian Bearing Ratio test results

Sample Location	Sample Depth (m)	Material	MC (%)	MDD (t/m^3)	OMC (%)	CBR (%)
TP01	0.2-0.5	Clay (alluvium)	15.9	1.59	22.0	2.5
TP03	1.0-1.3	Clay (residual)	21.2	1.52	24.2	2.5
TP04	0.6-0.9	Clay (residual)	12.2	1.69	17.3	3.0

Where: MC = Field moisture content MDD = Maximum dry density
OMC = Optimum moisture content CBR = Californian Bearing Ratio

The results of the standard compaction tests indicate that the tested materials possessed moisture contents between 12% and 30% dry of the optimum moisture content. CBR values were in the range of 2.5% to 3.0% for tested materials.

6. Discussion and recommendations

6.1 Subgrade CBR

The natural subgrade encountered across the two sites comprised clay with CBR results in the order of 2.5 to 3%. Therefore, a subgrade CBR of 2.5% was adopted for pavement design.

6.2 Pavement design

6.2.1 Design traffic

Traffic input parameters

The traffic data used for the pavement design was based on the recommendation of the GHD Traffic Team as per the am/pm peak hour traffic observed for the project.

The Average Annual Daily Traffic (AADT) and Heavy Vehicle (HV) percentage recommended is as per Table 6-1. The AADT and HV% of New England Highway north of Thompson Street was adopted for the pavement design traffic calculation of Thompson Street & New England Highway Intersection and widening at New England Highway. The AADT and HV% of Rutherford Street west of Woollybutt Way was adopted for the pavement design traffic calculation of roundabout and approaches to roundabout.

Table 6-1 Recommended AADT and HV%

Road	AADT (both directions)	HV%
New England Highway north of Thompson Street	30196	5
New England Highway south of Thompson Street	23198	6
Thompson Street west of New England Highway	9957	1
Rutherford Street west of Woollybutt Way	9624	3
Rutherford Street east of Woollybutt Way	13206	2
Woollybutt Way south of Rutherford Street	1289	2
Woollybutt Way north of Rutherford Street	5349	0

Traffic Load Distribution (TLD) and Standard Axle Repetitions per Equivalent Standard Axle (SAR/ESA) factors have been adopted based on the values recommended in the Austroads Pavement Design Guide (Austroads, 2012) for the New England Highway at Branxton. The traffic parameters adopted are summarised in Table 6-2 and Table 6-3. The design life of 40 yeasr is adopted for the New England Highway as the pavement qualifies as the heavy duty pavement based on design traffic analysis as per RMS Pavement Design Supplement (RMS, 2015a). The design life of 40 years has been adopted for the concrete roundabout pavement design and a design life of 25 years has been adopted for the flexible approaches pavement design as per the Council Design Specifications (Muswellbrook Shire Council, 2013).

Table 6-2 Design Traffic for the Thompson Street & New England Highway intersection

Traffic parameters	Value
Design life	40 years
Annual growth rate (%)	1
AADT in opening year - 2017 (both direction)	30196
Direction factor	0.5
Lane distribution factor	1.0
Heavy vehicle (%)	5
Average number of HV axle groups (NHVAG)	2.82
ESA/HVAG	0.982
SAR5/ESA (Asphalt fatigue)	1.22
SAR7/ESA (Subgrade damage)	2.02
SAR12/ESA (Cemented fatigue)	10.4

Table 6-3 Design Traffic for the Woollybutt Way & Rutherford Road intersection and approaches

Traffic parameters	Value
Design life	25 years (flexible pavement approaches) 40 years (rigid pavement roundabout)
Annual growth rate (%)	1
AADT in opening year - 2017 (both direction)	9624
Direction factor	0.5
Lane distribution factor	1.0
Heavy vehicle (%)	3
Average number of HV axle groups (NHVAG)	2.82
ESA/HVAG	0.982
SAR5/ESA (Asphalt fatigue)	1.22
SAR7/ESA (Subgrade rutting)	2.02

An annual growth rate of 1% has been adopted for the traffic as per the recommendations from the GHD Traffic Team. The year of the new pavement opening to traffic is assumed to be 2017.

Pavement design traffic

The Design Equivalent Standard Axle loadings (DESA) adopted for the pavement design of the Thompson Street & New England Highway intersection and New England Highway widening over a 40-year design period is 38 million ESAs.

The DESA adopted for the pavement design of the Woollybutt Way & Rutherford Road roundabout approaches over a 25-year design period is 4.2 million ESAs.

The design traffic adopted for the pavement design of the roundabout at the intersection of Woollybutt Way & Rutherford Road over a 40-year design period is 7.3 million Cumulative HVAG.

The pavement design traffic calculations are included in Appendix F of this report.

6.2.2 New pavement design

A mechanistic-empirical flexible pavement design was carried out in accordance with the Austroads Guide to Pavement Technology (Austroads, 2012), the RMS Pavement Design Supplement (RMS, 2015a) and (Muswellbrook Shire Council, 2012a). CIRCLY was used to determine the Cumulative Damage Factor (CDF) for each of the critical pavement layers in the flexible pavement configurations.

The design philosophy adopted for the flexible pavement options was aimed at reducing the horizontal tensile strain at the bottom of the asphalt base and cemented subbase layers, as well as the vertical compressive strain at the top of the subgrade materials. As such, the following failure criteria apply to the flexible pavement options:

- Fatigue cracking at the bottom of the asphalt layers.
- Fatigue cracking at the bottom of the cement stabilised layers.
- Rutting at the top of the subgrade layers.

The design philosophy adopted for the rigid pavement was aimed at reducing the flexural fatigue cracking of the concrete pavement base.

Pavement design input parameters

The input parameters used for the pavement design are summarised in Table 6-4 below. The heavy vehicle design speed for calculation of asphalt design modulus is adopted 50 km/h.

Table 6-4 Pavement Design Input Parameters

Input parameters	Value
Applied load	80 kN Standard axle (750 kPa tyre pressure)
AC14 (A15E) asphalt stiffness	2800 MPa (50 km/h heavy vehicle speed)
AC20 (AR450) asphalt stiffness	3900 MPa (50 km/h heavy vehicle speed)
Slow setting heavily bound subbase stiffness	5000 MPa (pre-cracked phase)
Steel fibre concrete pavement (SFCP) base 28 day flexural strength	5.5 MPa
DGB20 (HD) granular base	500 MPa
DGS20 granular subbase	250 MPa
Select material zone (SMZ) stiffness (CBR 30%)	150 MPa (sub-layered)
Lower Upper Zone of Formation (Lower UZF) (CBR 8%)	80 MPa (sub-layered)
Subgrade stiffness	25 MPa (CBR 2.5%)
Project reliability	95%
Damage and fatigue relationships	As per Austroads Guide to Pavement Technology (Austroads, 2012)

Thompson Street & New England Highway intersection

The pavement design undertaken for the New England Highway intersection is outlined below. The pavement design calculations are included in Appendix G.

The pavement incorporates a 300 mm slow setting heavily bound cement treated subbase layer (5000 MPa) as support to the asphalt base. The construction of this layer shall be in accordance to R73 H (RMS, 2015b). The asphalt layers shall be constructed in accordance to the RMS Specification R116 (RMS, 2013a) and Muswellbrook Shire Council specifications 1144 (Muswellbrook Shire Council, 2012). The SMZ, Lower UZF and subgrade needs to be constructed in in accordance to the RMS Specification R44 (RMS, 2014). The recommended pavement structure is therefore as follows:

- 45 mm AC14 (A15E) Wearing Course
- 65 mm AC20 (AR450) Base Layer
- 7 mm Low cutter seal (C170 Binder)
- 300 mm Slow Setting Heavily bound Cement Treated Subbase (CTSB)
- 7 mm primer seal (C170 binder)
- 300 mm SMZ (CBR 30%)
- 300 mm Lower UZF (CBR 8%)
- Subgrade CBR 2.5% (minimum)

Only the pre-cracked phase of the cemented subbase layer was considered in the pavement design calculations. While the RMS pavement design supplement (RMS, 2015a) states that a minimum 175 mm of cover is required over the heavily bound subbase, this minimum cover has been reduced to 105 mm for the Hunter Valley Region as per the recommendation from RMS on a similar project (Scone Bypass, New England Highway).

A 10 mm construction tolerance has been added to the critical layer, which in this case is the CTSB.

The SMZ, Lower UZF and subgrade shall be constructed in accordance with the RMS Specification R44 (RMS, 2014).

Woollybutt Way & Rutherford Road roundabout

The pavement design undertaken for the Woollybutt Way and Rutherford Road roundabout is outlined below. The pavement design calculations are included in Appendix G.

The SFCP concrete base shall be constructed in accordance to the RMS Specification R83 (RMS, 2013c), and the Lean Concrete Subbase (LCS) is to be constructed in accordance with the RMS Specification R82 (RMS, 2010). The SMZ and subgrade shall to be constructed in accordance with the RMS Specification R44 (RMS, 2014).

The recommended pavement structure is therefore as follows:

- 210 mm SFCP Concrete Base
- 2 coat wax emulsion curing & bonding treatment
- 150 mm Lean Concrete Subbase (LCS)
- 7 mm primer seal (C170 binder)
- 300 mm SMZ (CBR 30%)
- Subgrade CBR 2.5% (minimum)

A 10 mm construction tolerance has been included for the critical layer, which in this case is the SFCP base.

Woollybutt Way & Rutherford Road roundabout approaches

The approaches to the roundabout have been designed as flexible granular pavements with an asphalt wearing course. The pavement has been designed with the mechanistic-empirical method and checked against the empirical method, in accordance with Austroads Guide to Pavement Technology Part 2 (Austroads, 2012).

The asphalt wearing course has a fatigue life of about 6 years, however asphalt fatigue was not considered the governing factor for the flexible granular pavement design. It is assumed that the asphalt wearing course will be replaced based on the functional requirements during the course of the pavement life.

The proposed pavement structure is as follows:

- 45 mm AC14 (A15E) wearing course
- 7 mm Low cutter seal (C170 Binder)
- 180 mm DGB20 (HD) base layer
- 200 mm DGS20 subbase layer
- 7 mm primer seal (C170 binder) (if required)
- 300 mm SMZ (CBR 30%)
- Subgrade CBR 2.5% (minimum)

The asphalt layers shall be constructed in accordance with the RMS Specification R116 (RMS, 2013a) and Muswellbrook Shire Council specifications 1144 (Muswellbrook Shire Council, 2012). The granular base and subbase shall be constructed in accordance with the RMS Specification R71 (RMS, 2013b). The SMZ and subgrade shall be constructed in accordance with the RMS Specification R44 (RMS, 2014).

A 10 mm construction tolerance has been included for the critical layer, which in this case is the DGB20 (HD) base.

6.2.3 Pavement design assumptions

The following key assumptions were made for the development of the pavement designs:

- The pavement designs were based on the procedures described in the Roads and Maritime Austroads Guide Supplement – Pavements and Geotechnical Section (RMS, 2015a), Austroads Guide to Pavement Technology Part 2 (Austroads, 2012) and Muswellbrook Shire Council specifications (Muswellbrook Shire Council, 2012a).
- The fatigue life of asphalt wearing course is not considered for the design of the Approaches to Roundabout at the Rutherford Road and Woollybutt Way.
- The subgrade conditions adopted for the pavement design were based on the recommendations by the GHD geotechnical team as per the geotechnical testing carried out for the project.
- The Annual Average Daily Traffic (AADT) adopted for the pavement design is based on the recommendations by the GHD traffic team as per the am/pm peak hour traffic observed for the project.

- The traffic load distribution and traffic multiplier factors adopted for the pavement design were of the New England Highway at Branxton as per the Austroads Pavement Design Guide (Austroads, 2012).
- The recommendations in this Report assume that the pavements will be constructed in accordance with RMS and Muswellbrook Shire Council specifications and procedures.
- The future performance of the recommended pavement configurations will largely depend on timely and appropriate maintenance/rehabilitation being carried out that is typically required for each pavement type.

6.1 Site preparation

Prior to construction of the intersections, the site area should to be stripped to remove all uncontrolled fill, vegetation, topsoil and root affected or other potentially deleterious material. Material should be stockpiled for landscaping or other approved purposes. Based on the subsurface investigation, existing fill material was generally found to be between 0.1 m and 0.35 m thick.

Following stripping and boxing, the subgrade should be test rolled using a minimum 10 T static drum roller under the direction of an experienced geotechnical engineer or geo-technician, to identify the presence of any soft or compressible zones.

Where proof rolling reveals areas of poor subgrade conditions, such areas should be over-excavated, and replaced with granular select material with CBR of 15% or greater, and compacted to 100% Standard Compaction (AS1289 5.1.1-2003).

Exposed subgrade and foundation soils should be protected from damage caused by wetting and drying and by traffic loading.

Adequate surface and subsurface drainage should be provided as appropriate to prevent moisture ingress into new pavement layers. Adequate cross falls should be provided within subgrade, subbase, basecourse and wearing course layers to ensure that water does not become trapped within the pavement layers.

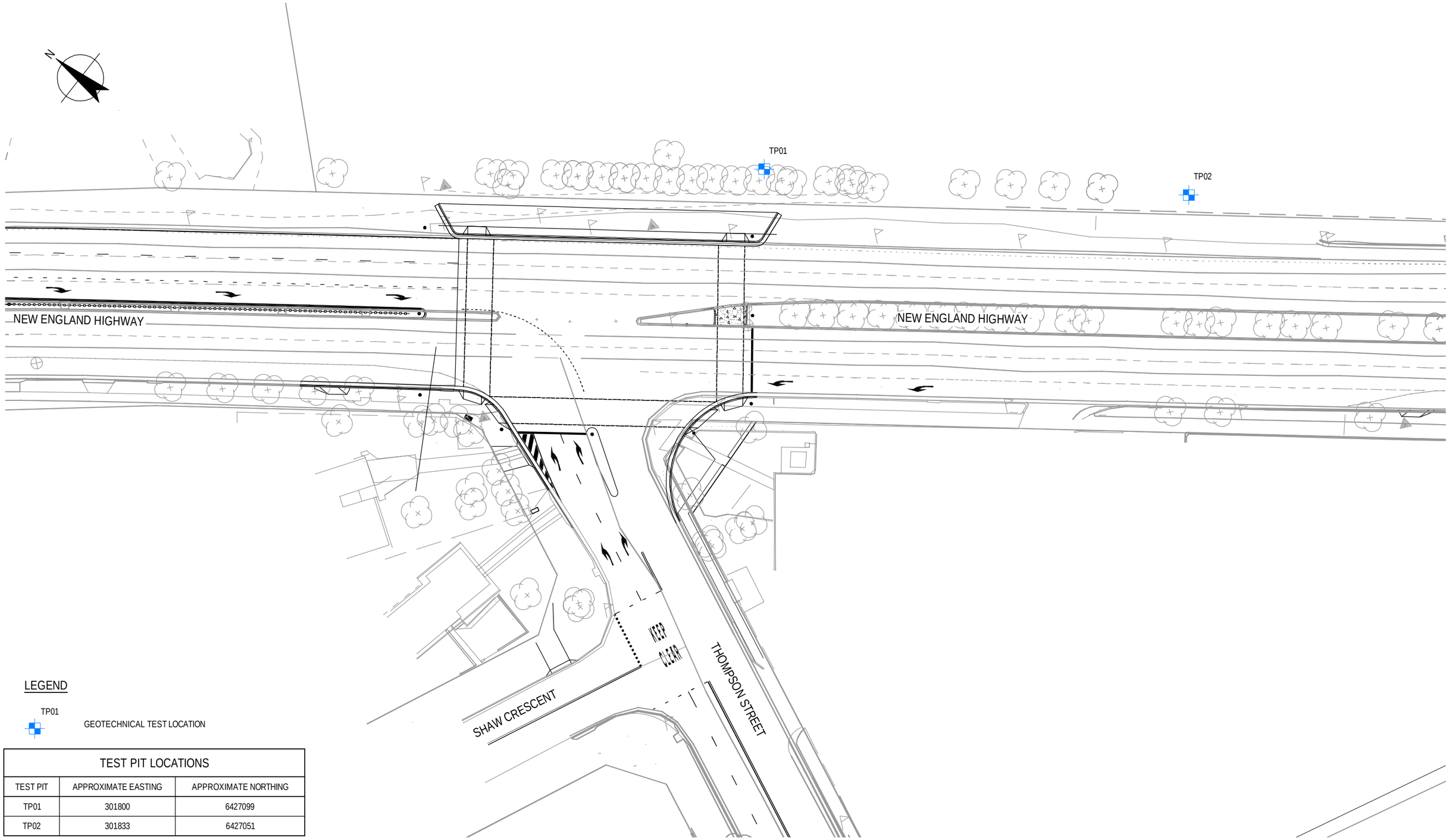
7. References

The following design references were used for the new pavement designs:

- Austroads Guide to Pavement Technology, Part 2: Pavement Structural Design (Austroads, 2012).
- Roads and Maritime Supplement to Austroads Guide to Pavement Technology Part 2: Pavement Structural Design, Publication No: 11.050 (RMS, 2015a).
- Muswellbrook Shire Council, Development Design Specification, AUS-SPEC (Cot 09), 0042 Pavement Design, Rev 2 (Muswellbrook Shire Council, 2012a).
- Muswellbrook Shire Council, Construction Specification, AUS-SPEC (Cot 09), 1144 Asphaltic Concrete (Roadways), Version 01 (Muswellbrook Shire Council, 2013).
- Muswellbrook Shire Council, Construction Specification, AUS-SPEC (Cot 09), 1112 Earthworks (Roadways), Version 01 (Muswellbrook Shire Council, 2012b).
- Roads and Maritime Services, Specification R73H, Construction of Plant Mixed Heavily Bound Pavement Course (RMS, 2015b).
- Roads and Maritime Services, QA Specification R116, Heavy Duty Dense Graded Asphalt (RMS, 2013a).
- Roads and Maritime Services, QA Specification R44, Earthworks (RMS, 2014).
- Roads and Maritime Services, QA Specification R71, Construction of Unbound and Modified Pavement Course (RMS, 2013b).
- Roads and Maritime Services, QA Specification R82, Lean Mix Concrete Subbase (RMS, 2010).
- Roads and Maritime Services, QA Specification R83, Concrete Pavement Base (RMS, 2013c).

Appendices

Appendix A – Figures



LEGEND

TP01 GEOTECHNICAL TEST LOCATION

TEST PIT LOCATIONS		
TEST PIT	APPROXIMATE EASTING	APPROXIMATE NORTHING
TP01	301800	6427099
TP02	301833	6427051

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE

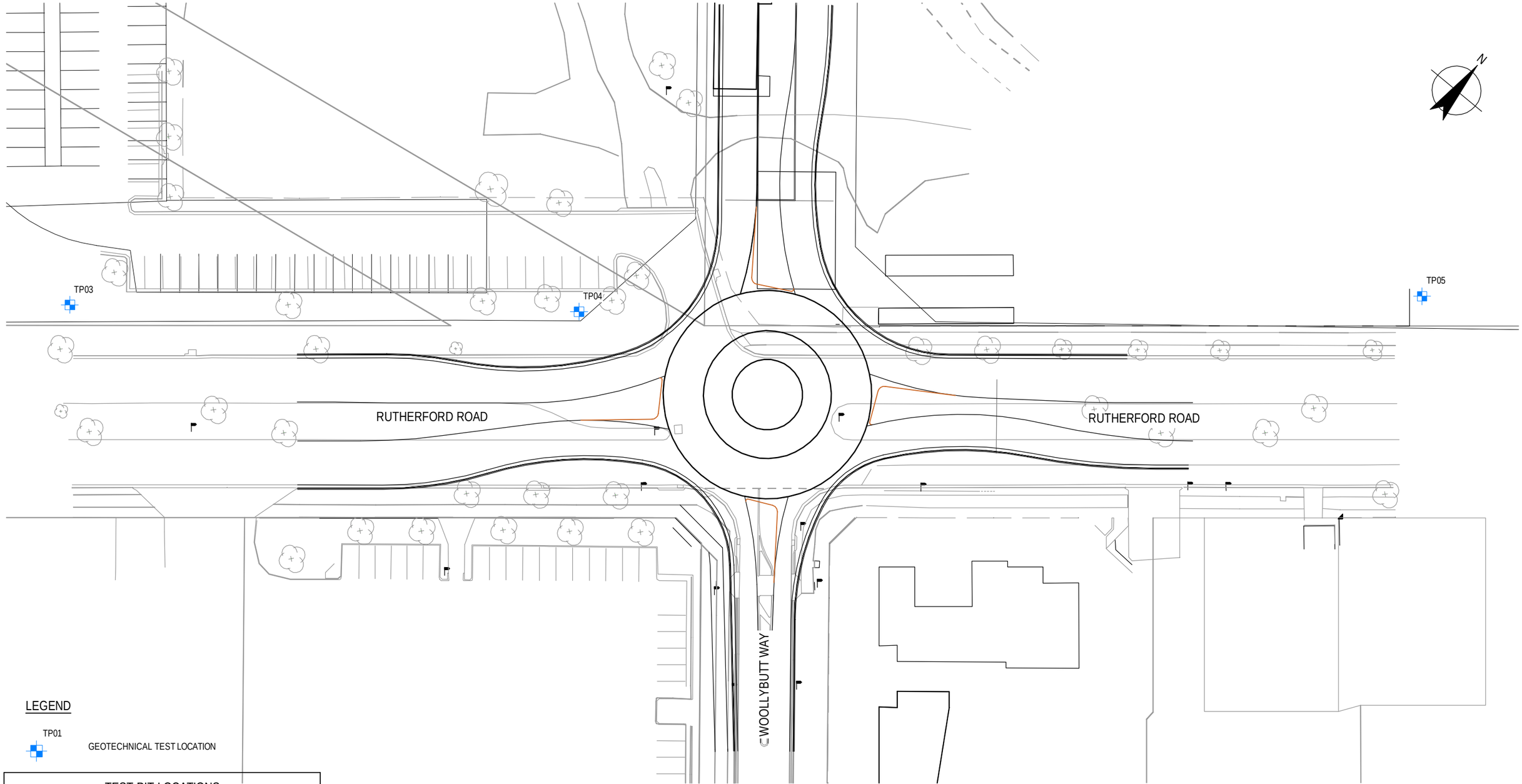
MUSWELLBROOK SHIRE COUNCIL
THOMPSON STREET
INTERSECTION UPGRADE
GEOTECHNICAL TEST LOCATION PLAN

Job Number 22-18812
Revision A
Date MAY 2017

Figure 01

Levels 2 & 3 GHD Tower, 24 Honeysuckle Drive Newcastle NSW 2300 Australia **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com

Plot Date: 15 May 2017 - 11:33 AM Plotted by: Blake Drew Cad File No: G:\22\18812\CADD\Drawings\SKETCHES\22-18812-FIG1.dwg



LEGEND

TP01 GEOTECHNICAL TEST LOCATION

TEST PIT LOCATIONS		
TEST PIT	APPROXIMATE EASTING	APPROXIMATE NORTHING
TP03	301870	6426412
TP04	301932	6426462
TP05	302032	6426548

0 6 12 18m

SCALE 1:600 AT ORIGINAL SIZE

MUSWELLBROOK SHIRE COUNCIL
WOOLLYBUTT WAY
INTERSECTION UPGRADE
GEOTECHNICAL TEST LOCATION PLAN

Job Number 22-18812
Revision A
Date MAY 2017

Figure 02

Levels 2 & 3 GHD Tower, 24 Honeysuckle Drive Newcastle NSW 2300 Australia **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com

Plot Date: 15 May 2017 - 12:26 PM Plotted by: Blake Drew Cad File No: G:\22\18812\CADD\Drawings\SKETCHES\22-18812-FIG2.dwg

Appendix B – Standard Sheets and General Notes

GENERAL NOTES

GHD GEOTECHNICS
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The report contains the results of a geotechnical investigation or study conducted for a specific purpose and client. The results may not be used or relied on by other parties, or used for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the report are excluded unless they are expressly stated to apply in the report.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Moreover, the location of test holes should be considered approximate, unless noted otherwise (refer report). Reference should also be made to the relevant standard sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

GROUNDWATER

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeabilities (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data, often with only approximate locations (e.g. GPS). Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in the generalised ground conditions do occur in the natural environment, particularly between discrete test hole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to this firm for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system and/or to conduct monitoring as a result of this natural variability. Allowance for verification by appropriate geotechnical personnel must be recognised and programmed for construction.

FOUNDATIONS

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, caissons, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions must include at least all of the relevant test hole and test data, together with the appropriate Standard Description sheets and remarks made in the written report of a factual or descriptive nature.

Ref: DS5.5.1 Issue 1.7 Date: 25/06/2012

SOIL DESCRIPTION

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This procedure involves the description of a soil in terms of its visual and tactile properties, and relates to both laboratory samples and field exposures as applicable. A detailed soil profile description, in association with local geology and experience, will facilitate the initial (and often complete) site assessment for engineering purposes.

The method involves an evaluation of each of the items listed below and is in general agreement with both Australian Standard AS 1726 (the Site Investigation Code) and ASTM D2487 and D2488.

MOISTURE

The moisture condition of the soil is most applicable for cohesive soils as a precursor to the assessment of consistency and workability. The moisture condition is described as:-

Dry (dusty, dry to the touch) ***Slightly Moist*** ***Moist*** (damp, no visible water) ***Very Moist*** or ***Wet*** (visible free water, saturated condition)

In addition, the presence of any seepage or free water is noted on the testhole logs.

COLOUR

Colour is important for correlation of data between testholes and during subsequent excavation operations. The prominent colour is noted, followed by (spotted, mottled, streaked etc.) then secondary colours as applicable. Colour is usually described at as-received moisture condition, though both wet and dry colours may also be appropriate.

CONSISTENCY / DENSITY INDEX

This assessment is based on the effort required to penetrate and/or mould the soil, and is an indicator of shear strength.

Granular soils are generally described in terms of density index as listed in AS 1726. These soils are inherently difficult to assess and normally a penetration test procedure (SPT, DCP or CPT) is used in conjunction with published correlations. Alternatively, in-situ density tests can be conducted in association with minimum and maximum densities performed in the laboratory.

Term	Symbol	Density Index (%)
Very Loose	VL	< 15
Loose	L	15 - 35
Medium Dense	MD	35 - 65
Dense	D	65 - 85
Very Dense	VD	>85

Cohesive soils can be assessed by direct measurement (shear vane, CPT etc), or estimated approximately by tactile means and/or the aid of a geological pick as given on the following table. It is emphasised that a "design shear strength" must take cognisance of the mode of testing and the in-situ moisture content with the possible variations of moisture with time.

Term	Symbol	Tactile Properties	Undrained Strength S_u (kPa)
Very Soft	VS	Extrudes between fingers when squeezed in hand	<12
Soft	S	Easily penetrated by thumb about 30-40 mm. Pick head can be pushed in up to shaft.	12-25
Firm	F	Penetrated by thumb 20-30mm with moderate effort. Sharp end of pick pushed in 30-40mm.	25-50
Stiff	St	Indented by thumb about 5mm with moderate effort. Pick pushed in up to 10mm.	50-100
Very Stiff	VSt	Readily indented by thumb nail. Slight indentation produced by pushing pick into soil.	100-200
Hard	H	Difficult to indent with thumb nail. Requires power tools for excavation.	>200

STRUCTURE/OTHER FEATURES

The soil structure is generally applicable to cohesive soils and mainly refers to the presence or absence of joints and layering. Typical terms use are intact (no joints), fissured (closed joints), shattered (open joints), slickensided (polished joints indicative of movement), and stratified/laminated. In addition, the presence of other features (ferricrete nodules, timber inclusions) should also be noted as applicable.

For granular soils, an assessment of grading (well, uniform or poor), particle size (fine, medium etc.) and angularity and shape may also be given.

SOIL TYPE

The soil is described in terms of its estimated grain size composition and the tactile behaviour (plasticity of any fines (less than *0.06 mm)). This system does not differentiate on grading below 0.06 mm, in accordance with the Unified Soil Classification (USC) procedure.

However, in some situations a soil can exhibit different characteristics between the undisturbed and disturbed/remolded condition (eg. 'sand' sized particles which break down a clay). The Soil Type generally relates to the latter state but the former condition should be noted where applicable.

Furthermore, as most natural soils frequently are combinations of various constituents, the primary soil is described and modifed by minor components. In brief, the system is as follows:-

Coarse Grained Soils		Fine Grained Soils	
% Fines	Modifier	% Coarse	Modifier
<5	omit, or use "trace"	<15	omit, or use "trace"
5-12	describe as "with clay/silt" as applicable	15-30	described as "with sand/gravel" as applicable
>12	prefix soil as "silty/clayey" as applicable	>30	prefix soil as "sandy/gravelly" as applicable

(*The 200# sieve (0.075 mm) is commonly used in practice to differentiate between fine and coarse grained soils).

Note: For soils containing both sand and gravel the minor coarse fraction is omitted if less than 15%, or described as "with sand/gravel" as applicable when greater than 15%.

The appropriate USC symbol may also be given after the soil type description in accordance with ASTM D2487 and D2488.

ORIGIN

An attempt is made, where possible, to assess origin (transported, residual, pedogenic, or fill etc.) since this assists in the judgement of probable engineering behaviour. This assessment is generally restricted to field logging activities. An interpretation of landform is a useful guide to the origin of transported soils (e.g. colluvium, talus, slide debris, slope wash, alluvium, lacustrine, estuarine, aeolian and littoral deposits) while local geology and remnant fabric will assist identification of residual soils.

Ref: DS6.5.1.1 Issue 1.6 Date: 19/11/2008

ROCK DESCRIPTION

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This method is based on Australian Standard AS 1726 and is orientated to the field logging of diamond drill core, but may be used for the profiling of natural exposures and cuttings, as applicable. The procedure involves a visual and tactile assessment of the rock mass and the nature of defects within it in order to facilitate a prediction of engineering behaviour.

DESCRIPTION: Rock Type is described on the basis of origin (sedimentary, metamorphic and igneous) with the common types listed below:-

Sedimentary				Metamorphic	Igneous				
Clastic	**Non clastic (chemical)**	**Non clastic (organic)**	**Pyroclastic**			**Acid**	**Intermediate**		**Basic**
Conglomerate Sandstone Siltstone Shale Claystone	Limestone Chert Gypsum Salt	Coal Some Limestone	Tuff Agglomerate Volcanic Breccia	Slate Phyllite Schist Quartzite Gneiss	Extrusive	Rhyolite	Trachyte	Andesite	Basalt
					Intrusive (medium grained)	Quartz Porphyry	Porphyry	Porphyrite	Dolerite
					(coarse grained)	Granite	Syenite	Diorite	Gabbro

Colour is given to assist in rock identification and the interpolation of field data. Colour is usually described at as-received moisture condition, though both wet and dry colours may also be appropriate.

Texture refers to the degree of crystallinity and granularity (grain size) and the fabric relationship between the constituents of a rock. Often only grain size is given for simplified descriptions of certain sedimentary rocks.

Structure and texture are commonly used synonymously in describing rocks since there is no clear delineation between terms. In general, structure refers to large-scale features recognisable in the field (banding, lineation, massive, porphyritic, schistose etc.). For sedimentary rocks in particular, the thickness of sedimentary layering (bedding) is described as:-

Thinly laminated	<6mm	very thinly bedded	20-60mm	medium bedded	0.2-0.6m	very thickly bedded	>2m
Laminated	6-20mm	thinly bedded	60-200mm	thickly bedded	0.6-2m		

In addition, mineral composition, hardness, alteration, cementation is given as applicable.

WEATHERING: The assignment of weathering is somewhat subjective. Weathering assists identification and does not imply engineering behaviour. No distinction is drawn between chemical weathering and alteration for most engineering purposes. These procedures are collectively described as "weathering" using the following terms which do not describe the related strength change. This system is general, and in this format may not apply to all rock types. Carbonate rocks generally do not conform to this classification.

Term	Symbol	Definition
Completely Weathered	CW	Residual soil with rock fabric not visible.
Extremely Weathered	EW	The rock exhibits soil-like properties though the texture of the original rock is still evident.
Highly Weathered	HW	Limonite staining or colour change affects the whole of the rock mass and other signs of chemical or physical decomposition are evident.
Moderately Weathered	MW	Staining extends throughout the whole of the rock mass and the original colour is no longer recognisable.
Slightly Weathered	SW	Partial staining or discolouration of the rock mass, usually by limonite, has taken place.
Fresh	Fr	Rock mass unaffected by weathering.

ESTIMATED STRENGTH: This refers to the strength of the rock substance and not that of the rock mass. The strength of the rock substance is estimated by the Point Load Strength Index $I_S(50)$ and refers to the strength measured in the direction normal to the bedding for sedimentary rocks. A field guide is given below:-

Term	Symbol	$I_S(50)$ MPa	Field Guide (The core refers to a 150mm long x 50mm dia. sample)
Extremely Low	EL	<0.03	Remoulded by hand to a material with soil properties.
Very Low	VL	0.03-0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low	L	0.1-0.3	The core may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium	M	0.3-1.0	The core may be broken by hand with considerable difficulty. Readily scored with knife.
High	H	1-3	The core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
Very High	VH	3-10	The core may be broken readily with hand held hammer. Cannot be scratched with knife.
Extremely High	EH	>10	The core is difficult to break with hand held hammer. Rings when struck with a hammer.

DEFECTS: This important feature can control the overall engineering behaviour of a rock mass. All types of natural fractures across which the core is discontinuous are noted. These fractures include bedding plane partings, joints and other defects but exclude artificial fractures such as drilling breaks. The nature of the defects (joints, bedding partings, seams, zones and veins) is also noted with description, orientation, infilling or coating, shape, roughness, thickness, etc. given generally in accordance with AS 1726. The spacing of natural fractures excludes bedding partings unless there is evidence that they were separated prior to drilling. This notwithstanding, bedding partings maybe considered as planes of weakness in an engineering assessment.

Ref: DS6.5.2.1 Issue 1.6 Date: 04/06/2008

GLOSSARY OF SYMBOLS

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This standard sheet should be read in conjunction with all test hole log sheets and any idealised geological sections prepared for the investigation report.

GENERAL

Symbol	Description	Symbol	Description
D	Disturbed Sample	PZ	Piezometer Installation
U	Undisturbed Sampled (suffixed by sample size or tube diameter in mm if applicable)	R	Rising Head Permeability Test
		F	Falling Head Permeability Test
C	Core Sample (suffixed by diameter in mm)	PBT	Plate Bearing Test
SV	Shear Vane Test (suffixed by value in kPa)		Water Inflow (make)
SPT	Standard Penetration Test (with blows per 0.15m)		Water Outflow (loss)
N	SPT Value		Temporary Water Level
HB	SPT hammer bouncing		Final Water Level
PM	Pressuremeter Test		Point Load Test (axial)
PP	Pocket Penetrometer (suffixed by value in kPa)		Point Load Test (diametric)
PK	Packer Test	IMP	Impression Device Test

SOIL SYMBOLS

Main Components

SAND | CLAY | SILT

GRAVEL | FILL | TOPSOIL

Minor Components

sandy | clayey | silty

gravelly | vegetation, roots

Note: Natural soils are generally a combination of constituents, e.g. sandy CLAY

ROCK SYMBOLS

Sedimentary

SANDSTONE | SHALE

CLAYSTONE | CONGLOMERATE

SILTSTONE | COAL

Igneous

GRANITIC ROCK

IGNEOUS DYKE

BASALTIC ROCK

Note: Additional rock symbols may be allocated for a particular project.

NATURAL FRACTURES (Coding)

Fracture Type

JT	Joint
BP	Bedding Plane
Cb	Cross Bed
SS	Sheared Surface
SM	Seam
CS	Crushed Seam
FZ	Fragmented Zone
SZ	Shear Zone
VN	Vein

Orientation

For vertical non-oriented core ... “Dip” angle (eg. 5°) measured relative to horizontal
For inclined non-oriented core ... “Angle” measured relative to core axis.
For inclined oriented core ... “Dip” angle and “Dip Direction” angle (eg. 45°/225° mag.)

VT	Vertical
HZ or 0°	Horizontal
d	degrees

Infilling or Coating

CN	Clean
X	Carbonaceous
CLAY	Clay
KT	Chlorite
CA	Calcite
FE	Iron Oxide
MI	Micaceous
Mn	Manganese
Py	Pyrite
QZ	Quartz
VE	Veneer

Shape

PLN	Planar
CU	Curved
UN	Undulating
ST	Stepped
IR	Irregular

Roughness

POL	Polished
SLK	Slickensided
SO	Smooth
RF	Rough
VR	Very Rough

Others

DIS	Discontinuous
OP	Open
CL	Closed
TI	Tight

Ref: DS6.5.1 Issue 1.7 Date: 20/09/2010

LABORATORY TESTING

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GENERAL

Samples extracted during the fieldwork stage of a site investigation may be “disturbed” or “undisturbed” (as generally indicated on the trial hole logs) depending upon the nature and purpose of the sample as well as the method of extraction, transportation, extrusion and testing. This aspect should be taken into account when assessing test results, which must of necessity reflect the effects of such disturbance.

All soil properties (as measured by laboratory testing) exhibit inherent variability and thus a certain statistical number of tests is required in order to predict an average property with any degree of confidence. The site variability of soil strata, future changes in moisture and other conditions and the discrete sampling positions must also be considered when assessing the representative nature of the laboratory programme.

Certain laboratory test results provide interpreted soil properties as derived by conventional mathematical procedures. The applicability of such properties to engineering design must be assessed with due regard to the site, sample condition, procedure and project in hand.

TESTING

Laboratory testing is normally carried out in accordance with Australian Standard AS 1289 as amended, or RTA Standards when specified. The routine Australian Standard tests are as follows:-

Moisture Content	AS1289 2.1.1	
Liquid Limit	AS1289 3.1.1)	
Plastic Limit	AS1289 3.2.1)	collectively known as Atterberg Limits
Plasticity Index	AS1289 3.3.1)	
Linear Shrinkage	AS1289 3.4.1	
Particle Density	AS1289 3.5.1	
Particle Size Distribution	AS1289 3.6.1, 3.6.2 and 3.6.3	
Emerson Class Number	AS1289 3.8.1)	
Percent Dispersion	AS1289 3.8.2)	collectively, Dispersive Classification
Pinhole Dispersion Classification	AS1289 3.8.3)	
Hole Erosion (HE)	GHD Method	
No Erosion Filter (NEF)	GHD Method	
Organic Matter	AS1289 4.1.1	
Sulphate Content	AS1289 4.2.1	
pH Value	AS1289 4.3.1	
Resistivity	AS1289 4.4.1	
Standard Compaction	AS1289 5.1.1	
Modified Compaction	AS1289 5.2.1	
Dry Density Ratio	AS1289 5.4.1	
Minimum Density	AS1289 5.5.1	
Density Index	AS1289 5.6.1	
California Bearing Ratio	AS1289 6.1.1 and 6.1.2	
Shear Box	AS1289 6.2.2	
Undrained Triaxial Shear	AS1289 6.4.1 and 6.4.2	
One Dimensional Consolidation	AS1289 6.6.1	
Permeability Testing	AS1289 6.7.1, 6.7.2 and 6.7.3	

Where tests are used which are not covered by appropriate standard procedures, details are given in the report.

LABORATORY

Our laboratory is NATA accredited to AS ISO / IEC17025 for the listed tests.

The oedometer, triaxial and shear box equipment are fully automated for continuous operation using computer controlled data acquisition, processing and plotting systems.

Ref: DS5.5.2 Issue 1.6 Date: 04/06/2008

DYNAMIC CONE PENETROMETER (DCP) TESTING

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SCOPE

The Dynamic Cone Penetrometer (DCP) test comprises the measurement of the soil resistance to a steel rod driven into the ground by a dropped weight.

The DCP test is a simple manual test used in both sandy and clayey soils. The test is a measure of the shear strength of the soil at relatively shallow depth.

EQUIPMENT AND METHOD

A general description of the dynamic penetrometer apparatus used by our firm is presented in Australian Standard AS 1289.6.3.2. The equipment utilises a 9kg sliding weight with a drop height of 510mm. It is fitted with a conical tip. The equipment can be adjusted for a fall of 600mm and use of a blunt tip in accordance with AS 1289.6.3.3.

The test data are generally recorded as the number of blows (n) per 50mm of penetration. The test data are processed by our in-house computer software. For specific applications (such as pavement investigations), the data may be collected in the reverse form, i.e. as mm per blow. The results are presented either in tabular or graphic form for reporting purposes.

INTERPRETATION

The interpretation of the DCP results is generally based on the assumption that the measured resistance is a function of soil strength. A profile of soil strength (cohesive soils) or density index (cohesionless soils) can thus be established. The test often can be used to qualitatively indicate the presence of soft or loose zones within a soil profile.

The energy of the system per unit area is similar to that of an SPT approach. Thus, the common relationships of SPT and other parameters (say Dutch cone) can be utilised as a means of estimating soil properties, after appropriate site specific correlation. The interpretations from the test are approximate only, and this is particularly pertinent to sand profiles where the magnitude of confinement stress is important in the assessment of the results.

Interpretation of the DCP penetration rate at depth (up to 5m) must be conducted with due regard to side friction effects. In particular, care must be exercised with soft clay profiles where shaft resistance may have a significant unconservative impact upon the results.

In-situ California Bearing Ratio (CBR) values of clay soil subgrades are sometimes interpreted directly from DCP test results for use in road pavement design. In this case, the correlation between DCP and CBR based on that published in AUSTROADS Pavement Design Manual (1992) may be applied. This correlation should be verified by site specific laboratory testing, where appropriate. In addition, the effects of moisture content variations (in-situ verses design conditions) must be considered, as clearly the DCP test only reflects the shear strength of the soil at the time of testing.

Ref: DS5.4.3 Issue 1.3 Date: 04/06/2008

Appendix C – Test Pit Log Sheets and Photos

TEST PIT LOG SHEET

Client: Muswellbrook Shire Council

Project: South Muswellbrook Intersection Design

Location: New England Highway, Muswellbrook

HOLE No. TP01

SHEET 1 **OF** 1

Position: 301800.0 E 6427099.0 N	**Surface RL:** -	**Processed:** BS
Method of Exploration: 5t Excavator	**Hole Size:** 450mm diameter	**Checked:** JP*
Date: 01/03/17	**Logged by:** BS	**Date:** 5/05/2017

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
	Nil	D			ML	SILT, grey to grey-brown, low plasticity (MC<PL), with fine grained sand (alluvium).	SM	VSt	
			0.20		CI-CH	CLAY, dark brown, medium to high plasticity (MC=<PL) (alluvium).	M	H	0.2-1.8m, PP>400kPa.
		B							
		D				0.9m, dark brown-grey with minor white mottling, MC<PL, trace fine to medium gravel.	SM		
1									
		D				1.4m, dark grey with minor white spotting, MC<=PL.			
			1.80			End of Test pit at 1.8 metres. Target Depth.			
2									
3									

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 22-18812

TEST PIT LOG SHEET

Client: Muswellbrook Shire Council

Project: South Muswellbrook Intersection Design

Location: New England Highway, Muswellbrook

HOLE No. TP02

SHEET 1 **OF** 1

Position: 301833.0 E 6427051.0 N	**Surface RL:** -	**Processed:** BS
Method of Exploration: 5t Excavator	**Hole Size:** 450mm diameter	**Checked:** JP*
Date: 01/03/17	**Logged by:** BS	**Date:** 5/05/2017

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
	Nil				CL	Sandy CLAY, mottled brown and dark brown, low plasticity (MC=PL), sand is fine grained (fill).	M	-	0.0-0.3m, appears moderately compacted.
			0.15						
		D			CI	CLAY, dark grey and dark brown, medium plasticity (MC<PL), with sand and minor bands of silt (fill).	SM	-	
			0.30						
		D			CI-CH	CLAY, mottled brown and dark brown, medium to high plasticity (MC<=PL), trace fine to medium grained sand (alluvium).	SM	H	0.3-1.9m, PP>400kPa.
1		B							
						1.3m, as above, but with minor white spotting, with fine to medium grained sand, trace fine to medium gravel.			
		D							
						1.7m, brown to brown-grey mottled white.			
			1.90						
2						End of Test pit at 1.9 metres. Target Depth.			
3									

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 22-18812

TEST PIT LOG SHEET

Client: Muswellbrook Shire Council

Project: South Muswellbrook Intersection Design

Location: Rutherford Road, Muswellbrook

HOLE No. TP03

SHEET 1 **OF** 1

Position: 301870.0 E 6426412.0 N	**Surface RL:** -		**Processed:** BS
Method of Exploration: 5t Excavator	**Hole Size:** 450mm diameter		**Checked:** JP*
Date: 01/03/17	**Logged by:** BS		**Date:** 5/05/2017

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
	Nil		0.05		CL	Sandy CLAY, dark brown, low plasticity (MC=PL), sand is fine to medium grained (fill/topsoil).	M	-	0.0-0.95m, appears well compacted.
		D			CL	Sandy CLAY, brown to dark brown, low plasticity (MC<PL), sand is fine to coarse grained, with fine to coarse gravel (fill).	SM	-	
			0.40		CI	Sandy CLAY, dark brown, medium plasticity (MC<PL), sand is fine to coarse grained, trace fine to coarse gravel (fill).	SM	-	0.4m, geofabric material.
		D							
			0.75		CL	Sandy CLAY, pale grey-brown, low plasticity (MC<PL), sand is fine to medium grained, with fine to medium gravel (fill).	SM	-	
		B	0.95						
1					CI	CLAY, brown mottled red-brown, medium plasticity (MC=PL), trace fine to coarse grained sand and fine to medium gravel (residual).	M	H	0.95-1.95m, PP>400kPa.
		B				1.3m, as above, but with pale grey-brown mottling, with gravel.			
						1.7m, brown mottled pale brown.			
		D	1.95						
2						End of Test pit at 1.95 metres. Target Depth.			
3									

Note: * indicates signatures on original issue of log or last revision of log

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TEST PIT LOG SHEET

Client: Muswellbrook Shire Council

Project: South Muswellbrook Intersection Design

Location: Rutherford Road, Muswellbrook

HOLE No. TP04

SHEET 1 **OF** 1

Position: 301932.0 E 6426462.0 N	**Surface RL:** -		**Processed:** BS
Method of Exploration: 5t Excavator	**Hole Size:** 450mm diameter		**Checked:** JP*
Date: 01/03/17	**Logged by:** BS		**Date:** 5/05/2017

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
	Nil		0.05		CL	Sandy CLAY, dark brown, low plasticity (MC=PL), sand is fine to medium grained (fill/topsoil).	M	-	0.0-0.6m, appears well compacted.
					CL	Sandy CLAY, brown, low plasticity (MC<PL), sand is fine to coarse grained, with fine to coarse gravel (fill).	SM	-	
		D							0.2m, trace steel inclusions.
		D				0.4m, pale grey-brown, sand is fine to medium grained, gravel is fine to medium.			
			0.60						
		B			CI	CLAY, brown mottled pale brown, medium plasticity (MC<PL), trace fine to medium grained sand and fine to medium gravel (residual).	SM	H	0.6-1.8m, PP>400kPa.
1						1.0m, as above, but with red-brown mottling, MC=<PL.	M		
		D				1.4m, brown to red-brown, with fine to coarse grained sand.			
			1.80			1.7m, as above, but with pale grey mottling.			
						End of Test pit at 1.8 metres. Target Depth.			
2									
3									

GEO_TEST PIT (HOLE SIZE SINGULAR) 2218812_TEST PIT LOGS.GPJ GHD_GEO_TEMPLATE.GDT 15/5/17

See standard sheets for details of abbreviations & basis of descriptions

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TEST PIT LOG SHEET

Client: Muswellbrook Shire Council

Project: South Muswellbrook Intersection Design

Location: Rutherford Road, Muswellbrook

HOLE No. TP05

SHEET 1 **OF** 1

Position: 302032.0 E 6426548.0 N	**Surface RL:** -	**Processed:** BS
Method of Exploration: 5t Excavator	**Hole Size:** 450mm diameter	**Checked:** JP*
Date: 01/03/17	**Logged by:** BS	**Date:** 5/05/2017

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
	Nil				CL	Sandy CLAY, dark brown, low plasticity (MC=PL), sand is fine to medium grained, trace gravel (fill).	M	-	0.0-0.45m, appears well compacted.
			0.15						
			0.17		-	Spray Seal Bitumen, dark grey.	-	-	
		D			SC	Clayey SAND, dark brown to brown, fine to coarse grained, trace gravel (fill).	SM	-	
			0.45		CL	Sandy CLAY, brown to red-brown, low plasticity (MC<PL), sand is fine to medium grained (residual).	SM	H	0.45-1.5m, PP>400kPa.
		D							
			0.90		CI	CLAY, brown to red-brown, medium plasticity (MC<=PL), with fine to medium grained sand (residual).	SM	H	
1		B							
			1.50		SC	Clayey SAND, brown to red-brown, fine to coarse grained, with bands of low plasticity sandy clay (residual).	SM-M	D	
		D							
			1.80			End of Test pit at 1.8 metres. Target Depth.			
2									
3									

Note: * indicates signatures on original issue of log or last revision of log

See standard sheets for details of abbreviations & basis of descriptions

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TP01

TP02

TP03

TP04

TP05

Appendix D – Dynamic Cone Penetrometer Sheets

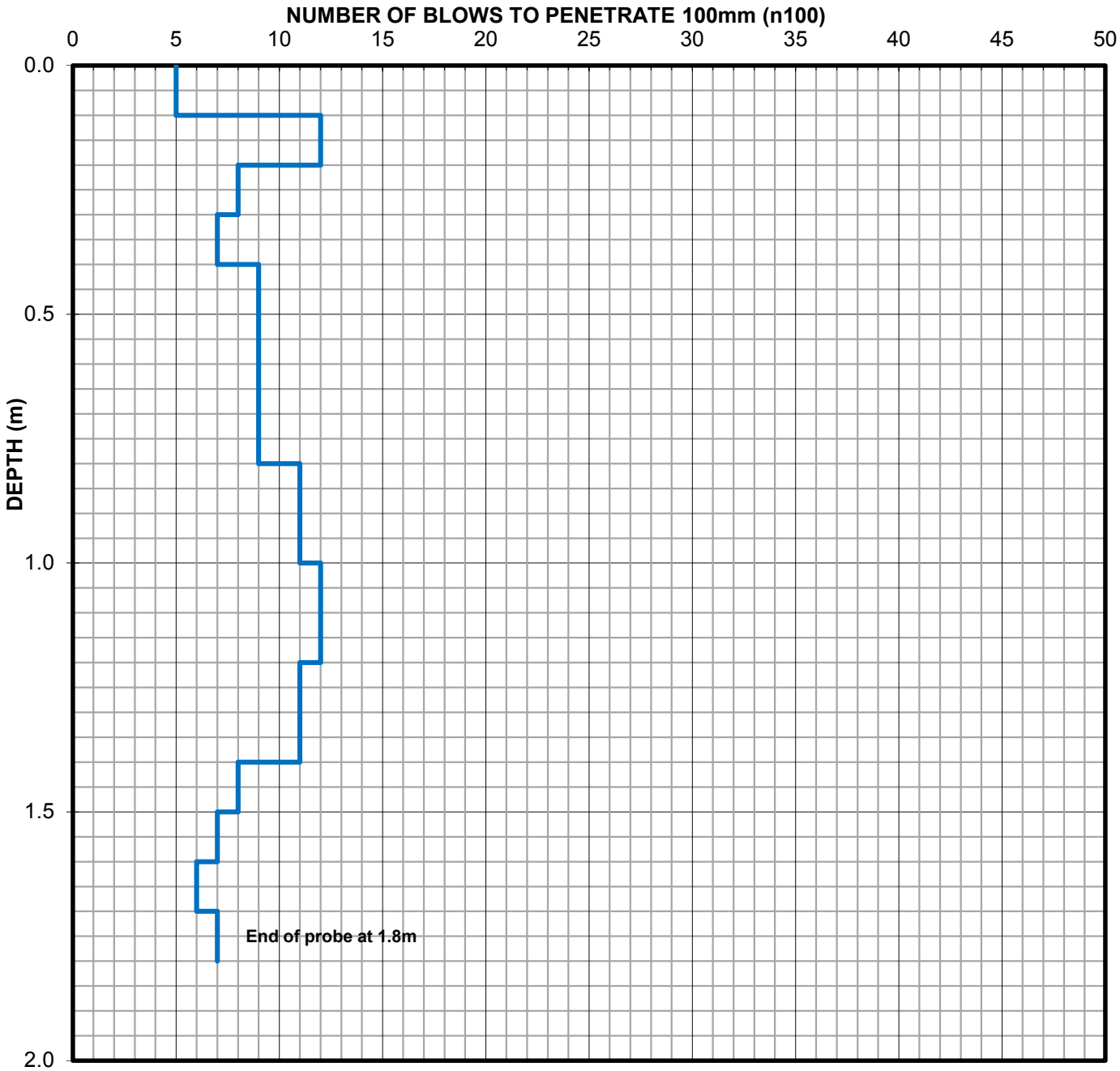
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Muswellbrook Shire Council
Project: South Muswellbrook Intersection Design
Location: New England Highway, Muswellbrook

PROBE: DCP01

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	301800, 6427099	**Chainage:**	-	**Operator:**	BS
Elevation:	-	**Offset:**	-	**Date:**	1/03/2017
Adjacent Test Hole /	TP01			**Checked:**	JP
Position Relative to Test Hole /	-			**Date:**	5/05/2017



Comments:

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Job No. **22-18812**

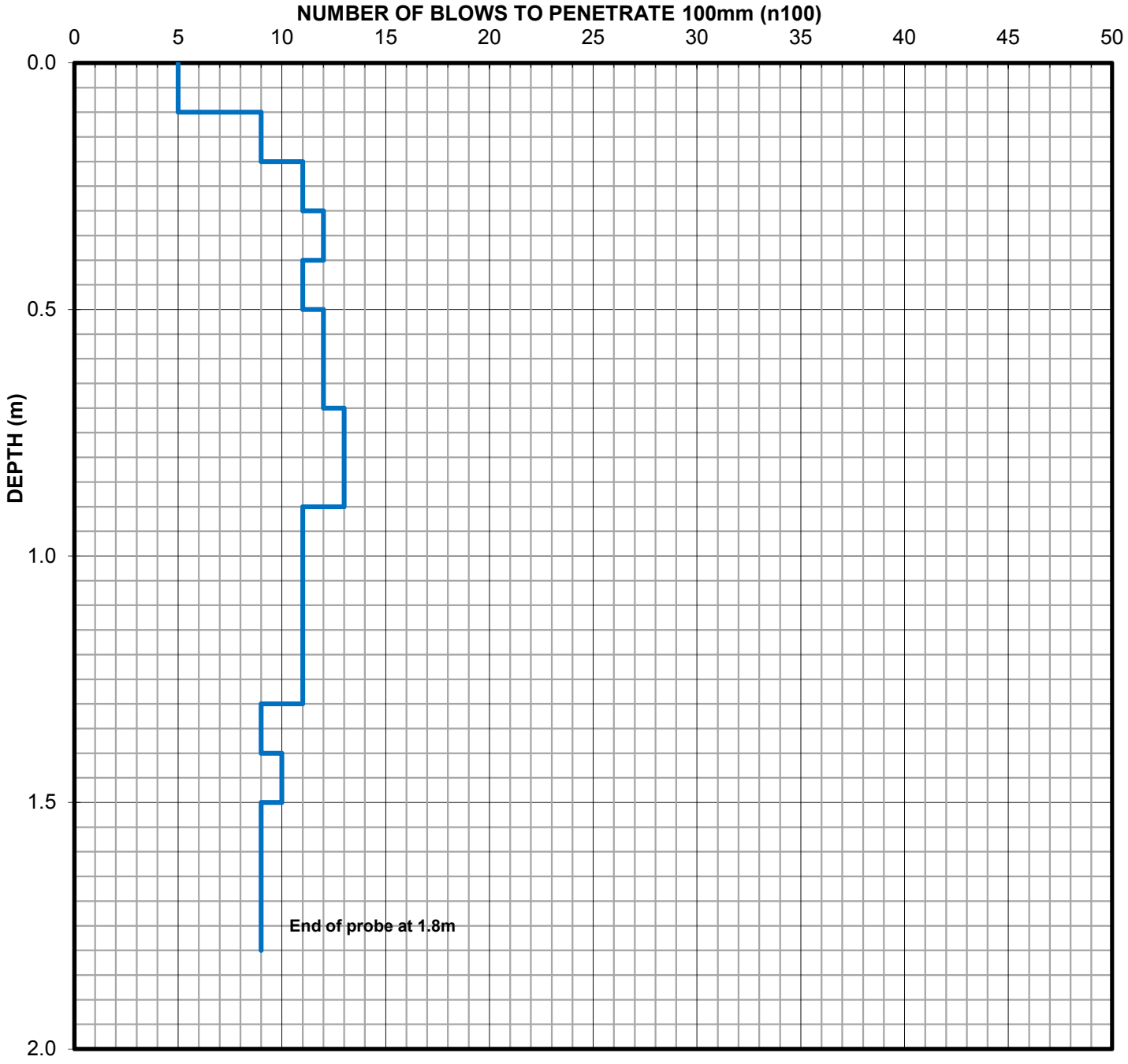
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Muswellbrook Shire Council
Project: South Muswellbrook Intersection Design
Location: New England Highway, Muswellbrook

PROBE: DCP02

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	301833, 6427051	**Chainage:**	-	**Operator:**	BS
Elevation:	-	**Offset:**	-	**Date:**	1/03/2017
Adjacent Test Hole / Pit:	TP02			**Checked:**	JP
Position Relative to Test Hole / Pit:	-			**Date:**	5/05/2017



Comments:

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Job No. **22-18812**

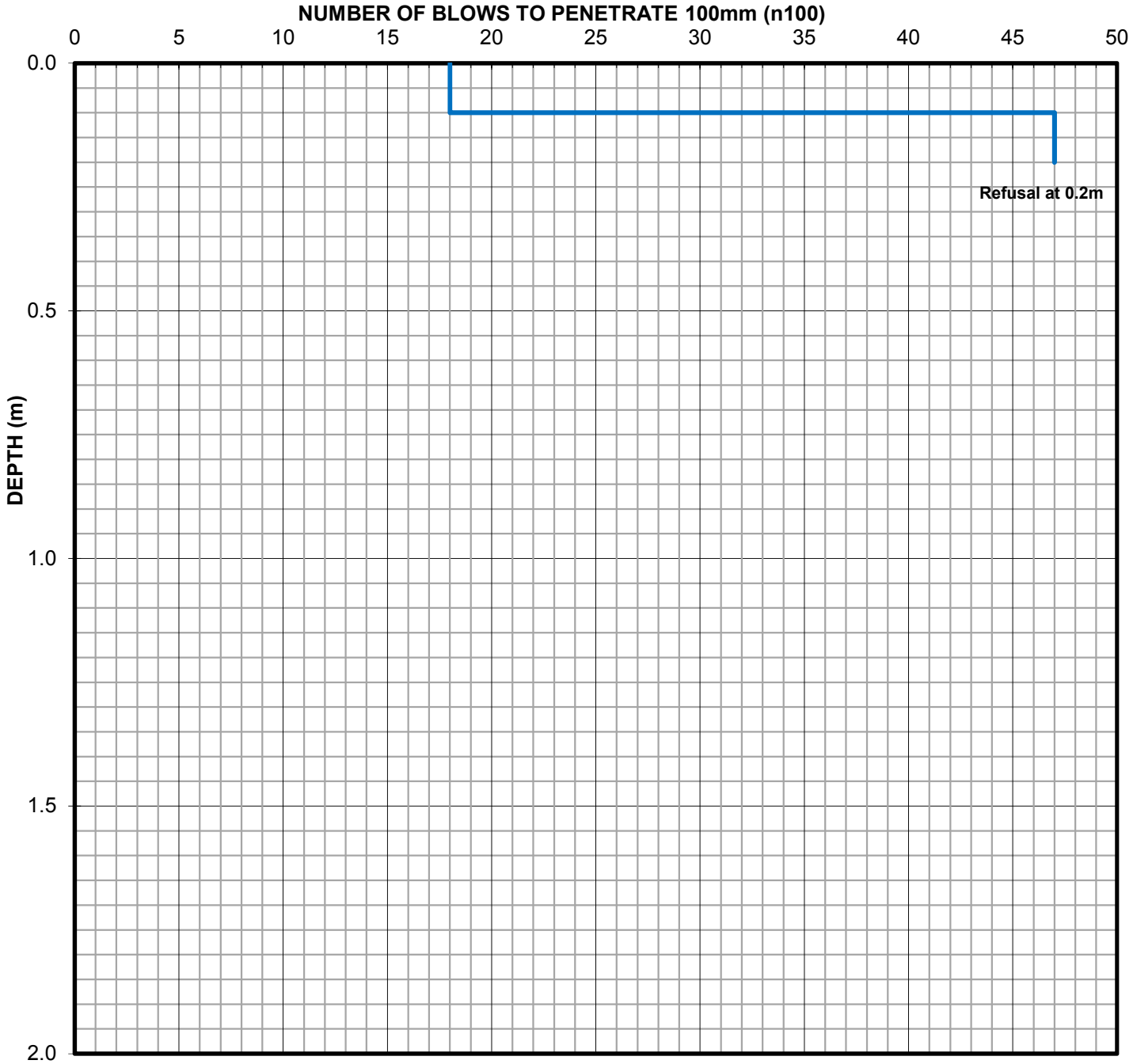
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Muswellbrook Shire Council
Project: South Muswellbrook Intersection Design
Location: Rutherford Road, Muswellbrook

PROBE: DCP03

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	301870, 6427412	**Chainage:**	-	**Operator:**	BS
Elevation:	-	**Offset:**	-	**Date:**	1/03/2017
Adjacent Test Hole / Pit:	TP03			**Checked:**	JP
Position Relative to Test Hole / Pit:	-			**Date:**	5/05/2017



Comments:

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Job No. **22-18812**

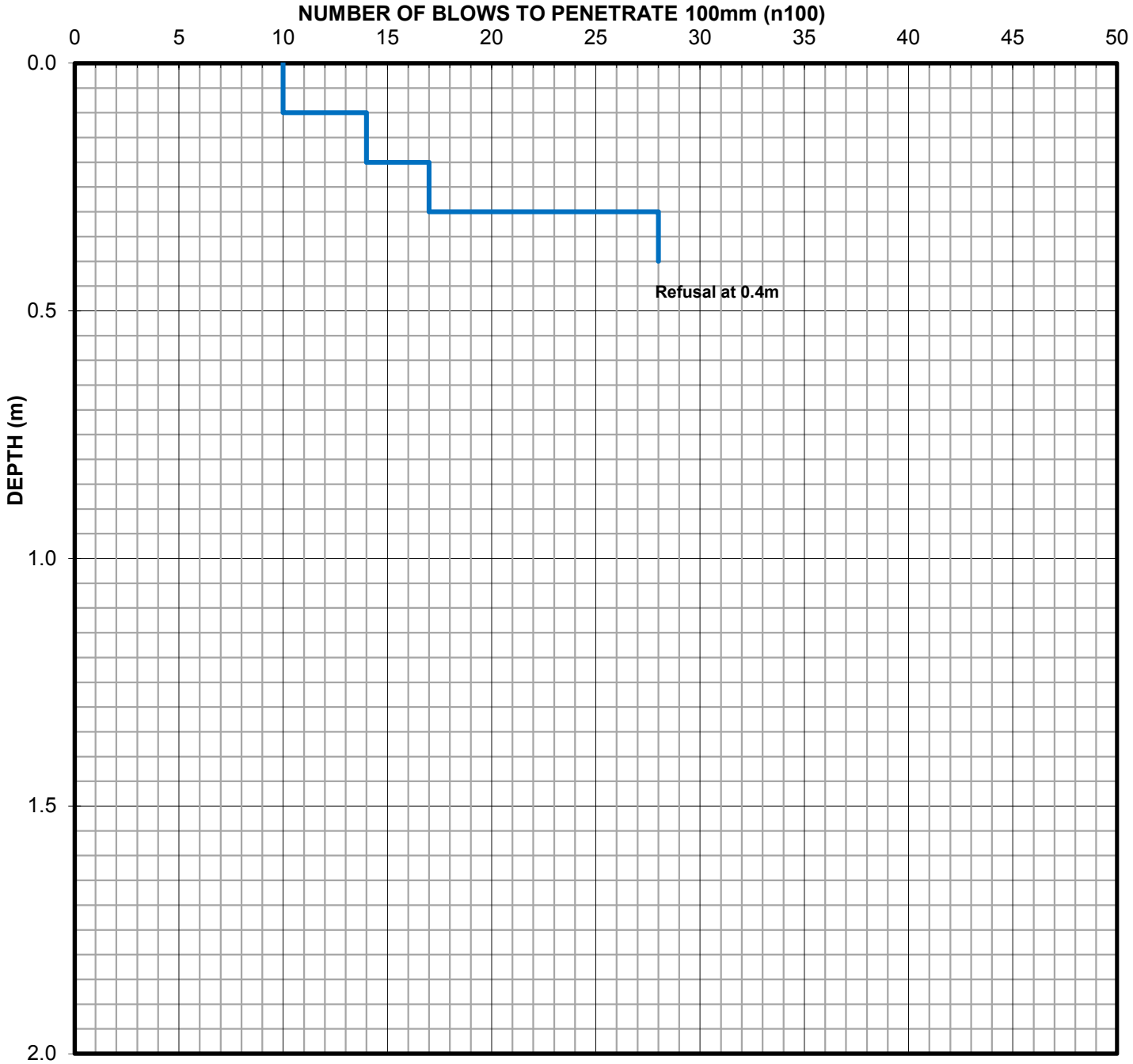
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Muswellbrook Shire Council
Project: South Muswellbrook Intersection Design
Location: Rutherford Road, Muswellbrook

PROBE: DCP04

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	301932, 6426462	**Chainage:**	-	**Operator:**	BS
Elevation:	-	**Offset:**	-	**Date:**	1/03/2017
Adjacent Test Hole / Pit:	TP04			**Checked:**	JP
Position Relative to Test Hole / Pit:	-			**Date:**	5/05/2017



Comments:

CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS
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GHD GEOTECHNICS

Job No. **22-18812**

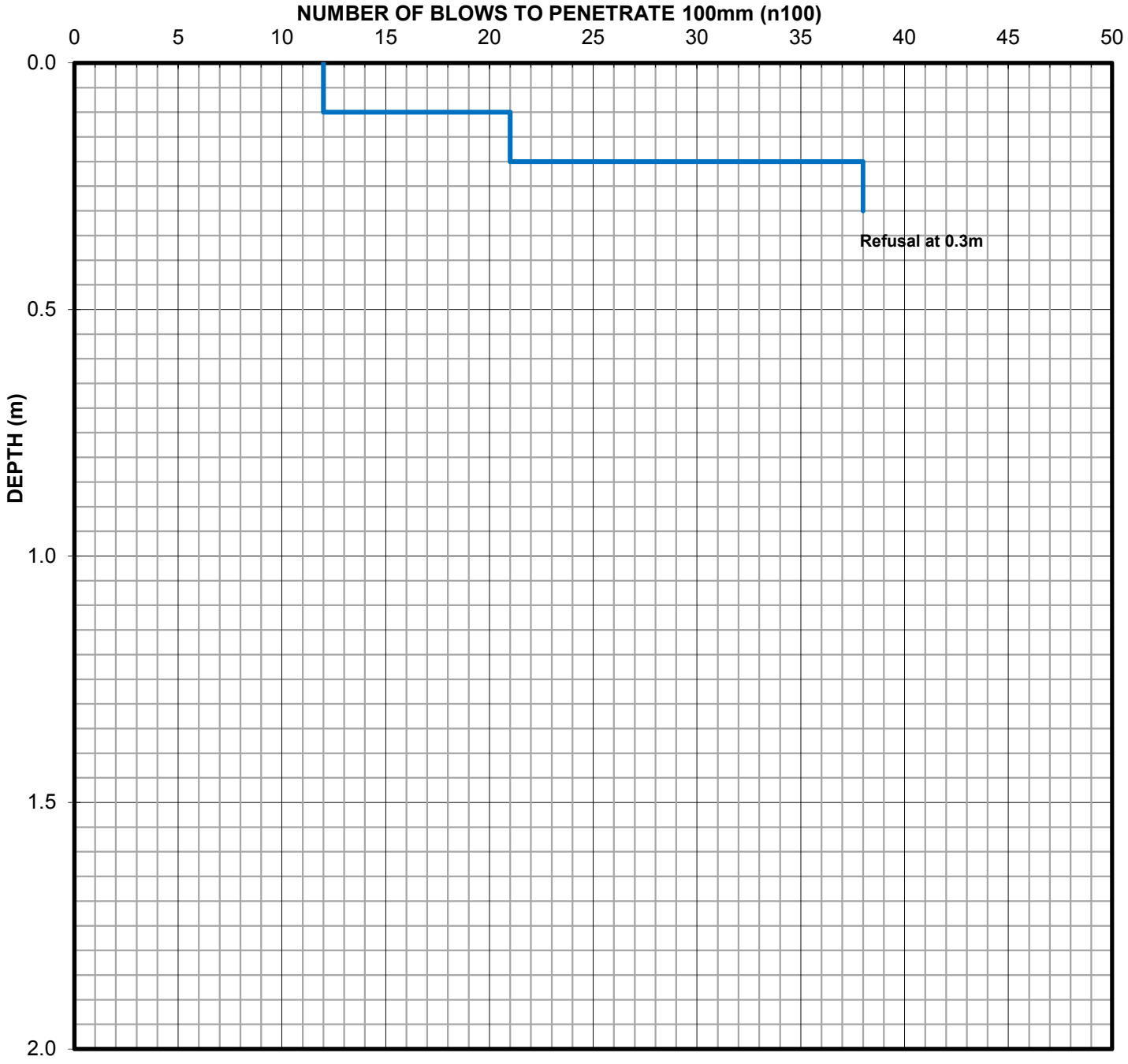
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Muswellbrook Shire Council
Project: South Muswellbrook Intersection Design
Location: Rutherford Road, Muswellbrook

PROBE: DCP05

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	302032, 6426548	**Chainage:**	-	**Operator:**	BS
Elevation:	-	**Offset:**	-	**Date:**	1/03/2017
Adjacent Test Hole / Pit:	TP05			**Checked:**	JP
Position Relative to Test Hole / Pit:	-			**Date:**	5/05/2017



Comments:

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GHD GEOTECHNICS

Job No. **22-18812**

Appendix E – Laboratory Result Sheets

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Aggregate/Soil Test Report

Report No: SYD1700614
Issue No: 1
This report replaces all previous issues of report no 'SYD1700614'.

Client:
Muswellbrook Shire Council
Sth Muswellbrook Intersection Design
Muswellbrook NSW

Project: 2218812/03

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 3/04/2017

Sample Details

GHD Sample No	SYD17-0139-01
Date Sampled	01/03/2017
Sampled By	Sampled by GHD
BH / TP No.	TP01
Depth (m)	0.2 - 0.5
Soil Description	CLAY: with sand brown

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	RMS T113	N/A	
Mould Length (mm)		0	
Liquid Limit (%)	RMS T108	48	
Method		Four Point	
Plastic Limit (%)	RMS T109	18	
Plasticity Index (%)	RMS T109	30	
Date Tested		21/03/2017	
Standard MDD (t/m³)	RMS T111	1.59	
Standard OMC (%)		22.0	
Method of Determination		Cubic Spline	
Retained Sieve 19mm (%)		0	
Mould Size (Ltr)			
Date Tested		14/03/2017	
CBR At 2.5mm (%)	RMS T117	2.5	
Maximum Dry Density (t/m³)		1.59	
Specified Laboratory Density Ratio (%)		100	
Laboratory Density Ratio (%)		100	
Optimum Moisture Content (%)		22.0	
Specified Laboratory Moisture Ratio (%)		100	
Laboratory Moisture Ratio (%)		101	
Swell (%)		2.6	
Moisture Content Top 30mm (%)		31.8	
Moisture Content of Full Depth of Specimen (%)		26.4	
Compactive Effort		Standard	
Period of Soaking (Days)		10	
Oversize Material (%)		0	
Date Tested		27/03/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1700614
Issue No: 1
This report replaces all previous issues of report no 'SYD1700614'.

Client:
Muswellbrook Shire Council
Sth Muswellbrook Intersection Design
Muswellbrook NSW

Project: 2218812/03

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 3/04/2017

Sample Details

GHD Sample No	SYD17-0139-01
Date Sampled	01/03/2017
Sampled By	Sampled by GHD
BH / TP No.	TP01
Depth (m)	0.2 - 0.5
Soil Description	CLAY: with sand brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	RMS T120 - 1999	15.9	
Date Tested		14/03/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1700615
Issue No: 1
This report replaces all previous issues of report no 'SYD1700615'.

Client:
Muswellbrook Shire Council
Sth Muswellbrook Intersection Design
Muswellbrook NSW

Project: 2218812/03

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 3/04/2017

Sample Details

GHD Sample No	SYD17-0139-02
Date Sampled	01/03/2017
Sampled By	Sampled by GHD
BH / TP No.	TP02
Depth (m)	0.4 - 0.6
Soil Description	CLAY: brown

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	RMS T113	N/A	
Mould Length (mm)		0	
Liquid Limit (%)	RMS T108	53	
Method		Four Point	
Plastic Limit (%)	RMS T109	18	
Plasticity Index (%)	RMS T109	35	
Date Tested		21/03/2017	
Moisture Content (%)	RMS T120 - 1999	18.8	
Date Tested		13/03/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1700616
Issue No: 1
This report replaces all previous issues of report no 'SYD1700616'.

Client:
Muswellbrook Shire Council
Sth Muswellbrook Intersection Design
Muswellbrook NSW

Project: 2218812/03

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 3/04/2017

Sample Details

GHD Sample No	SYD17-0139-03
Date Sampled	01/03/2017
Sampled By	Sampled by GHD
BH / TP No.	TP03
Depth (m)	1.0 - 1.3
Soil Description	CLAY: red brown

Test Results

Description	Method	Result	Limits
Standard MDD (t/m³)	RMS T111	1.52	
Standard OMC (%)		24.2	
Method of Determination		Cubic Spline	
Retained Sieve 19mm (%)		0	
Mould Size (Ltr)			
Date Tested		14/03/2017	
CBR At 2.5mm (%)	RMS T117	2.5	
Maximum Dry Density (t/m³)		1.52	
Specified Laboratory Density Ratio (%)		100	
Laboratory Density Ratio (%)		100	
Optimum Moisture Content (%)		24.2	
Specified Laboratory Moisture Ratio (%)		100	
Laboratory Moisture Ratio (%)		100	
Swell (%)		3.0	
Moisture Content Top 30mm (%)		35.0	
Moisture Content of Full Depth of Specimen (%)		28.4	
Compactive Effort		Standard	
Period of Soaking (Days)		10	
Oversize Material (%)		0	
Date Tested		27/03/2017	
Moisture Content (%)	RMS T120 - 1999	21.2	
Date Tested		14/03/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1700617
Issue No: 1
This report replaces all previous issues of report no 'SYD1700617'.

Client:
Muswellbrook Shire Council
Sth Muswellbrook Intersection Design
Muswellbrook NSW

Project: 2218812/03

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 3/04/2017

Sample Details

GHD Sample No	SYD17-0139-04
Date Sampled	01/03/2017
Sampled By	Sampled by GHD
BH / TP No.	TP04
Depth (m)	0.6 - 0.9
Soil Description	CLAY: with sand brown

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	RMS T113	N/A	
Mould Length (mm)		0	
Liquid Limit (%)	RMS T108	39	
Method		Four Point	
Plastic Limit (%)	RMS T109	15	
Plasticity Index (%)	RMS T109	24	
Date Tested		21/03/2017	
Standard MDD (t/m³)	RMS T111	1.69	
Standard OMC (%)		17.3	
Method of Determination		Cubic Spline	
Retained Sieve 19mm (%)		0	
Mould Size (Ltr)			
Date Tested		14/03/2017	
CBR At 2.5mm (%)	RMS T117	3.0	
Maximum Dry Density (t/m³)		1.69	
Specified Laboratory Density Ratio (%)		100	
Laboratory Density Ratio (%)		100	
Optimum Moisture Content (%)		17.3	
Specified Laboratory Moisture Ratio (%)		100	
Laboratory Moisture Ratio (%)		99	
Swell (%)		2.0	
Moisture Content Top 30mm (%)		24.3	
Moisture Content of Full Depth of Specimen (%)		20.9	
Compactive Effort		Standard	
Period of Soaking (Days)		10	
Oversize Material (%)		0	
Date Tested		27/03/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1700617
Issue No: 1
This report replaces all previous issues of report no 'SYD1700617'.

Client:
Muswellbrook Shire Council
Sth Muswellbrook Intersection Design
Muswellbrook NSW

Project: 2218812/03

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 3/04/2017

Sample Details

GHD Sample No	SYD17-0139-04
Date Sampled	01/03/2017
Sampled By	Sampled by GHD
BH / TP No.	TP04
Depth (m)	0.6 - 0.9
Soil Description	CLAY: with sand brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	RMS T120 - 1999	12.8	
Date Tested		14/03/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1700618
Issue No: 1
This report replaces all previous issues of report no 'SYD1700618'.

Client:
Muswellbrook Shire Council
Sth Muswellbrook Intersection Design
Muswellbrook NSW

Project: 2218812/03

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 3/04/2017

Sample Details

GHD Sample No	SYD17-0139-05
Date Sampled	01/03/2017
Sampled By	Sampled by GHD
BH / TP No.	TP05
Depth (m)	0.5 - 0.7
Soil Description	Clayey SAND: orange brown

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	RMS T113	N/A	
Mould Length (mm)		0	
Liquid Limit (%)	RMS T108	23	
Method		Four Point	
Plastic Limit (%)	RMS T109	15	
Plasticity Index (%)	RMS T109	8	
Date Tested		21/03/2017	
Moisture Content (%)	RMS T120 - 1999	9.9	
Date Tested		13/03/2017	

Comments

N/A

Appendix F – Traffic calculations

Design traffic new england hw

REF: Austroads Pavement Design Feb 2012
SECT: 7 & 8

P	Design Period		**40**	yrs	
R	Growth Rate		**1.0%**	pa	
CGF	Cumulative Growth Factor		**48.9**		
AADT 2 dir	Annual Average daily Traffic PD + CD	2015	**30,498**		
DF		Direction Factor	**0.50**		
		AADT PD or CD	**15,249**		
LDF		Lane Distribution Factor	**1.00**		
	ADTLV	LV% =			
	ADTMV	MV% =			
%HV	% Heavy Vehicles Vehicles		**5.0%**		
N_{HVAG}		Avg no. Axle Groups /HV	**2.82**		Appendix D (As per New England Highway Branxton)
LDF		Lane Distribution Factor	**1.00**		Section 7.4.3
N_{DT} HVAG	Design Traffic in cumulative HV axle		**3.8E+07**		Section 7.4.1
ESA/HVAG			**0.982**		Appendix D (As per New England Highway Branxton)
DESA	Design Equivalent Standard Axles		**37674946.96**		Section 7.6.3

Year	AADT
2016	30196
2017	30497.96

REF: Austroads Pavement Design Feb 2012
SECT: 7 & 8

PAVEMENT DESIGN EMPERICAL ROUNDABOUT APPROACHES

P	Design Period	**25**	yrs	
R	Growth Rate	**1.0%**	pa	
CGF	Cumulative Growth Factor	**28.2**		
AADT 2 dir	Annual Average daily Traffic PD + CD	2015 **9,721**		
DF	Direction Factor	**0.50**		
	AADT PD or CD	**4,861**		
LDF	Lane Distribution Factor	**1.00**		
	ADTLV	LV% =		
	ADTMV	MV% =		
%HV	% Heavy Vehicles Vehicles	**3.0%**		
N_{HVAG}	Avg no. Axle Groups /HV	**2.82**		Appendix D (As per New England Highway Branxton)
LDF	Lane Distribution Factor	**1.00**		Section 7.4.3
N_{DT} HVAG	Design Traffic in cumulative HV axle	**4.2E+06**		Section 7.4.1
ESA/HVAG		**0.982**		Appendix D (As per New England Highway Branxton)
DESA	Design Equivalent Standard Axles	**4162646.74**		Section 7.6.3
	ADOPT	**4.20E+06**		(Rounded as desired)

For design CBR	2.0%	require	**740 mm**	REF: Figure 8.4
For design CBR	2.5%	require	**660 mm**	
For design CBR	5.0%	require	**460 mm**	
For design CBR	6.0%	require	**410 mm**	
For design CBR	8.0%	require	**350 mm**	
For design CBR	10.0%	require	**300 mm**	

Year	AADT
2016	9624
2017	9720.24

REF: Austroads Pavement Design Feb 2012
SECT: 7 & 8

Design Traffic Roundabout

P	Design Period	**40**	yrs	
R	Growth Rate	**1.0%**	pa	
CGF	Cumulative Growth Factor	48.9		
AADT	Annual Average daily Traffic PD + CD	0 **9,721**		
DF	Direction Factor	**0.50**		
	AADT PD or CD	4,861		
LDF	Lane Distribution Factor	**1.0**		
	ADTLV	LV% =		
	ADTMV	MV% =		
%HV	% Heavy Vehicles Vehicles	**3.0%**		
N_{HVAG}	Avg no. Axle Groups /HV	**2.82**		Appendix D (As per New England Highway Branxton)
LDF	Lane Distribution Factor	**1.0**		Section 7.4.3
N_{DT} **HVAG**	Design Traffic in cumulative HV axle	7.3E+06		Section 7.4.1

Year	AADT
2016	9624
2017	9720.24

Appendix G – Pavement design calculations

DESIGN ASPHALT MODULUS (AC Modulus - Ver 5E (17 July 2012))

Inputs

Project details:	Pavement Design New England Highway AC14 A15E MCW
Date:	12 April 2017
Mix size:	14 mm
Binder content (by mass):	5.10%
Binder absorption:	0.30%
SG of binder:	1.03
Design air voids:	6.00%
Combined bulk density of mineral aggregate:	2.64 tonnes/m3
Bitumen penetration at 25° C (0.1 mm):	28 (after RTFO)
Bitumen viscosity at 60° C:	1,000 Pa.s (after RTFO)
Loading speed:	50 km/h
WMAPT:	28.0° C
Austroads binder grade:	A15E
Modulus adjustment factor:	0.75

Results

Time of loading:	0.02 seconds
Bitumen T800 pen:	58.3° C
Bitumen Penetration Index:	-0.6
Binder stiffness:	22.3 MPa
Binder volume:	10.8%
Aggregate volume:	83.2%
Voids in mineral aggregate:	16.8%
Voids filled with binder:	64.3%
Nominal mix modulus:	3,754 MPa
Adjusted mix modulus:	2,800 MPa

DESIGN ASPHALT MODULUS (AC Modulus - Ver 5E (17 July 2012))

Inputs

Project details:	Pavement Design New England Highway AC20 AR450 MCW
Date:	12 April 2017
Mix size:	20 mm
Binder content (by mass):	4.90%
Binder absorption:	0.30%
SG of binder:	1.03
Design air voids:	6.00%
Combined bulk density of mineral aggregate:	2.64 tonnes/m3
Bitumen penetration at 25° C (0.1 mm):	28 (after RTFO)
Bitumen viscosity at 60° C:	1,000 Pa.s (after RTFO)
Loading speed:	50 km/h
WMAPT:	28.0° C
Austroads binder grade:	AR450
Modulus adjustment factor:	1

Results

Time of loading:	0.02 seconds
Bitumen T800 pen:	58.3° C
Bitumen Penetration Index:	-0.6
Binder stiffness:	22.3 MPa
Binder volume:	10.4%
Aggregate volume:	83.6%
Voids in mineral aggregate:	16.4%
Voids filled with binder:	63.3%
Nominal mix modulus:	3,915 MPa
Adjusted mix modulus:	3,900 MPa

CIRCLY Version 5.0s (25 October 2011)

Job Title: Roundabout access pavement design, Rutherford Road, NSW

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: 4.5 MESA Title: 4.5 Million ESAs

Load No.	Load ID	Movements
1	ESA75-Full	4.50E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 2500 Xdel: 5
Y: 0

Details of Layered System:

ID: Rutherford Title: Roundabout approaches, Rutherford Rd, NSW

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.60E+02	1.75E+02	0.35
2	rough	Gran_250	Aniso.	2.50E+02	0.35	1.90E+02	1.25E+02	0.35
3	rough	SGSltCBR30	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
4	rough	Sub_CBR2.5	Aniso.	2.50E+01	0.45	1.72E+01	1.25E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
3	top	selAus2004	EZZ	0.009300	7.000	2.020
4	top	Sub_2004	EZZ	0.009300	7.000	2.020

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
3	1.00	Subgrade (Selected Material)
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 1: Austroads (2004) sublayering
Layer no. 2: Austroads (2004) sublayering
Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	170.00	Gran_350		n/a	n/a
2	200.00	Gran_250		n/a	n/a

3	300.00	SGSltCBR30	ESA75-Full	7.41E-04	1.86E-01
4	0.00	Sub_CBR2.5	ESA75-Full	9.40E-04	9.83E-01

CIRCLY Version 5.0s (25 October 2011)

Job Title: New England HW, Mussellbrook, NSW

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: 38 MESA Title: 38 MESA

Load No.	Load ID	Movements
1	ESA75-Full	3.80E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 2100 Xdel: 5
Y: 0

Details of Layered System:

ID: new englan Title: New england highway, NSW

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC14A15Es5	Iso.	2.80E+03	0.40			
2	rough	Ac20AR450s	Iso.	3.90E+03	0.40			
3	rough	Cement5000	Iso.	5.00E+03	0.20			
4	rough	SGSltCBR30	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
5	rough	SGSltCBR8	Aniso.	8.00E+01	0.35	5.93E+01	4.00E+01	0.35
6	rough	Sub_CBR2.5	Aniso.	2.50E+01	0.45	1.72E+01	1.25E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	AC14A15Es5	ETH	0.004101	5.000	1.220
2	bottom	AC20AR450s	ETH	0.003519	5.000	1.220
3	bottom	Cement5000	ETH	0.000310	12.000	10.400
4	top	selAus2004	EZZ	0.009300	7.000	2.020
5	top	selAus2004	EZZ	0.009300	7.000	2.020
6	top	Sub_2004	EZZ	0.009300	7.000	2.020

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
2	1.00	Asphalt
3	1.00	Cement Stabilised
4	1.00	Subgrade (Selected Material)
5	1.00	Subgrade (Selected Material)
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 4: Austroads (2004) sublayering
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	45.00	AC14A15Es5	ESA75-Full	-1.35E-05	1.77E-05
2	65.00	Ac20AR450s	ESA75-Full	-5.83E-06	5.79E-07
3	290.00	Cement5000	ESA75-Full	-5.92E-05	9.26E-01
4	300.00	SGSltCBR30	ESA75-Full	8.63E-05	4.53E-07
5	300.00	SGSltCBR8	ESA75-Full	9.91E-05	1.20E-06
6	0.00	Sub_CBR2.5	ESA75-Full	1.80E-04	7.86E-05

CIRCLY Version 5.0s (25 October 2011)

Job Title: Roundabout access pavement design, Rutherford Road, NSW

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: 0.91 MESA Title: 0.91 MESA

Load No.	Load ID	Movements
1	ESA75-Full	9.10E+05

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 2100 Xdel: 5
Y: 0

Details of Layered System:

ID: Rutherford Title: Roundabout approaches, Rutherford Rd, NSW

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	AC14A15Es5	Iso.	2.80E+03	0.40			
2	rough	Gran_500	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	Gran_250	Aniso.	2.50E+02	0.35	1.90E+02	1.25E+02	0.35
4	rough	SGSltCBR30	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
5	rough	Sub_CBR2.5	Aniso.	2.50E+01	0.45	1.72E+01	1.25E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	AC14A15Es5	ETH	0.004101	5.000	1.220
4	top	selAus2004	EZZ	0.009300	7.000	2.020
5	top	Sub_2004	EZZ	0.009300	7.000	2.020

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt
4	1.00	Subgrade (Selected Material)
5	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 2: Austroads (2004) sublayering
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	45.00	AC14A15Es5	ESA75-Full	-2.50E-04	9.42E-01
2	180.00	Gran_500		n/a	n/a

3	200.00	Gran_250		n/a	n/a
4	300.00	SGSltCBR30	ESA75-Full	4.74E-04	1.65E-03
5	0.00	Sub_CBR2.5	ESA75-Full	6.10E-04	9.64E-03

RIGID PAVEMENT DESIGN - THICKNESS CALCULATION

Austroads Method, 2012

PROJECT:
CLIENT:
JOB No.:
DATE:

Design traffic =	7.30E+06	(HVAG)	Characteristic flexural strength, f'_{cf} =	5.5	(MPa)	
Design project reliability =	95.0%	Defines L_{SF} see Table 2.1	Subgrade CBR =	2.5	(%)	Defines Eff S/g CBR see Eff CBR sheet
	SFCP	Defines L_{SF}	Subbase thickness =	150	(mm)	Defines Eff S/g CBR see Table 9.1 for minimum thickness
Concrete shoulders =	yes	(Yes or No)	Subbase type =	LMC		Defines Eff S/g CBR
CRC/Dowelled joints =	No	(Yes or No) Defines L_{SF}	Effective subgrade CBR =	32	(%)	Input from Fig 9.1
Load safety factor, L_{SF} =	1.5	Input from Table 9.2 (plus 0.3 as per AUSTROADS for SFCP 9.3.6)	Adjustment for slab edge effects, F_2 =	0.94		
Traffic load distribution type =	rural	(Urban/Rural/Other)				

Trial Pavement Thickness (mm) = 200.00

Total Fatigue (%) = 62.9 **Design is OK for Fatigue**
Total Erosion (%) = 342.9 ***Erosion damage exceeds 100%***

Axial Group	SAST	SADT	TAST	TADT	TRDT	QADT
Proportion of each axle group	0.344	0.098	0.007	0.32	0.231	0
Equivalent stress, S_e	0.84	1.27	0.84	1.06	0.85	0.85
Load adjustment for fatigue, F_1	9	18	18	36	54	72
Erosion factor, F_3	1.96	2.56	2.60	2.60	2.61	2.61
Load adjustment for erosion, F_4	9	18	18	36	54	54
Stress ratio factor, $S_e/(0.944\ f'_{cf})$	0.161	0.245	0.161	0.205	0.164	0.164

Table 9.2 (Austroads 2012): Load safety factors (L_{SF}) for rigid pavement types.

Pavement Type	Project Design Reliability				
	80%	85%	90%	95%	97.5%
PCP	1.15	1.15	1.20	1.30	1.35
Dowelled & CRCP	1.05	1.05	1.10	1.20	1.25

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