Shoalhaven City Council

Boondobah and Bridge Creek Bridge Renewals

Prepared By: Caitlin Battersby

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Executive Summary

The environmental assessment and determination of the proposal has been undertaken in accordance with Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

For this proposal, Shoalhaven City Council is both a public authority proponent (EP&A Act s5.3) and the determining authority (EP&A Act s5.1). The REF has been prepared in accordance with Section 171 of the EP&A Regulation (2021) and Guidelines for Division 5.1 Assessments.

An impact assessment of biodiversity was undertaken and there were no threatened ecological communities or migratory species mapped in the vicinity of the proposed activity sites. A site assessment occurred with confirmed no threatened communities are present.

It is considered that the project poses very low risk to biodiversity at both sites as all construction is proposed inside the existing footprint of the bridge and roadway, with minimal disturbance to surrounding vegetation. A target site survey occurred and confirmed the threatened Scrub Turpentine is not present.

Due to the location of the proposed activity sites, the noise impact is not a significant issue. However, standard construction times will be abided by, being 7am – 6pm Monday to Friday, 8am – 1pm Saturday and no work to occur on Sunday or Public Holidays.

The highest environmental risk posed by the proposed activity would be an impact to the state and commonwealth listed threatened species, The Australian Grayling *Prototroctes maraena*. Although, according to Fisheries NSW mapping data, Boondobah and Bridge Creek are not classified as Australian Grayling habitat, it is important to consider due to their proximity to the Clyde River which is an Australian Grayling identified habitat. It is considered that any impact would be temporary due to an estimated 8 week construction period. However, to mitigate the risks associated with any negative impact to the species, construction is proposed during January to March 2024 to avoid the migration and spawning periods for Australian Grayling between the end of March to the beginning of July and the beginning of September to end of December.

Additionally, threatened microbats also need to be considered given that the underside of bridges are often utilised for roosting. In order to mitigate the risks associated with any negative impact to the species, a survey was undertaken which identified that no species were present. Appropriate measures will be in place to remove bats if identified prior to demolition of the existing bridge.

Additional work required includes:

- Part 7 permit under the NSW Fisheries Management Act 1994 (FM Act) is required.
- Bridge design will form part of the Construction Environmental Management Plan (CEMP) to be provided to NSW Fisheries a minimum of two weeks prior to any works commencing.
- The construction tender will request contractors to provide a suitable traffic management plan that will be assessed during the tender evaluation process. This REF will then be updated with the specific details.
- This REF shall be reviewed once detailed plans have been prepared and prior to the commencement of works.
- The REF shall be published on the NSW Planning Portal prior to the commencement of works.
- Public and stakeholder engagement in relation to temporary closing the road will be required prior to the commencement of works, following Council's community engagement policy.

1. Introduction

This proposed activity involves the activities necessary for the design and construction of replacement bridges at the two sites. The existing timber bridges are approaching the end of their operational life and have been identified as being due for replacement. The proposed activity would reduce the risk for future disruption for surrounding residents, forestry, land management authorities and emergency services.

The environmental assessment and determination of the proposal has been undertaken in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). For this proposal, Shoalhaven City Council (SCC) is both a public authority proponent (EP&A Act s5.3) and the determining authority (EP&A Act s5.1). The REF has been prepared in accordance with Section 171 of the NSW *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation 2021) . Table 1 below outlines the proponent contact details.

Table 1: Proponent details

Project Name	**Boondobah and Bridge Creek Bridge Renewals**
Proponent (Council) Name	Shoalhaven City Council
Project Manager	Robert Burke
Position	Project Management Consultant
Contact Details	robert@taprojects.com.au

1.1. Project Description and Background

1.1.1. Detailed Scope of Works

The proposed works include the activities necessary for the design and construction of a modern equivalent of a timber bridge. Bridge design will form part of the Construction Environmental Management Plan (CEMP) to be provided to Fisheries a minimum of two weeks prior to any works commencing. The bridges will be closed for the duration of the construction period.

Site photos for the sites can be viewed using the following links:

- Site 1 Boondobah Creek Bridge: Site Photos
- Site 2 Bridge Creek Bridge: Site Photos

Figure 1. Boondobah Bridge Creek Bridge

Figure 2. Boondobah Bridge Creek Bridge

Figure 3. Bridge Creek Bridge

Figure 4. Bridge Creek Bridge

An indication of works staging is outlined below:

Stage 1 - Design Phase

a) Initial Conceptual Design

- Develop an initial design that aligns with local council regulations, Australian Bridge Standards, and aesthetics of the surrounding area (Appendix D).

b) Detailed Design

- Perform structural analysis and detailed design of the bridge and its components.
- Prepare the Bill of Quantities (BOQ).
- Develop detailed design reports, including all assumptions and methodologies used.

c) Design Review

- Review the design against Australian Bridge Standards and T44 load requirements.
- Adjust design as necessary in response to feedback.

Stage 2 Construction Phase

a) Pre-construction

<u>Permits, authorization, and engagement</u>

- Part 7 permit under the NSW Fisheries Management Act 1994 (FM Act) will be obtained.
- Public and stakeholder engagement in relation to temporary closing the road will be obtained, following Council's community engagement policy.
- REF will be published on the NSW Planning Portal.
- CEMP will be provided to NSW Fisheries two weeks prior to any work within waterways commencing.

<u>Site Establishment</u>

- Establish a site compound, lunchroom, office & toilet facilities, in a central location to facilitate both bridge sites.
- Delineate areas/zones/paths of movement on site to ensure visibility for pedestrians, vehicles and operators of plant to help control the interface of plant, pedestrians and vehicles.
- Implement the CEMP and set up environmental controls for the site. This will include silt curtains along each side of the river bank to trap floating sediment as result of placing rock on the riverbed and hydrocarbon booms to capture any contaminants in the event of a hydraulic failure or oil leak whilst working in or near the water.
- Delineate temporary stockpile locations and set up appropriate sediment controls.

<u>Service Search</u>

- Prior to commencing any excavation work, a dial before you dig service search will be carried out.
- The exact location of any identified services will be located and identified using nondestructive digging/potholing. The result of these findings will be handed over to SCC if there is a temporary location required.

<u>Dismantle the Existing Bridge Structure</u>

All workers will be briefed on the demolition plan prior to commencing works. Each workers role will be clearly identified. An exclusion area will be established and maintained during these works to delineate the area and prevent any workers entering the zone.

All environmental controls i.e., hydrocarbon boom, sediment fence, and turbidity curtains will be in place prior to demolition of the bridge. A layer of geofab / bidim, spanning the length and width of the bridge will be hung from the underside of the bridge to catch/prevent any loose debris from entering the water.

Plant & Equipment required for the demolition process include:

- 55tn mobile crane
- 14tn excavator with hydraulic grabs
- Power tools - Heavy Duty Impactor
- Cutting Tools - Grinder, Oxy Set

A brief outline of the demolition is below:

1. Initially all bolts will be unscrewed from the decking and handrails. Any bolts that cannot be removed will be cut using a grinder / oxy cutting, ensuring all controls are in place whilst carrying out these works i.e., fire extinguishers, etc.
2. All handrails will be removed from the bridge
3. The transverse decking will be removed in mattress-like sections. The mattress sections will be approx. 3m long x width of the bridge. They will be disconnected from the bearers and craned out of position.
4. The longitudinal bearers will then be removed using the mobile crane. The bearers will be disconnected from both existing abutments and lifted out of position individually.
5. Abutments will then be removed. The pile and cross beams will be exposed by removing the soil behind the abutments with the excavator and dismantling.
6. Existing piles will be cut off at underside of new blinding/rock scour protection.

This sequence would allow contractors to dismantle rather than demolish the bridge, keeping as many components as possible of the existing bridge in good condition for SCC to reuse later.

Requirements for notification to Work safe are below, both requirements extracted direct from Work Safe website.

Demolition notification requirements will apply to:

- a structure, or a part of a structure, that is load-bearing, or otherwise related to the physical integrity that is over 6m high
- load shifting machinery on a suspended floor
- explosives

Requirements for a restricted demolition license are below:

You need this license to demolish or partly demolish any structure or part of a structure that is loadbearing or otherwise related to the physical integrity of the structure and:

- is between 6-15m high
- involves using load-shifting machinery on a suspended floor, such as bulldozers, cranes, excavators, front-end and skid-steer loaders

Both proposed projects will not include any load shifting equipment or plant on the bridge deck and the bridge deck to riverbed measurement is 4.6 m. Due to this, notification to safe work or the requirement to have a restricted demolition license is not required.

b) Construction

Abutment Preparation and Scour Rock

Both abutment location areas will be trimmed to level and the front face/creek side of the abutment batter will be shaped and scour rock placed. This will avoid the need to work around the piles after they have been placed and also help stabilise the working platform for pile installation.

Piling

As the new bridge is wider than the existing bridge, increasing both bridges from an average of 3.8m to 4.2m, the piling platform will be constructed within the zone of the new approach works. The platform will be widened out of existing material, with the necessary clearing and grubbing (of regrowth and under scrub, no trees will be removed) and foundation inspection carried out prior to placement. This will allow the job to be completed once, rather than placing fill for the working platform, then stripping, and placing the approach formation layers.

- The 310UC beams will be driven using an excavator with hydraulic grabs, mobile crane and Dawson impact hammer.
- Piling will commence on Abutment A side, once completed the crane will set up on Abutment B side and complete the works.
- The piles will then be cut off at to the required level, leaving the required projection into the abutment as per the design drawings and top plates welded to piles.
- Pile length are in accordance with Geotech reports for rock level /siltstone on both sides of the bridge.

Abutment Blinding and Installation

- Abutment Blinding will be placed after the piles have been trimmed to level, the locations for the abutment installation will then be set out.
- The abutment reinforcement cage will be prefabricated and lifted into position.
- The abutment will be closed out using a modular framework system and concrete poured.

Deck Beam Installation and cast insitu concrete deck

- The prestressed precast reinforced concrete beams will be manufactured off site and delivered to site for installation. The beam are 11.95m long, 500mm wide x 350mm deep.
- Temporary handrails will be fixed to the external beams to facilitate deck construction and for fall protection during works.
- Bondek or Fibre cement sheeting will be placed between the spaced beams as sacrificial formwork for the deck pour. All joints will be tested with water to ensure there are no leaks and to avoid this risk of any concrete slurry entering the water during the pour.
- The reinforcement will then be fixed into position along with edge the edge boards for the cast insitu concrete deck. All ferrules to accommodate the side mounted bridge rail will be set in position on the outer edge/face of the deck.
- The concrete deck can then be poured. Once the deck is poured and cured, edge boards will be stripped and the side mounted rail will be installed. After the side mounted rail is installed, the temporary handrail can be removed.

Road Approaches

We have allowed for localised backfilling behind the abutments. Pavement pricing includes T18 for 200mm DGB20 for 50m to approaches to the bridges and a 14/7mm C170 two coat seal.

c) Post-construction

Handover, Defects, Demobilise and Restoration

- A final inspection will be carried out on the bridge as part of the handover process. If any defects are found, they can be addressed in this period.
- Site compounds will be demobilised, and any areas disturbed by construction works be regraded and seeded.
- All environmental controls will be removed from the river. Minor sediment controls can be left in place to prevent silt run off into the creek, until the grass has established on the new formation batters.

Deliverables

- Initial and detailed design reports
- Bill of Quantities
- Construction management plan
- Completed bridge structure meeting AS 5100 and T44 load requirements
- Completion report

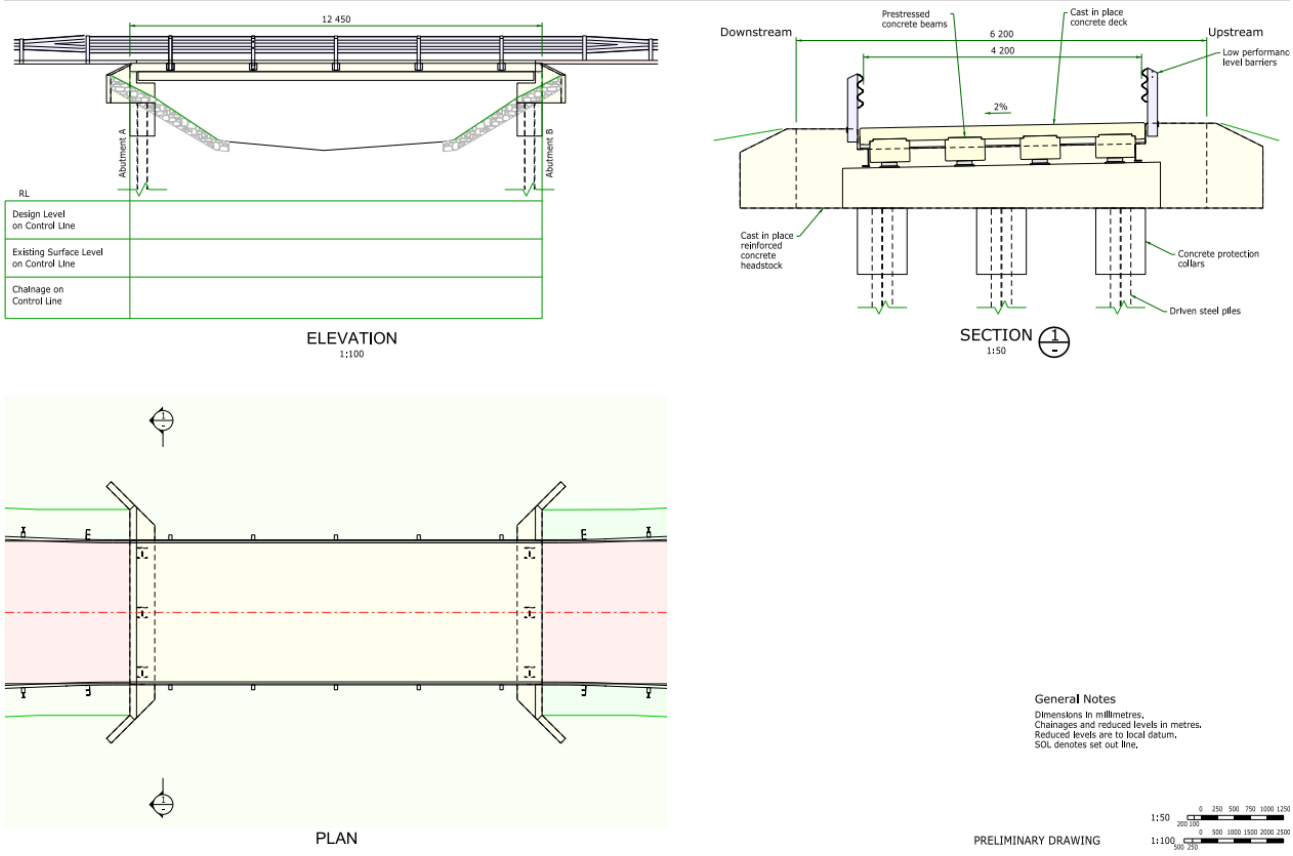

Figure 5. Draft Design Plans

Figure 5 demonstrates the 75% completion design plans for Boonabah Creek Bridge. The design is identical for Bridge Creek Bridge and will be replication upon completion. Design Plans will be updated upon completion.

Additional aspects of the design plans can be viewed using the following link: Brooman 75% Plans.pdf and are provided in Appendix D of this REF.

1.1.2. Machinery and Equipment

- Excavator
- Skid Steer
- Roller
- Water Cart
- Rigid Truck or Truck and Dog
- Other as required

1.1.3. Duration and Working Hours

The works are short term, as outlined in Table 2.

Table 2: Project timeframes

Commencement Date	January 2024
Work Duration	The estimates total timeframe for the proposed works is: 8 weeks (Design Phase) 8 weeks (Construction Phase)
Work Hours	Standard construction hours: * Monday to Friday 7:00am to 6:00pm * Saturdays 8:00am to 1:00pm * No work on Sundays or Public Holidays

1.2. Project Location and Context

1.2.1. Location of the Proposed Activity

Both sites are located within the locality of Brooman, within the Shoalhaven City Council LGA. The sites are located approximately 30 km from the main centre of Ulladulla and 40km from Batemans Bay. The sites of the existing and proposed replacement bridges are located:

- Site 1 - Brooman Road and crosses Boondobah Creek, Brooman
  Lot 1 DP872169
  Coordinates: -35.460368, 150.248448
- Site 2 - The River Road and crosses Bridge Creek, Brooman
  Lot 7002 DP1050272
  Coordinates: -35.517650, 150.214381

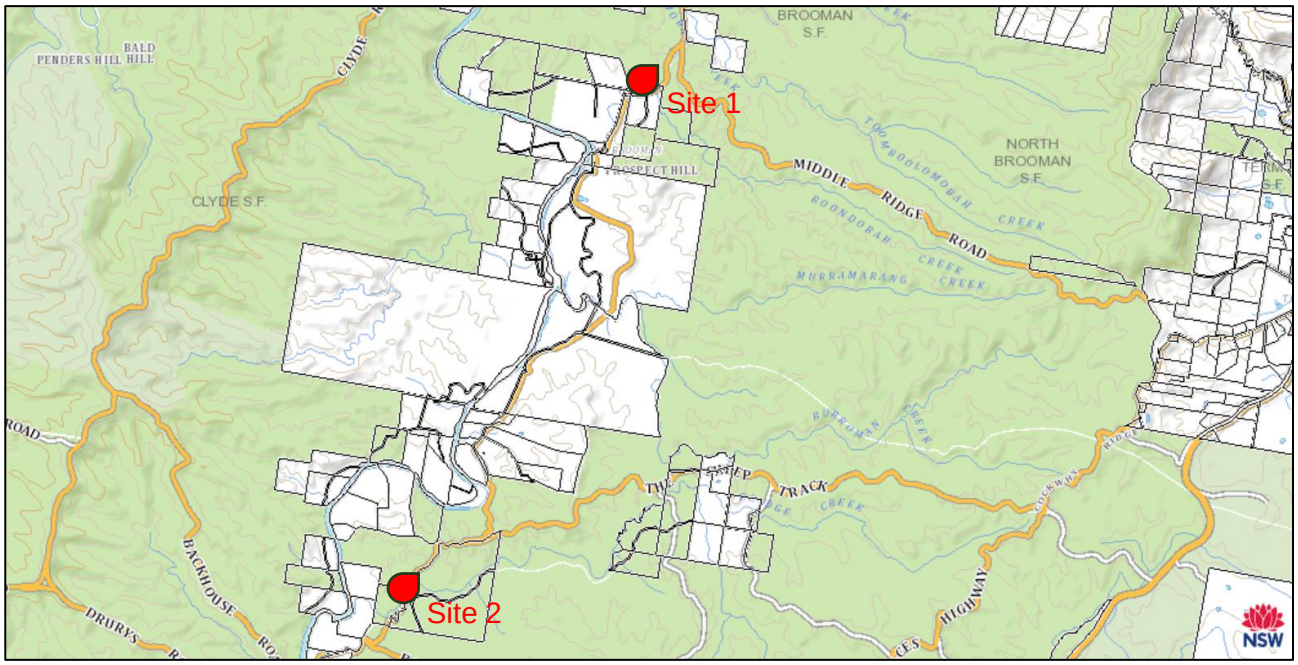

Image 6. Topographic Map of Area

Image 7. - Site 1 "Boondobah Creek Bridge", Brooman Road over Boondobah Creek

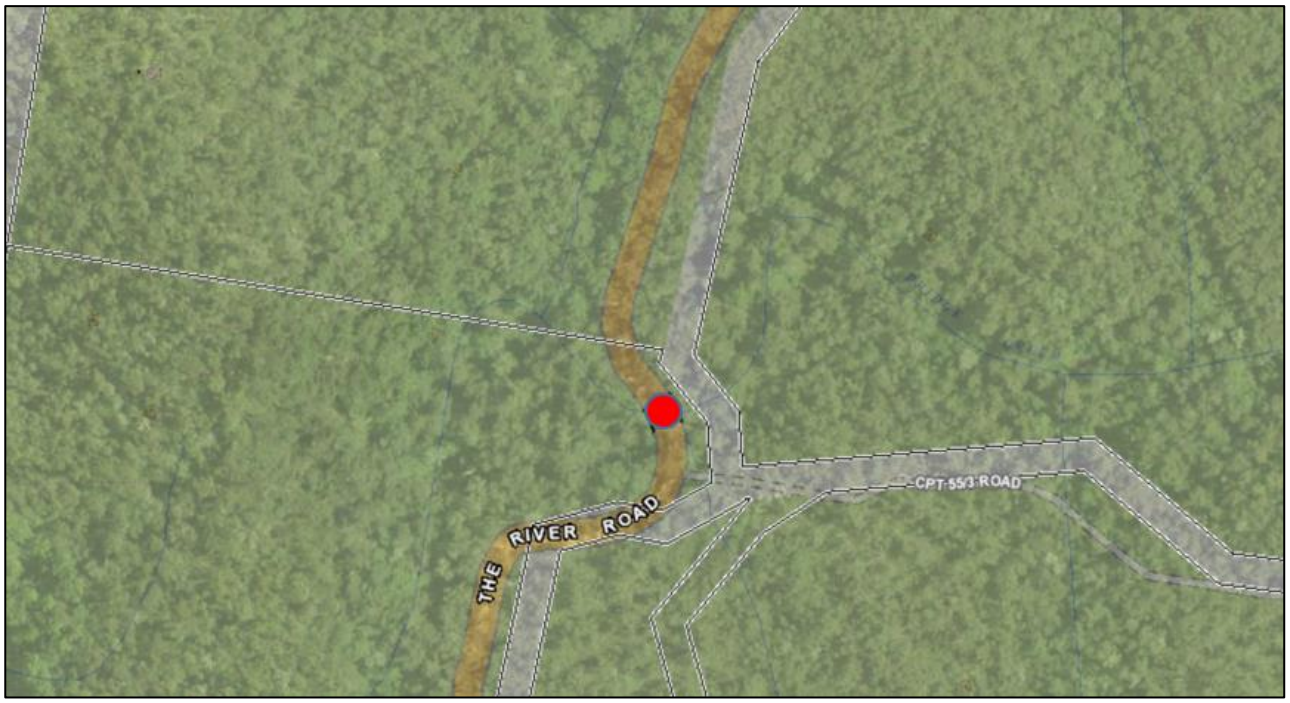

Image 8. – Site 2 "Bridge Creek Bridge" The River Road over Bridge Creek– Brooman

1.2.2. Site Context

Shoalhaven City Local Government Area is located on the far south coast of NSW and covers 130 kilometres of coastline. The coastline stretches from Berry's Bay (Shoalhaven Heads) on the northern end to North Durras on the southern end and includes the main townships of Ulladulla, Sussex Inlet, Huskisson and Nowra. The two proposed activity sites are located approximately 20km west from the coast line within the locality of Brooman. The surrounding context of the sites are rural bushland, with site 1 being surrounded by rural land, a mix of cleared and forested, with limited development and site 2 being situated within South Brooman State Forest.

The water catchment of both sites is heavily dependent on rainfall, being classified as large scale named water courses. The surrounding runoff from the proposed activity sites drains into the subsequent creek and impact should be mitigated to avoid negative impacts during works.

Site 1 consists of Boondobah Creek which flows northwest at the site and eventually joins the Clyde River approximately 1km to the southwest of the project area, as shown in figure 9.

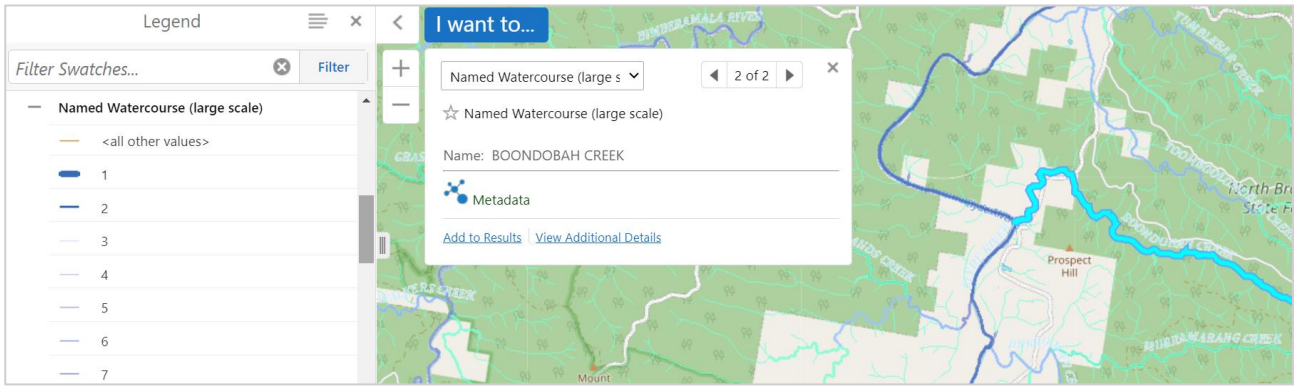

Figure 9. NSW Hydrography – Named Watercourse – Site 2 Boondobah Creek

Site 2 consists of Bridge Creek which flows west at the site and eventually joins the Clyde River approximately 0.8km to the southwest of the project area, as shown in figure 10.

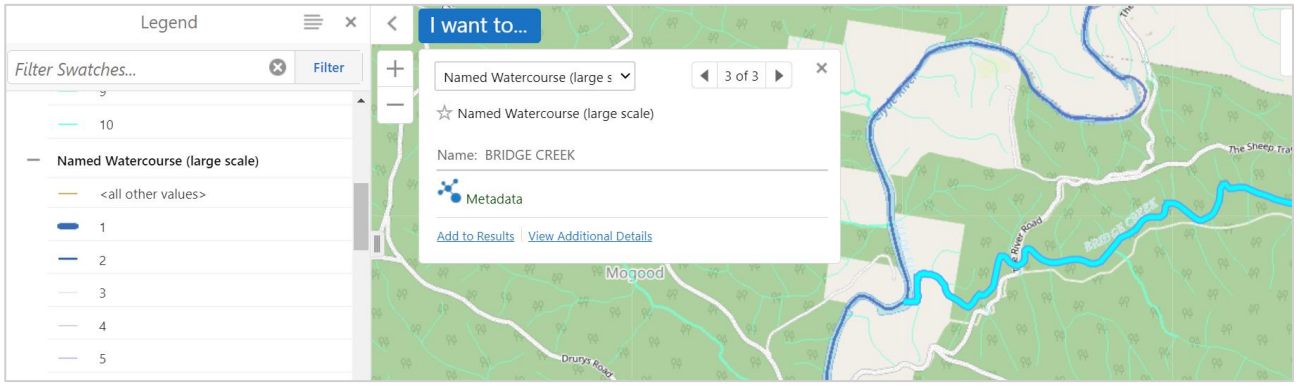

Figure 10. NSW Hydrography – Named Watercourse – Site 2 Bridge Creek

Site 1 is surrounded by wet sclerophyll forests (shrubby sub formation) in a south coast river flat peppermint and wet gully forest and south coast lowland shrub-grass forest. There are no EEC's within the vicinity of the works. The terrain of the proposed site is flat, with mountain ridges to the west and north. From the topography map contained in figure 11, it is evident the gully's, water catchments and mountains.

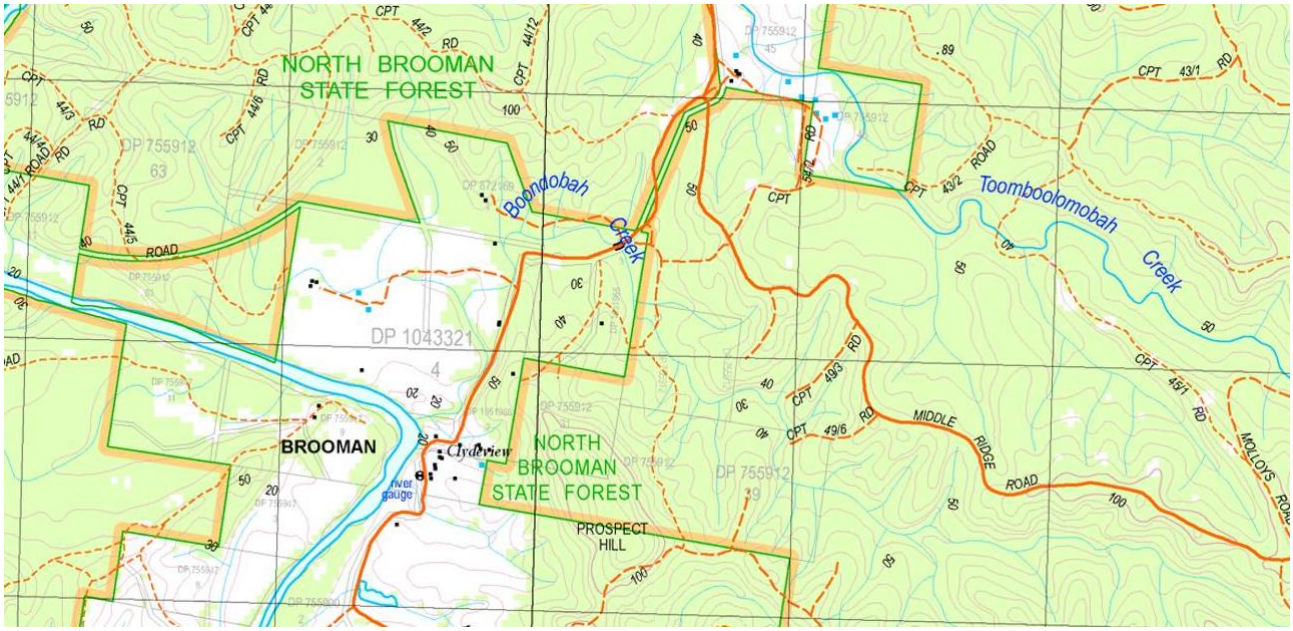

Figure 11. Site 1 Topography Map

Site 2 is surrounded by wet sclerophyll forests (shrubby sub formation) in a south coast river flat peppermint and wet gully forest. There are no EEC's within the vicinity of the works. The terrain of the land is flat as the proposed activity location lies within a gully, with mountain ridges to the west.

From the topography map contained in figure 12, it is evident the gully's, water catchments and mountains.

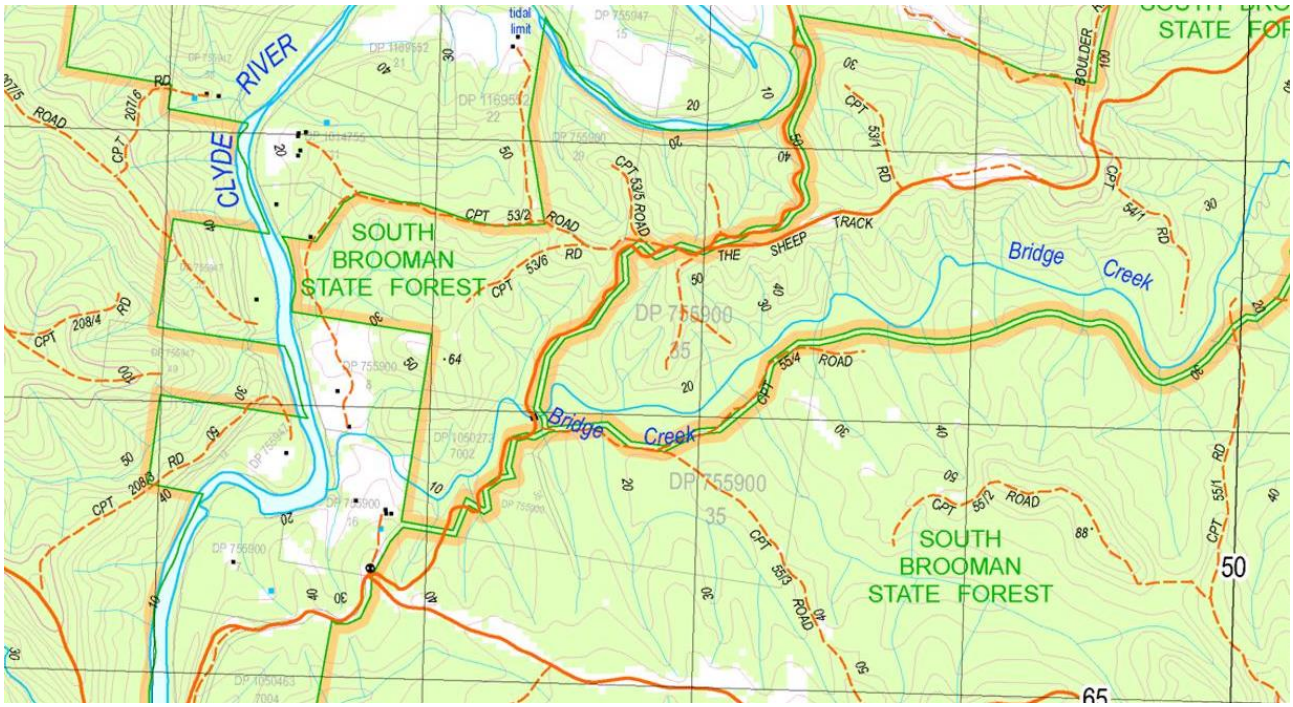

Figure 12. Site 2 Topography Map

1.2.3. Land use and ownership

Site 1 is located within RU2 Rural landscape were the surrounding land, known as South Brooman State Forest is owned by NSW Forestry and private, property which is both cleared and vegetated. The land in which the works are occurring are within an unsealed road reserve owned and maintained by SCC. The works do not impinge on a National Park or land owned by NPWS.

Figure 13. Land Zoning – Site 1 Boondobah Creek Bridge

Site 2 is located within RU3 Forestry were the surrounding land, known as South Brooman State Forest is owned by NSW Forestry and classified as a formal reserve, utilised for recreational use. The road reserve in which the works are occurring within, is classified as a major Forest unsealed Road, and is maintained by SCC, with no works impinging on a National Park or land owned by NPWS.

Figure 14. Land Zoning – Site 2 Bridge Creek Bridge

1.2.4. Project Justification and Consideration of Alternatives

This project is a restoration project funded under the State Government Fixing Country Bridges (FCB) Round 2A Bridge Replacements Program.

The existing bridges are approaching the end of their life and they have been identified as being due for renewal. The replacement of the bridges would reduce this risk for future disruption for surrounding residents, NSW Forestry, Emergency Services, and government agencies who utilise these roads. The replacement and upgrade of these bridges pose several benefits in comparison to the existing. Advantages include:

1. Enhanced safety: Old or damaged bridges can pose a significant risk to drivers, pedestrians, and cyclists. Through replacement of these bridges, safer and more resilient access can be provided to the community, emergency services etc. Additionally, it can minimise the risk of failure occurring during a natural disaster event such as a bushfire or flood.
2. Improved durability: The bridge structures would be more durable and long lasted compared to the existing structure. This means, the surface can withstand increased traffic, resist erosion, and remain stable under different weather conditions.
3. Infrastructure maintenance: Regular maintenance and upgrades to bridge infrastructure is necessary to ensure they remain functional and safe. Through this project, issues with the current infrastructure will be addressed which will prevent further deterioration of the existing infrastructure.
4. Enhanced drainage: Upgrades to the bridge infrastructure will enhance the drainage and assist with effective stormwater drainage, as currently due to the condition of the bridges, this is compromised.

5. Environmental benefits: Through upgrading the bridge, the fish passageway will be enhanced, reducing blockages which could occur during flooding, and assists with migration and movement.
6. Reduced flooding: Through upgrading the infrastructure, more stormwater movement will occur by reducing the number of blockages with the new infrastructure, which will reduce the impact that heavy rainfall will portray onto the infrastructure. This will assist with residents accessing properties and bodies such as NSW Forestry and emergency services who utilise the road.

2. Statutory and Planning Context

2.1. Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) provide the framework for development and environmental assessment in NSW.

Due to the Provisions of the Transport and Infrastructure SEPP, this development is permissible without consent. Accordingly, SCC must satisfy Sections 5.5, 5.6 and 5.7 of that Act by examining, and taking into account to the fullest extent possible, all matters which are likely to affect the environment. This REF is intended to address council's compliance with the EP&A Act including Sections 5.5, 5.6 and 5.7 and the requirements of Section 171 of the EP&A Regulation 2021. Environmental Planning Instruments made under the EP&A Act 1979 may also be relevant and are addressed below.

2.2. State Environmental Planning Policy (Transport and Infrastructure) 2021

The *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Infrastructure SEPP) aims to facilitate the delivery of infrastructure across NSW by identifying whether certain types of infrastructure require consent, can be carried out without consent or are exempt development.

Pursuant to clause 2.109 of the SEPP, development for the purpose of a road or road infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land. As the proposed activity does not require development consent, and as it constitutes an 'activity' for the purposes of Part 5 of the EP&A Act, being carried out by (or on behalf of) a public authority, environmental assessment under Part 5 of the EP&A Act is required. This REF provides this assessment.

2.3. Other Environmental Legislation

Table 3 outlines how the project has been considered under other relevant Commonwealth and State environmental legislation.

Table 3: Other environmental legislation

Legislation	Relevance to the Proposed Activity
COMMONWEALTH LEGISLATION	
***Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)**	The EPBC Act protects matters of National Environmental Significance (NES), such as threatened species and ecological communities, migratory species (protected under international agreements), and National Heritage places (among others). Matters of NES, including the Australian Greyling, have been identified on and near the site as outlined in section 3.3. An assessment of the activity has been undertaken in accordance with Significant Impact Criteria in the Significant Impact Guidelines 1.1 (Commonwealth of Australia 2013). A significant impact is not likely to result and therefore a referral to the Commonwealth Department of Environment is not required.
STATE LEGISLATION	
***Biodiversity Conservation Act 2016* (BC Act)**	Part 7 of the BC Act provides the environmental assessment requirements for activities being assessed under Part 5 of the EP&A Act 1979. If a significant impact is likely, a Species Impact Statement is required. A biodiversity development assessment report may also be required if the proponent elects for this. Section 7.2(1)(a) and 7.3 describe the assessment requirements and thresholds for what is considered a significant impact. Threatened species and communities listed under this act were identified as potentially being impacted by the works. Assessments of Significance were undertaken for these matters and concluded that a significant impact is not likely to result and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not Required.
***Local Land Services Act 2013* (LLS Act)**	The objects of the LLS Act include 'to ensure the proper management of natural resources in the social, economic and environmental interests of the State, consistently with the principles of ecologically sustainable development. The Act regulates the clearing of native vegetation; however section 60(O)(b)(ii) excludes the need for consent under the LLS Act where the clearing is an activity carried out by a determining authority within the meaning of Part 5 of the EP&A Act 1979.
***Fisheries Management Act 1995* (FM Act)**	FM Act provides for the protection, conservation, and recovery of threatened species, populations and ecological communities of fish and marine vegetation and fish habitats, as well as promoting the development and sharing of fishery resources in NSW. The development involves dredging and reclamation works and therefore a Part 7 permit under the FM Act is required. . Regarding the other provisions and controls in the Act the proposed activity: • would not affect declared aquatic reserves (Part 7, Division 2 of the Act); • would not involve blocking the passage of fish (s.219); • would not impact mangroves (Part 7, Division 4); • would not involve disturbance to gravel beds where salmon or trout spawn (s.208 of the Act); • does not involve the release of live fish (Part 7, Division 7); • does not involve the construction of dams and weirs (s.218); • would not result in the blocking of the passage of fish; • would not use explosives in a watercourse (Clauses 70 and 71 of the Fisheries Management (General) Regulation 2019).
***National Parks and Wildlife Act 1974* (NPW Act)**	The NPW Act regulates the control and management of all national parks, historic sites, nature reserves, and Aboriginal areas.

Legislation	Relevance to the Proposed Activity
	The main aim of the Act is to conserve the natural and cultural heritage of NSW. Where works will disturb Aboriginal objects, an Aboriginal Heritage Impact Permit (AHIP) is required. The proposed activity is within an existing footprint of the bridge and roadway and the area has been largely already disturbed. An AHIMS Web Service Search was conducted 12 July 2023 for an area of 200m surrounding both sites, contained within Appendix B. Site 1 returned a result showing 2 Aboriginal objects have been recorded within the search area. Both site 58-1-0844 and site 58-1-0845 were discovered during an archaeological survey conducted during PHD fieldwork during 1991 – 1993. Site 58-1-0844 is identified as a surface isolated grey basalt flake artefact with no additional information provided on its location. Site 58-1-0855 is identified as a surface isolated grey basalt hammerstone artefact with no additional information provided on its location. Therefore, the mapped location identified in the AHIMS search is to be taken, and mitigation measures implemented to prevent impact occurring to the known identified sites. Site 2 returned a result showing nil Aboriginal sites or places have been declared within the search area. The proposed activity is of low impact according to the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (DECCW 2010). No further assessment is required.
Heritage Act 1977	The proposed activity does not involve an item or place listed on the NSW State Heritage Register or the subject of an interim heritage order or listing and is therefore not a controlled activity. Approval of works on the site is therefore not required under Part 4 of the Heritage Act. The proposal would constitute 'minor works' under 'Relics of local heritage significance: a guide for minor works with limited impact.' The proposal would not result in any direct impacts on heritage items or values. Works can be undertaken with caution under an applicable exception under s139(1) and (2) of the act.
Protection of the Environment Operations Act 1997 **(POEO Act)**	The POEO Act is the key environmental protection and pollution statute. The POEO Act is administered by the EPA and establishes a licensing regime for waste, air, water and pollution. Relevant sections of the Act are listed below: • Part 5.3 Water Pollution • Part 5.4 Air Pollution • Part 5.5 Noise Pollution • Part 5.6 Land Pollution and Waste Any work potentially resulting in pollution must comply with the POEO Act. Relevant licences must be obtained if required. The proposed activity does not constitute scheduled development work or scheduled activities as listed in Schedule 1 of the Act, The proposed activity therefore does not require an environmental protection licence.
Water Management Act 2000 **(WM Act)**	The WM Act's main objective is to manage NSW water in a sustainable and integrated manner that will benefit today's generations without compromising future generations' ability to meet their needs. Section 91E of the Act establishes an approval regime for controlled activities within waterfront land. However Local councils are exempt from s.91E(1) of the Act in relation to all controlled activities that they carry out in, on or under waterfront land by virtue of clause 41 of the Water Management (General) Regulation 2018. The proposal would not interfere with the aquifer and therefore an interference licence is not required (s.91F).

Legislation	Relevance to the Proposed Activity
	Note: Although formal approval under the WM Act is not required, if the proposed activity is within 40m of a waterway, an attempt should be made to comply with the requirements of controlled activities in order to reduce risks to waterways.
Roads Act 1993	Section 88 of the *Roads Act* states that a roads authority may, despite any other Act or law to the contrary, remove or lop any tree or other vegetation that is on or overhanging a public road if, in its opinion it is necessary to do so for the purposes of carrying out road work or removing a traffic hazard. However, the environmental safeguards outlined in this REF still apply. No trees will be removed to carry out the proposed works at either site. Under scrubbing and removal of vegetation including grasses, shrubs and regrowth will occur however this will have a minimal impact as it is within the previous footprint of works.
Biosecurity Act 2015	The *Biosecurity Act 2015* and regulations provide requirements for state level priority weeds. The Act regulates all plants, with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. If weeds are identified onsite which pose as a biosecurity risk should be disposed of at an approved greenwaste/recycling facility where mitigation measures such as solar radiation to kill seeds/roots before disposal will occur.
State Environmental Planning Policy (Hazards and Resilience) 2021	The area of the proposed activity is not mapped as comprising coastal wetlands or littoral rainforest for the purpose of this SEPP. Other considerations of the SEPP are not applicable to the proposed activity.

3. Existing Environment and Impact Assessment

3.1. Landform, Geology and Soils

3.1.1. Existing Environment

Site 1 - Brooman Road at Boondobah Creek is located approximately 8.7km west of the Princes Highway near Brooman and can be accessed from Middle Ridge Road from The Old Princes Highway. The bridge is comprised of a short and narrow single span bridge.

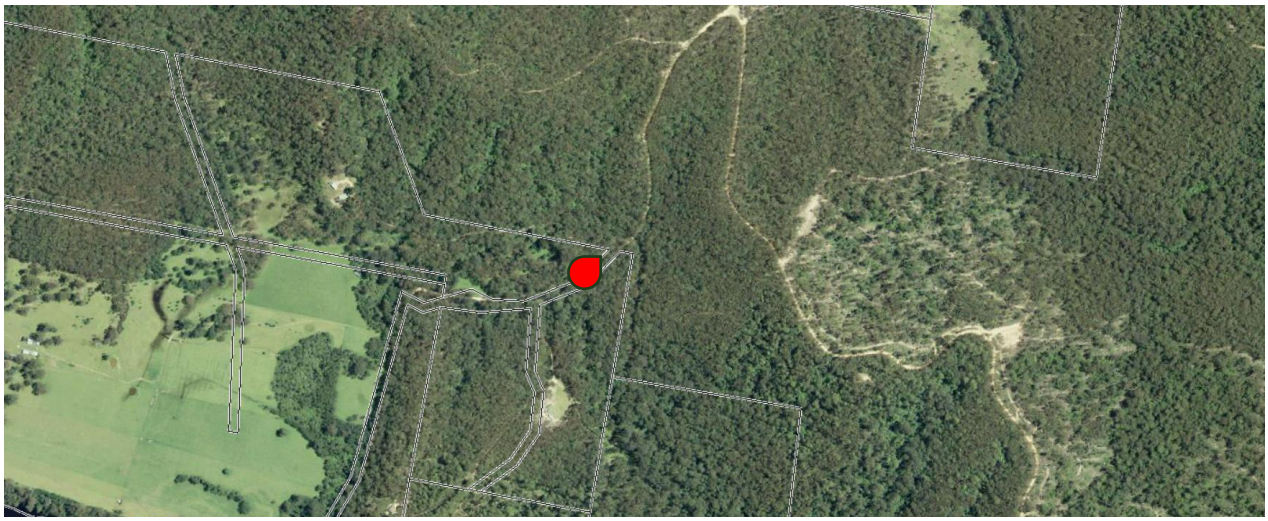

Figure 15. Subject Site 1

Site 2 – The River Road Bridge at Bridge Creek is located about 9.5km west of the Princes Highway within Mogood and can be accessed by The Sheep Track from The Old Princes Highway. The bridge is comprised of a single span bridge.

Figure 16. Subject Site 2

3.1.2. Impact Assessment

A geotechnical investigation was undertaken by Terra Insight Pty Ltd which indicates that the sites are underlain by Alluvial Valley Deposits comprised of silty, clay, lithic to quartz lithic sand and gravel. These deposits are underlain by the Abercrombie Formation which is expected to underly the sites at depth and is comprised of brown and buff to grey, thin- to thick-bedded, fine- to coarse-grained mica-quartz (±feldspar) sandstone, interbedded with laminated siltstone and mudstone. Sporadic chert-rich units.

Tables 3-1 and 3-2 below provides a summary of subsurface units identified during the investigation.

Table 3-1: Summary of subsurface investigation Site 1 - Brooman Road at Boondobah Creek

Subsurface conditions *(Soil name, plasticity or particle characteristics, colour, secondary components and minor components)* Approach side to bridge	Structure and other comments	Depth encountered in test pit/exposure (m) BH101 East	BH102 West	EXP101 West
Clayey Gravelly SAND: fine to medium sand, brown/yellow brown, lo plasticity fines, fine to medium angular gravel	Fill	0.0-0.4	NE	NE
Sandy CLAY: low plasticity, brown, fine to medium sand, with fine to medium angular gravels and quartz gravels (appears sandy, workable when moist)		0.4-1.7	0.0-0.4	NE
Silty CLAY: medium plasticity, yellow brown		NE	0.4-0.8	NE
Sandy CLAY, Silty SAND: fine to medium sand, dark brown, low plasticity fines, with fine to medium rounded gravels, trace of organics	Topsoil	NE	0.8-1.2	0.0-0.2
Silty Clayey SAND, Silty SAND, SAND: fine to coarse sand, brown/light brown, low plasticity fines	Alluvium	1.7-4.4	NE	NE
Silty CLAY: medium to high plasticity, white and yellow/orange mottled	Residual	4.4-5.5	1.2-2.7	0.2-0.6
Silty CLAY, Sandy Silty CLAY: low to high plasticity, white and grey banded, yellow brown, trace of fine angular gravels, some bands of white clay recovery	Residual/Extremely Weathered Material	5.5-7.0$^{T/C}$	2.7-4.1^{r}	0.6-1.0*
SILTSTONE: moderately weathered, low strength, light brown, greenish tinge in parts, iron stained, some quartz seams <10mm thick	Weathered Rock	7.0-9.0		
SILTSTONE: slightly weathered, very low to low strength, grey, thinly bedded, 45 to 50 degrees bedding, dark grey seams		9.0-9.8*		

*Notes * - End of hole at target depth; ^{r} - Early refusal on rock, VR- Virtual refusal, NE – not encountered, T/C – Tungsten carbine auger refusal and coring start,*

Table 3-2: Summary of subsurface investigation Site 2 - The River Road at Bridge Creek

Subsurface conditions *(Soil name, plasticity or particle characteristics, colour, secondary components and minor components)* Approach side to bridge	Structure and other comments	Depth encountered in test pit/exposure (m) BH201 South	BH202 North	BH203 North	EXP201 North
Clayey Sandy GRAVEL: fine to coarse angular gravel, light orange brown, fine to coarse sand, with cobbles	Base	0.0-0.4	NE	NE	NE
Gravelly Sandy CLAY: low plasticity, light orange brown, fine to medium sand	Fill	0.4-1.2	0.1-1.0	NE	NE
Sandy CLAY: low plasticity, brown, fine to medium sand, with gravel	Colluvial	NE	NE	0.0-1.0	0.0-0.5
Clayey SILT/Silty CLAY: low plasticity grey brown to dark brown, trace orange mottling, with fine sand	Alluvial	1.2-2.8	1.0-3.3		
Sandy Silty CLAY/Sandy Clayey SILT: low plasticity, brown with grey mottles, fine sand	Alluvial (possibly Residual in BH202)	2.8-5.2	3.3-5.0		
Gravelly CLAY: low plasticity, brown, fine to medium angular gravels	Extremely Weathered Material	NE	5.0-5.3^{r}		
SILTSTONE: very low strength, extremely weathered, blue, friable to Sandy SILT		5.2-6.5$^{T/C}$			
SILTSTONE: grey to light grey, slight blue tinge, thinly bedded, some 70 degree joints, weathered and crushed seams	Weathered Rock	6.5-7.6			
Sandy SILTSTONE: light brown, some near horizontal 60 degree joints and crushed seams		7.6-8.5*			

*Notes * - End of hole at target depth; ^{r} - Early refusal on rock, VR- Virtual refusal, NE – not encountered, T/C – Tungsten carbine auger refusal and coring start, SPTR*

The great soil group (GSG) soil type for site 1 is Amh Alluvial Soils – medium to heavy texture surrounded by YPI Yellow Podzolic soils – less fertile, demonstrated in figure 17. The soil classification (ASC) is Dermosols surrounded by Kurosols, as shown in figure 18.

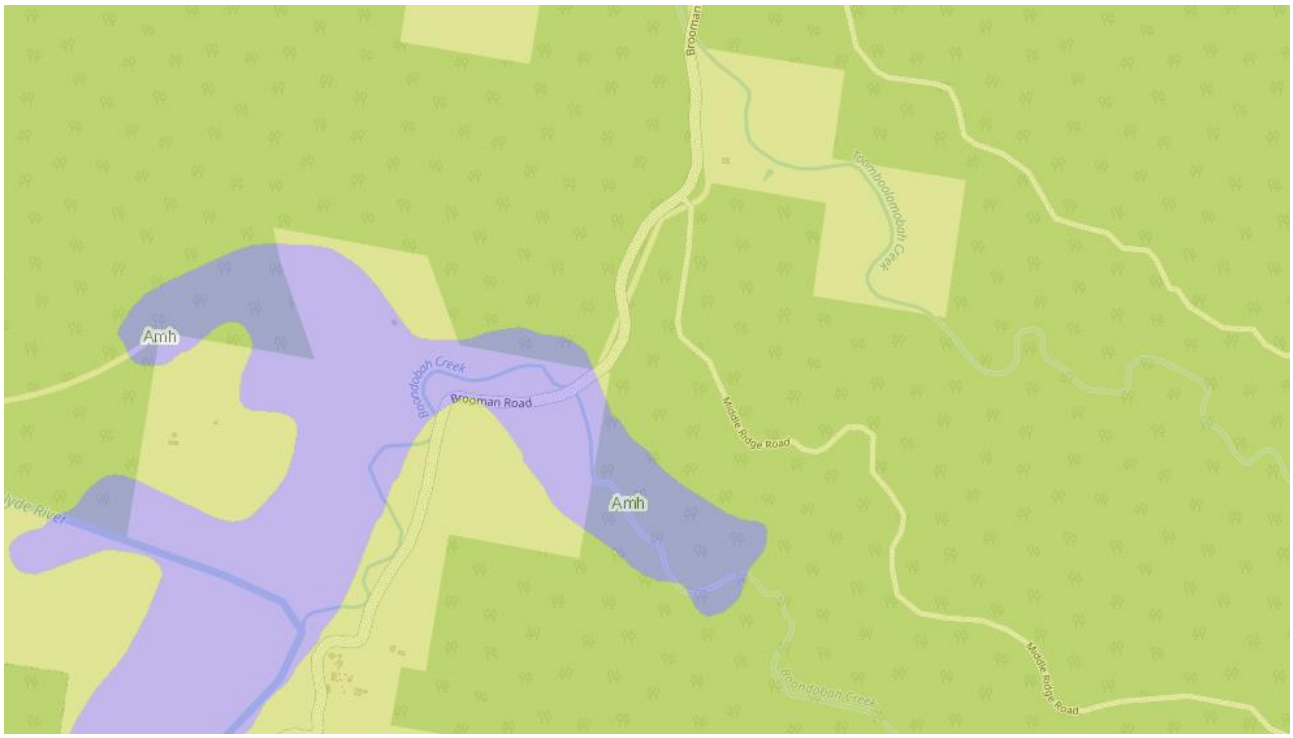

Figure 17. Site 1 Great soil group soil type

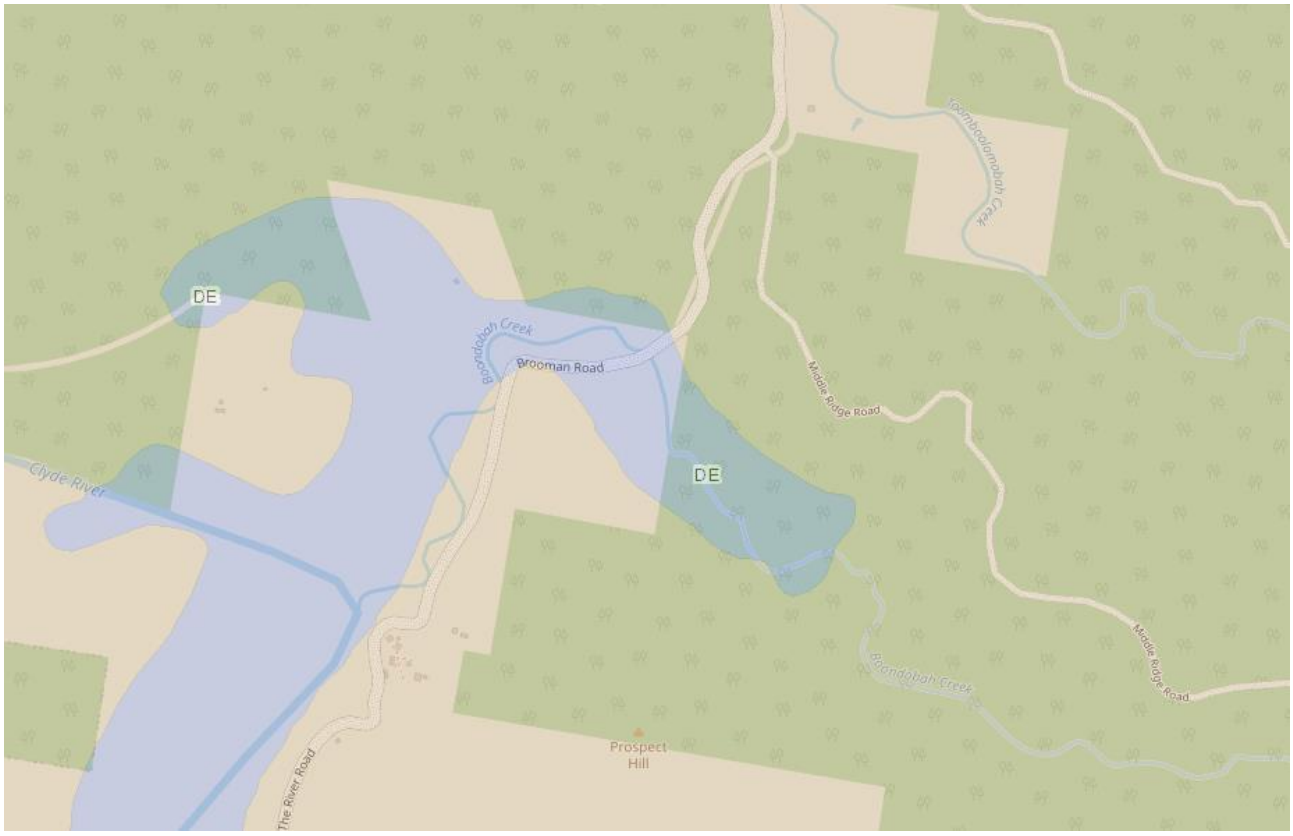

Figure 18. Site 1 Australian Soil Classification

The great soil group (GSG) soil type for site 2 is YPI Yellow Pozolic soils – less fertile as shown in figure 19. The soil classification (ASC) is Kurosols, as shown in figure 20.

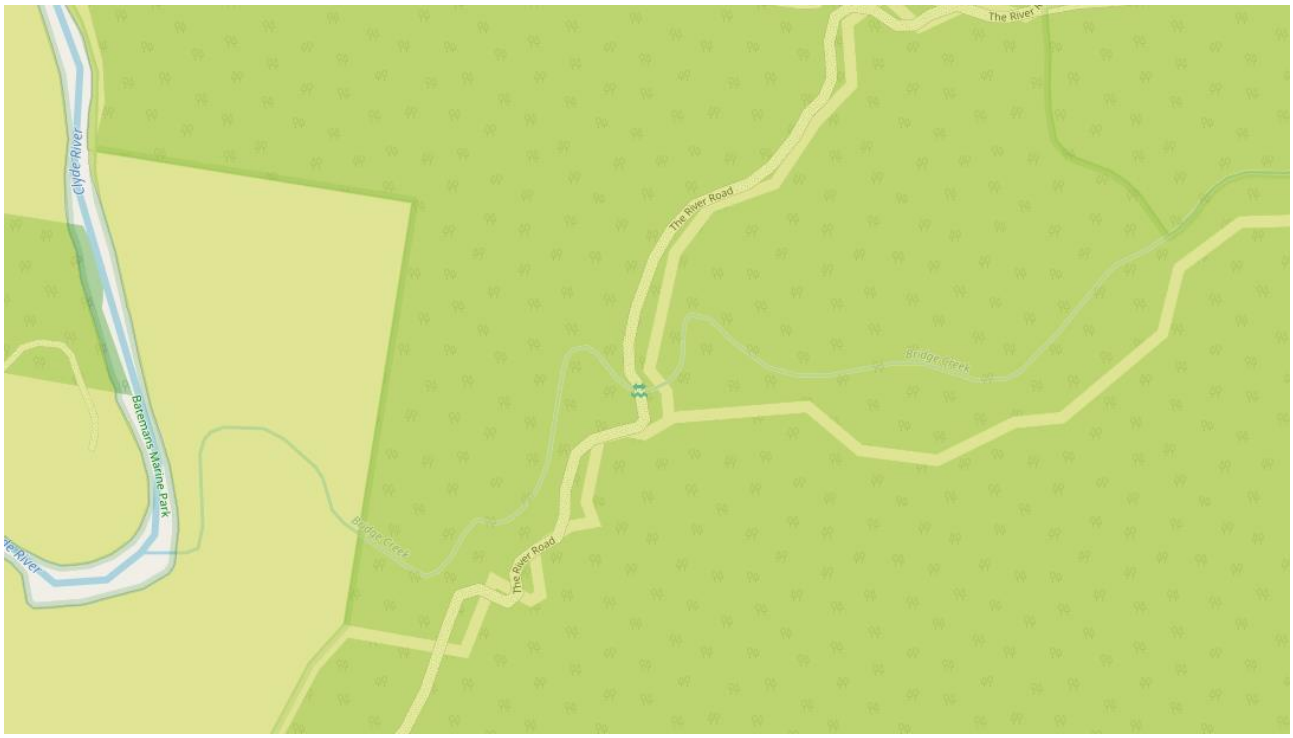

Figure 19. Site 2 Great soil group soil type

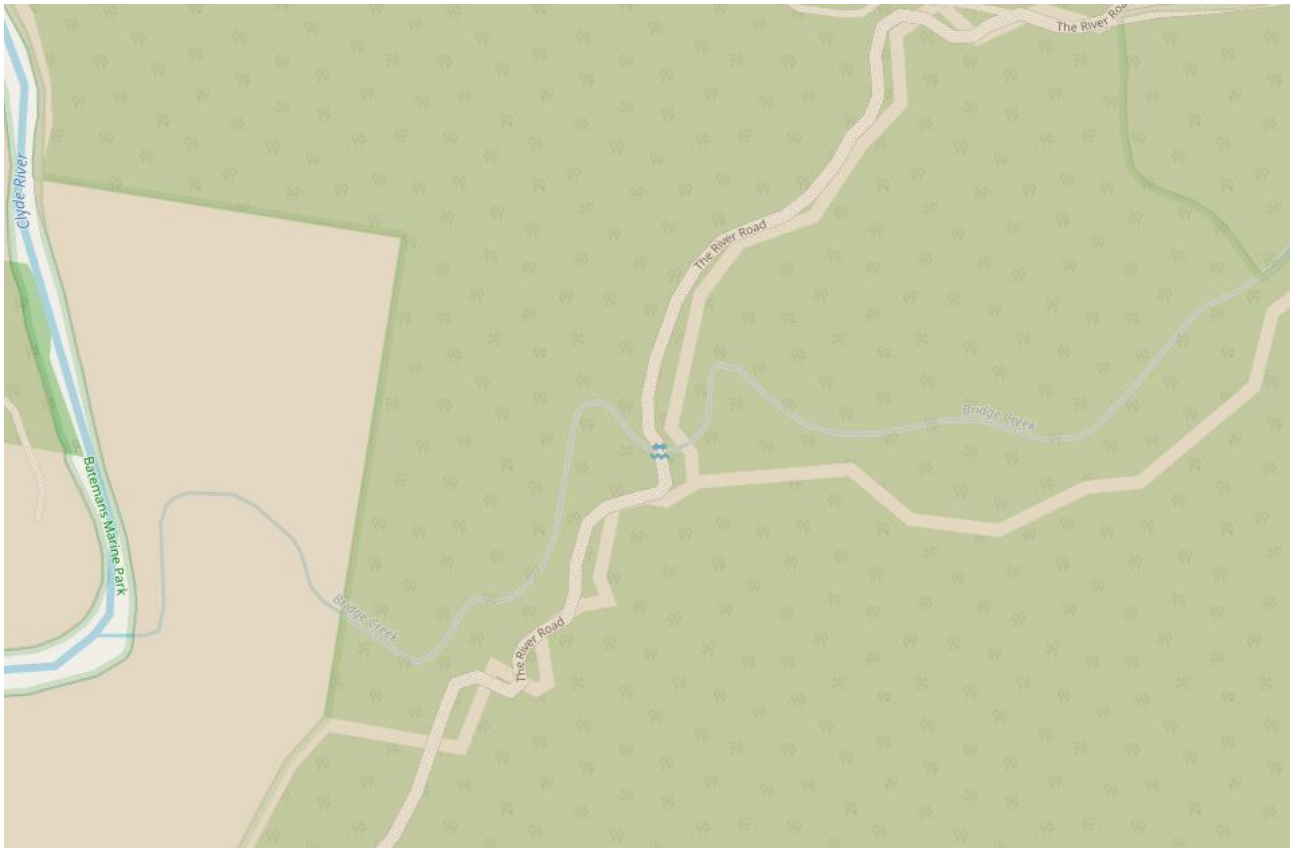

Figure 20. Site 2 Australian Soil Classification

Contaminated Land and Acid Sulfate Soils

Testing was undertaken to determine the risk of acid sulphate soil being present. The level of sulfates detected are negligible. The pH of the soils is within the neutral and acidic range for Site 1 and 2 respectively.

No records returned on a search of the NSW EPA Public Register in relation to Contaminated Land.

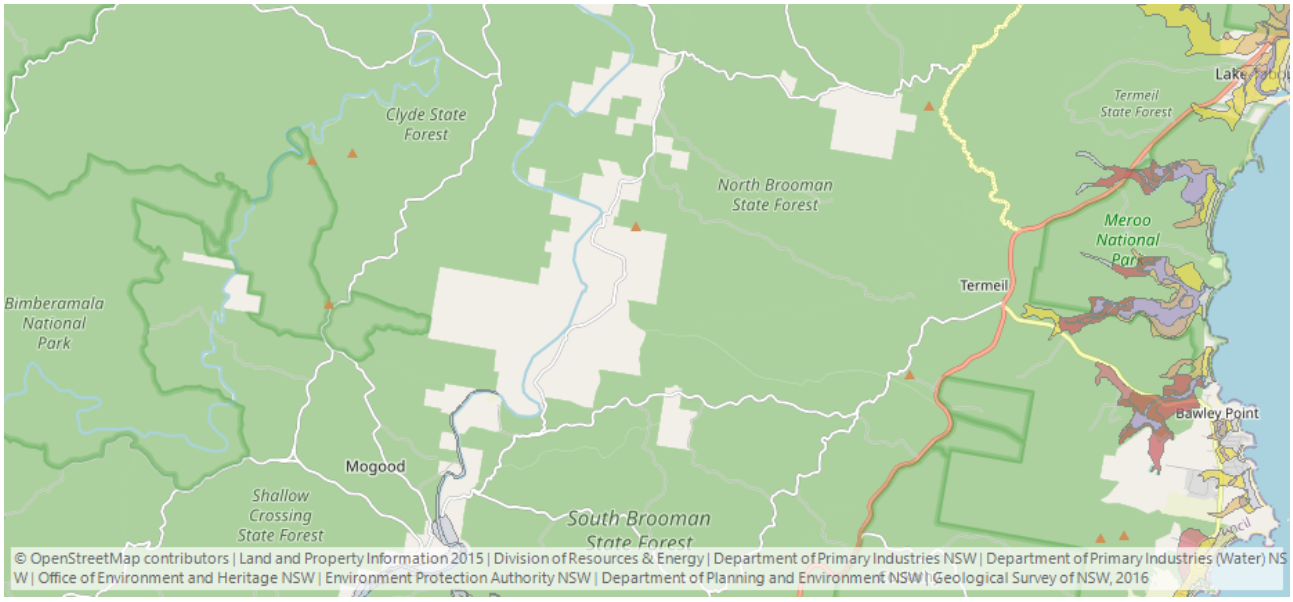

Figure 21. Acid Sulfate Soils Map

3.2. Water Quality and Hydrology

3.2.1. Existing Environment

Boondobah Creek (Site 1) flows northwest at the site and eventually joins the Clyde River approximately 1km to the southwest of the proposed activity area. Boondobah creek is classified as a large scale, level 5 named watercourse, being approximately 14.7 km long. At the point of the proposed activity, the creek has a width of 0.5m flow and 4m overall, located 3m below the existing deck level. The Australian Grayling is not mapped to be present within this creek therefore it is not classified as having habitat sensitivity. No impact to hydrology will occur as the works will remain within the existing disturbed footprint. The width of the bridge will increase which, due to the placement of the abutments, will not impact the creeks hydrology. The volume of water will remain consistent and the height of the bridge will remain consistent.

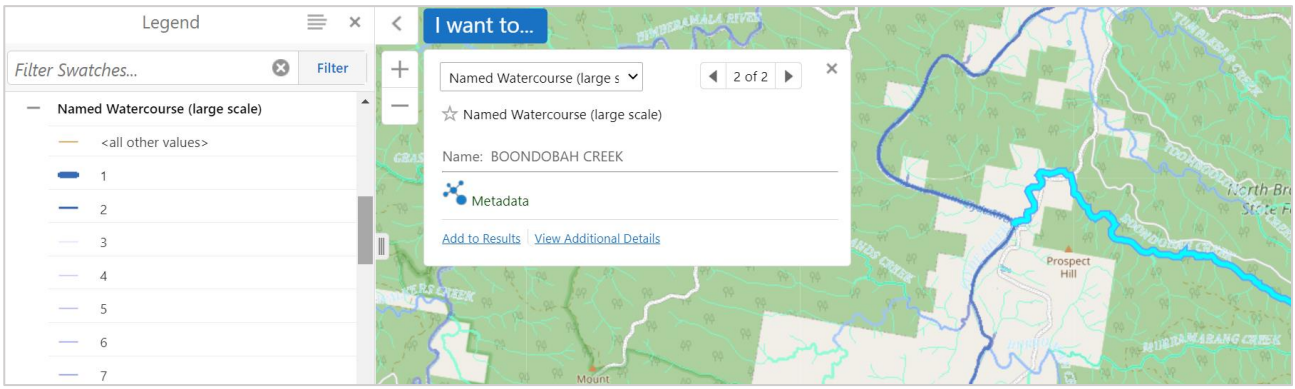

Figure 22. NSW Hydrography – Named Watercourse – Site 2 Boondobah Creek

Bridge Creek (Site 2) flows west at the site and eventually joins the Clyde River approximately 0.8km to the southwest of the proposed activity area. Bridge creek is classified as a large scale, level 5 named watercourse, being approximately 14.7 km long. At the point of the proposed activity, the creek has a width of 1.5m flow and 4m overall, located 3m below the existing deck level. The Australian Grayling is not mapped to be present within this creek therefore it is not classified as having habitat sensitivity. No impact to hydrology will occur as the works will remain within the existing disturbed footprint. The width of the bridge will increase which, due to the placement of the abutments, will not impact the creeks hydrology. The volume of water will remain consistent and the height of the bridge will remain consistent.

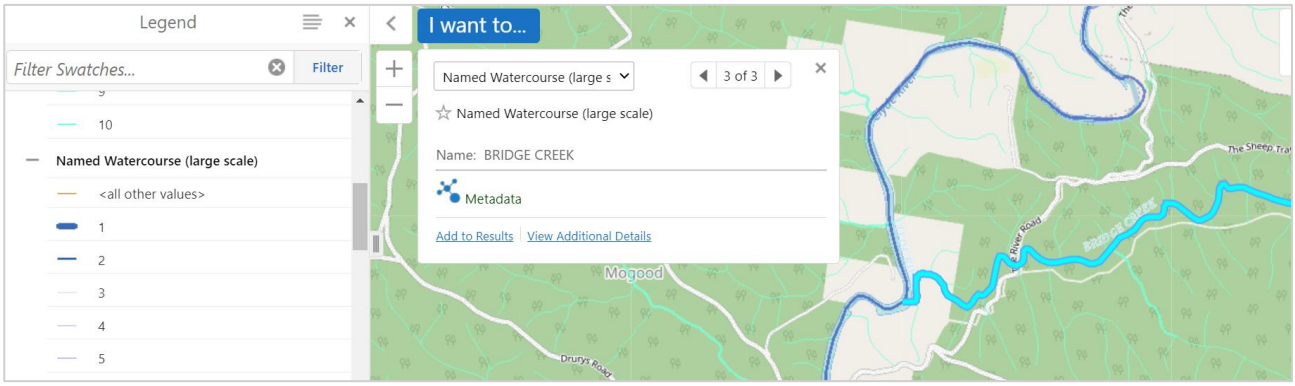

Figure 23. NSW Hydrography – Named Watercourse – Site 2 Bridge Creek

3.2.2. Impact Assessment

Proposed works have potential for erosion and sedimentation, and the movement of sediment into both Boondobah and Bridge Creek. In order to manage for erosion and sedimentation during construction, an erosion and sediment control plan (ESCP) shall be prepared and implemented. Managing Urban Stormwater; soils and construction Vol 1 (Landcom, 2004) and other associated guidelines should be used. An ESCP plan shall form part of the CEMP, and the CEMP is to be provided to regulatory authorities (Fisheries) two weeks prior to any works commencing at either site. The road will be closed and therefore no temporary crossing will be required for either site. The impact to the riparian and aquatic vegetation will be minimal due to the nature of the creek. A site inspection at site 1 identified no vegetation within the area of works. Within the site 2 inspection,

vegetation such as reeds were present, with lomandra and native grasses on the riverbank. As no bypass track will be constructed during the works, access will be maintained via alternative routes. This means no vehicles will be entering the riverbed during the course of the works. Dredging will occur to enable the construction of the piles and abutments, with fish passage being maintained and works will remain in the footprint of the existing structure.

3.2.3. Management and mitigation

Works adjacent to Boondobah or Bridge Creek (stockpiling of materials/equipment) should be carefully undertaken with suitable sediment and erosion controls, which should include primary and secondary systems, such as:

Land-based Primary & Secondary Containment

- Earth containment bund / windrow
- Geofabric-wrapped rock edge bund (temporary working platforms)
- Sediment fence
- Spill kits
- Sandbags or bulka bags (filled with washed river sand)
- Coir logs

Over Water Primary Containment

- Concrete formwork containment
- Earth containment bund / windrow
- Sandbags
- Self-bunded plant and equipment
- Plant nappies / trays
- Rubber or steel concrete delivery lines
- Concrete kibbles
- Concrete washout trays and management of alkaline curing water (if any is generated by works)

Over Water Secondary Containment

- Floating hydrocarbon absorbent boom
- Floating hydrocarbon containment boom
- Floating silt curtains
- Concrete delivery line containment (sheet pile, pipes or casings)
- Nappies around discharge end of boom pump line or kibble during extension / retraction over water
- Dirty water extraction containment (sheet pile, pipes or casings)
- Spill kit

Works staff should be aware of weather forecast conditions and minimize the exposure of disturbed areas and risk of sediment laden runoff in this area. Sediment and erosion controls should remain in place until all disturbed ground is stabilised with native grasses etc.

As the works will involve pumping of concrete into the formwork bridge structures, there is a risk of concrete accidentally entering the creek. This can be managed through standard control measures

for concrete pours, including using low flow concrete, and higher-level formwork so concrete does not need to reach the top edge.

3.3. Biodiversity

3.3.1. Existing Environment

Site 1 is surrounded by wet sclerophyll forests (shrubby sub formation) in a south coast river flat peppermint and wet gully forest and south coast lowland shrub-grass forest. There are no EEC's within the vicinity of the works. No trees will be removed for this project. Minimal clearing and scrubbing will occur of regrowth, shrubs and grasses within the previously disturbed footprint of the works. This will not have a significant impact due to the quality and location of the vegetation. A Bionet search was conducted which identified two threatened flora species at this site. Only one could occur at this site being Scrub Turpentine. A targeted survey was undertaken with no species identified at this location. An investigation into the habitat of Australian Graylings occurred which identified that Boondobah Creek is not classified as a habitat and therefore restrictions surrounding construction times do not apply. A Part 7 test of significance was conducted and is contained within Appendix A of this report. A Bionet search was undertaken for this site which identified of Microbats were identified as having the potential to be located within the footprint of works. This includes species such as the Golden-tipped Bat, Greater Broad-nosed Bat, and the Large Bent-winged Bat. A 5-part test of significance is therefore required along with a site survey. This survey identified that no Microbats were present however, appropriate measures will be in place for the careful removal of any microbats which may be roosting under the existing timber bridge during works. Therefore, it is evident that no impact should occur to the biodiversity of the site is the mitigation measures outlined within this REF are abided by and works remain within the existing disturbed footprint.

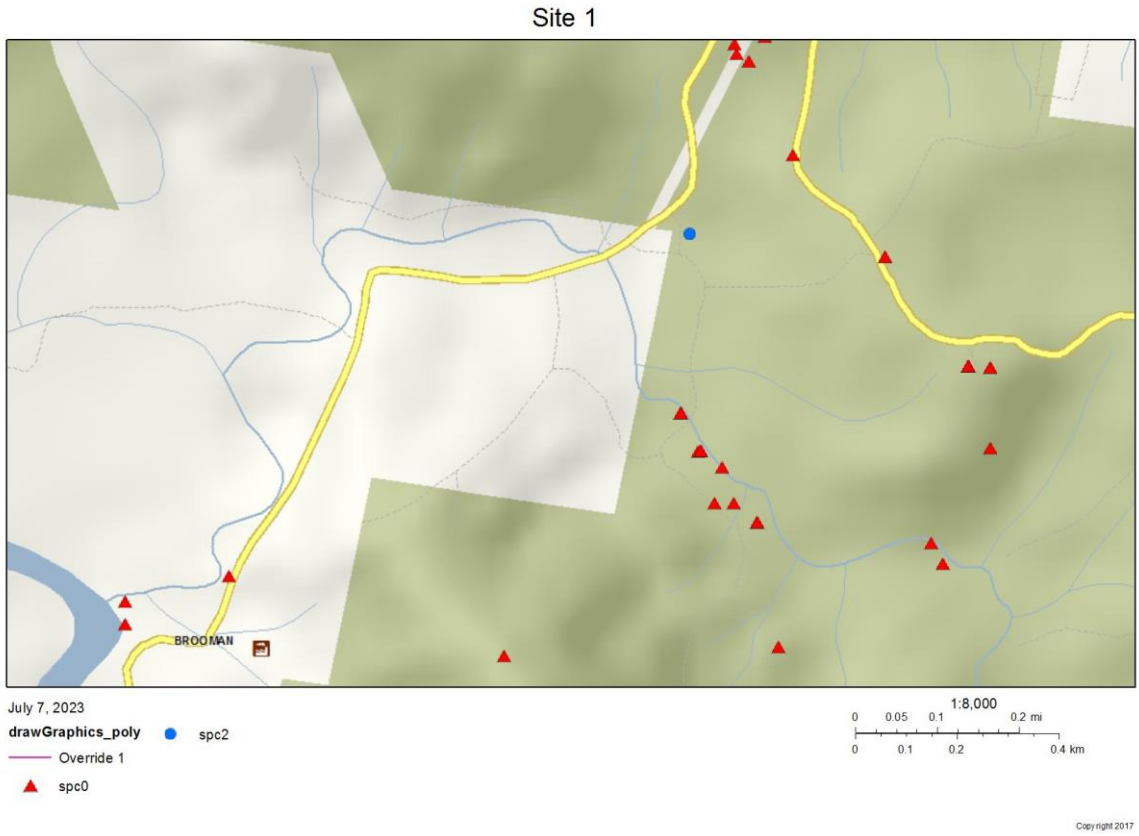

Figure 24. Site 1 BioAtlas Search Results

Site 2 is surrounded by wet sclerophyll forests (shrubby sub formation) in a south coast river flat peppermint and wet gully forest. There are no EEC's within the vicinity of the works. No trees will be removed for this project. Minimal clearing and scrubbing will occur of regrowth, shrubs and grasses within the previously disturbed footprint of the works. This will not have a significant impact due to the quality and location of the vegetation. A Bionet search was conducted which identified two threatened flora species at this site. Only one could occur at this site being Scrub Turpentine. A targeted survey occurred, and it was identified that scrub turpentine does not exist at this location. An investigation into the habitat of Australian Graylings occurred which identified that Bridge Creek is not classified as a habitat and therefore restrictions surrounding construction times do not apply. A Part 7 test of significance was conducted and is contained within Appendix A of this report. A Bionet search was undertaken for this site which identified of Microbats were identified as having the potential to be located within the footprint of works. This includes species such as the Golden-tipped Bat, Greater Broad-nosed Bat, and the Large Bent-winged Bat. A 5-part test of significance is therefore required along with a site survey. This survey identified that no Microbats were present however, appropriate measures will be in place for the careful removal of any microbats which may be roosting under the existing timber bridge during works. Therefore, it is evident that no impact should occur to the biodiversity of the site is the mitigation measures outlined within this REF are abided by and works remain within the existing disturbed footprint.

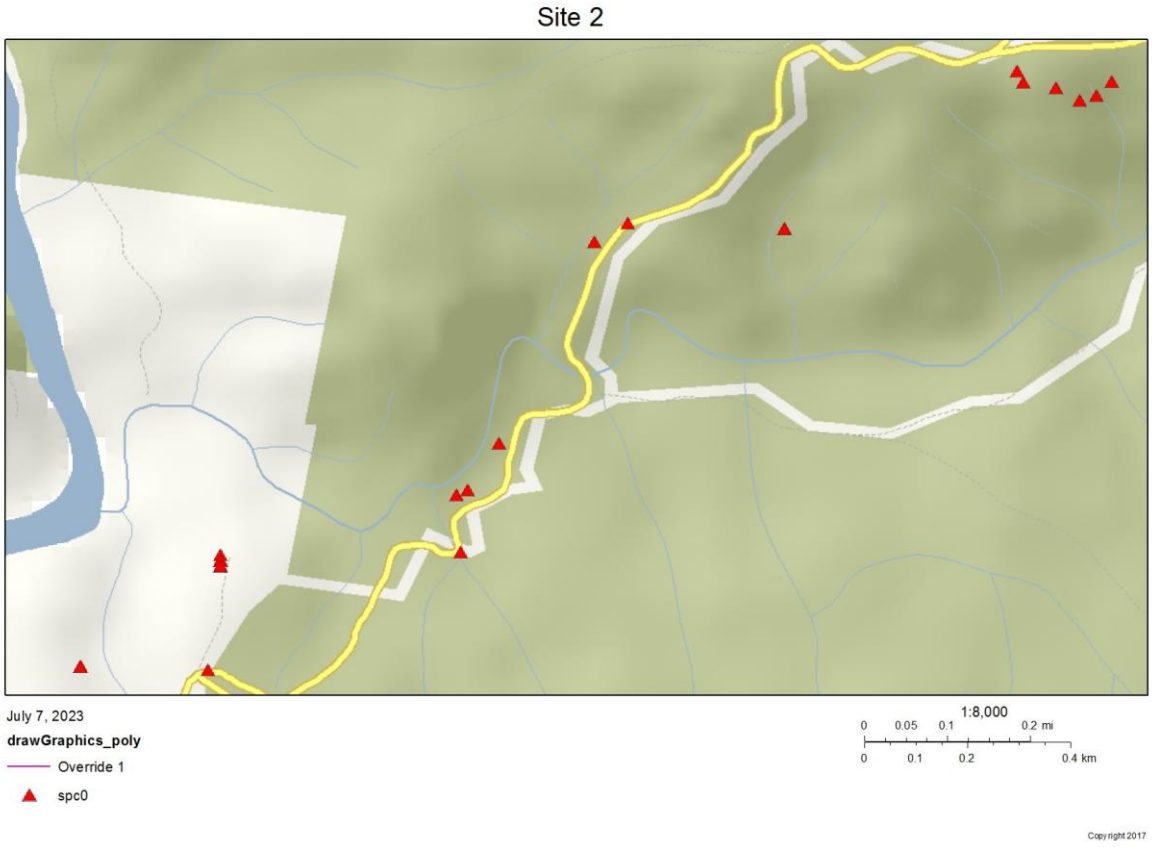

Figure 25. Site 2 BioAtlas Search Results

Threatened Ecological Communities

There were no TEC's mapped on the SEED Data base, in the vicinity of the proposed site. There are no River-Flat Eucalypt forest (BC and EPBC Act's) or Swamp Sclerophyll forest (EPBC act) on coastal floodplains within the footprint of the proposed activities.

(ii) Threatened Flora Species

A table of threatened flora records were recorded within 10km search of the site's from:

- NSW Bionet Atlas results
- EPBC Protected Matters Search Report.

The search returned a total of 2 species, with the Scrub Turpentine *Rhodamia rubesscens* and the Eastern Underground Orchid Rhizanthella slateri. Due to the nature sites biodiversity, it is unlikely that the Eastern Underground Orchid would be found. A targeted survey occurred, and it was identified that scrub turpentine does not exist at this location.

Scientific Name	Common Name	Simple Presence	Threatened Category	Website
Rhodamnia rubescens	Scrub Turpentine, Brown Malletwood	Likely	Critically Endangered	Species Profile and Threat Database (SPRAT)
Rhizanthella slateri	Eastern Underground Orchid	May	Endangered	Species Profile and Threat Database (SPRAT)

Therefore, it is considered very low risk that any this species will be impacted as all construction is proposed inside existing footprint of the bridge and roadway, with minimal disturbance to surrounding vegetation. No trees are to be removed at either site.

(iii) Threatened Fauna Species

A table of threatened fauna records were recorded within 10km search of the site's from:

- NSW Bionet Atlas results
- EPBC Protected Matters Search Report.

The search returned a total of 196 species; however, none were mapped within the immediate vicinity of either proposed site. The *Australian Grayling* is known in the area and given the nature of the project likely to be the more potentially impacted of the species. However, Boondobah and Bridge Creek are not mapped on the Fisheries data bases as habitat, meaning restrictions surrounding construction times is not applicable. A 7-part test of significance has been conducted as per the Fisheries Management Act, contained in Appendix A, which concluded that a significant impact would not be imposed upon the species.

For species located within 1km of the site, a five part test of significance under the BC act has been completed and is located within Appendix A.

Tyto novaehollandiae	Masked Owl	V,P,3		Species have been recorded some 150m northeast of Site 1. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Petaurus australis	Yellow-bellied Glider	V,P	V	Species have been recorded some 350m upstream of Site 1. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Prototroctes maraena	Australian Grayling	V		Species is known to occur in the area, however Fisheries mapping does not indicate that Boondobah or Bridge Creek are habitat. Due to its close location to the Clyde River, which is mapped as habitat, it is considered to be a potential risk of impact. Therefore, to mitigate any potential impact construction will aim to occur during January to March to avoid the migration and spawning periods for Australian Greyling from: • the end of March to the beginning of July • beginning of September to end of December.
Phoniscus papuensis	Golden-tipped Bat	V,P		Species have been recorded 3.5km southeast from site 1 and 8.5km northeast from site 2. The underside of bridges are

				often roosting sites for the bats and therefore there is a possible risk of impact as the works involve demolition of the existing bridge and construction of a new bridge. A survey has been conducted which confirmed that no microbat roosting is occurring at either site. If a microbat is located, appropriate measures and safeguards will be implemented to enable careful removal and relocation.
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P		Species have been recorded 4km from site 1 and 4.5km from site 2. The underside of bridges are often roosting sites for the bats and therefore there is a possible risk of impact as the works involve demolition of the existing bridge and construction of a new bridge. A survey has been conducted which confirmed that no microbat roosting is occurring at both site. If a microbat is located, appropriate measures and safeguards will be implemented to enable careful removal and relocation.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V,P		Species have been recorded 5.5km from site 1 and 8km from site 2. The underside of bridges are often roosting sites for the bats and therefore there is a possible risk of impact as the works involve demolition of the existing bridge and construction of a new bridge. A survey has been conducted which confirmed that no microbat roosting is occurring at both sites. If a microbat is located, appropriate measures and safeguards will be implemented to enable careful removal and relocation.
Petauroides volans	Southern Greater Glider	E1,P	E	Species have been recorded some 200m downstream from Site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Hieraaetus morphnoides	Little Eagle	V, P		Species have been recorded 6km from site 1 and 5km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Lophoictinia isura	Square-tailed Kite	V,P,3		Species have been recorded 9km from site 1 and 3km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to

				ground cover and low-lying shrubs and will be remediated.
Callocephalon fimbriatum	Gang-gang Cockatoo	V,P,3	E	Species have been recorded 2.5km northeast from site 1 and 1.5km southwest from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Glossopsitta pusilla	Little Lorikeet	V,P		Species have been recorded 4km from site 1 and 3.2km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Lathamus discolor	Swift Parrot	E1,P	CE	Species have been recorded 4km from site 1 and 2.2km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Ninox strenua	Powerful Owl	V,P,3		Species have been recorded 3.2km from site 1 and 3km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Tyto tenebricosa	Sooty Owl	V,P,3		Species have been recorded 1.4km from site 1 and 1km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Petroica boodang	Scarlet Robin	V,P		Species have been recorded 4.5km from site 1 and 2.6km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Dasyurus maculatus	Spotted-tail Quoll	V,P	E	Species have been recorded 5km from site 1 and 7km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to

				ground cover and low-lying shrubs and will be remediated.
Phascolarctos cinereus	Koala	E1,P	E	Species have been recorded 6km from site 1 and 2.4km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Cercartetus nanus	Eastern Pygmy-possum	V,P		Species have been recorded 10km from site 1 and 6km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Petaurus norfolcensis	Squirrel Glider	V,P		Species have been recorded 4km from site 1 and 6km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Pteropus poliocephalus	Grey-headed Flying Fox	V,P	V	Species have been recorded 2km from site 1 and 3km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V,P		Species have been recorded 4.5km from site 1 and 7km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.

(iv) Other MNES

Migratory Species

A table of Migratory Species records were recorded within 10km search of the site from:

- NSW Bionet Atlas results
- EPBC Protected Matters Search Report.

The search returned a total of 24 species, however none were mapped within the immediate vicinity of the proposed site.

It is considered very low risk that any migratory species will be impacted as any impact during construction will be short term and generally within the existing footprint of the existing bridges and roadway. The proposed construction works will not produce significant noise impacts outside of normal daily operating hours, as work will be carried out during designated construction times (7am-6pm, Monday to Friday; 8am-1pm Saturday). No ongoing noise emissions would occur.

3.3.2. Impact Assessment

Consideration was given to the potential impact of the proposed activity on each species assessed as potentially occurring in the REF Study Area.

See **Appendix A** for the full likelihood of occurrence assessment and consideration of potential impacts for each flora and fauna species identified in the 10km search of the NSW Bionet Atlas and EPBC Protected Matters Search Tool. An Assessment of Significance as per s7.3 of the *Biodiversity Conservation Act 2016* was undertaken for each of these species, contained within Appendix A. Note that if an Assessment of Significance determines that an impact is likely, a Species Impact Statement is required.

An Assessment of Significance conducted for these species concluded that there is unlikely to be a significant impact based on the following:

- Target Survey confirmed that Scrub Turpentine does not occur onsite.
- Survey confirmed bridges were not being used by Microbats for roosting.
- Breeding resources such as logs and burrows will be retained where possible and similar habitats are widespread in the locality;
- A significant area of foraging resources will be retained and similar resources are widespread in the locality;
- Similar or higher-quality habitat is widespread in the region;
- Construction is scheduled to avoid periods of migration and breeding;
- Breeding resources will be retained where possible and similar habitats are widespread in the locality.

3.4. Aboriginal Heritage

3.4.1. Existing Environment

The proposed activity is within an existing footprint of the bridge and roadway and the area has been largely already disturbed. An AHIMS Web Service Search was conducted 12 July 2023 for an area of 200m surrounding each proposed activity sites (Appendix B) and returned the following results:

- 2 Aboriginal object sites and 0 Aboriginal places have been declared within the search area for Site 1
- 0 Aboriginal object sites or places have been declared within the search area for Site 2

Site 1 returned a result showing 2 Aboriginal sites have been recorded within the search area. Both site 58-1-0844 and site 58-1-0845 were discovered during an archaeological survey conducted during PHD fieldwork during 1991 – 1993. Site 58-1-0844 is identified as a surface isolated grey basalt flake artefact with no additional information provided on its location. Site 58-1-0855 is identified as a surface isolated grey basalt hammerstone artefact with no additional information provided on its location. Therefore, the mapped location identified in the AHIMS search is to be taken, and mitigation measures implemented to prevent impact occurring to the known identified sites. It is noted that the mapped locations are both within the road reserve however not located on the bridge. Exclusion zones should be implemented in order to ensure damage to the sites does not occur.

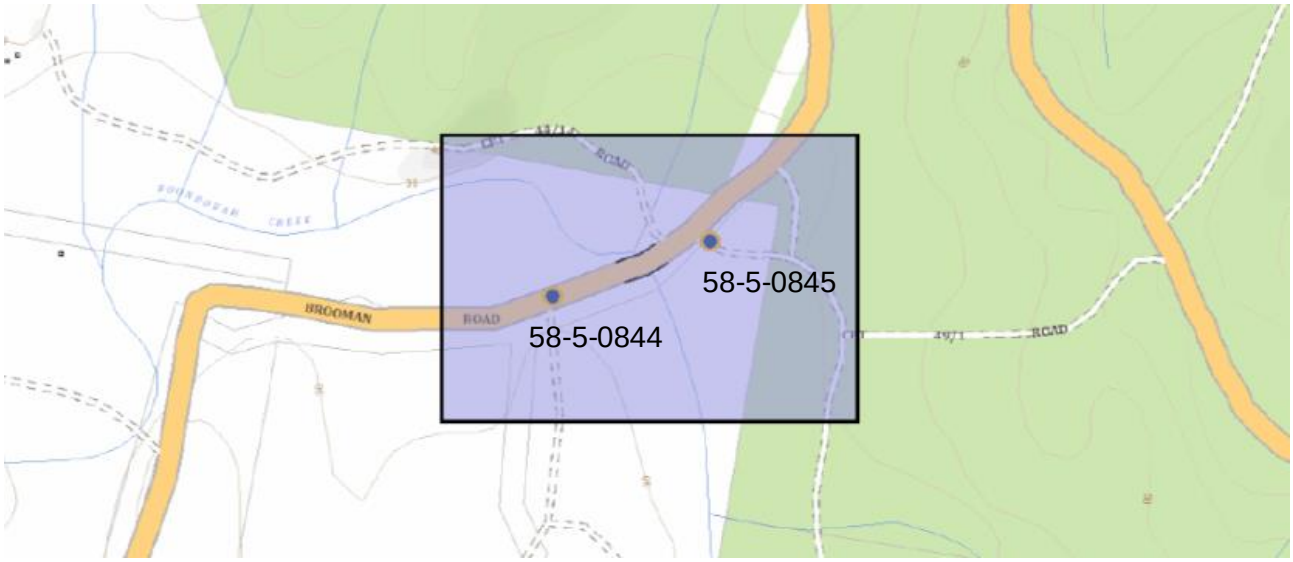

Figure 26. Site 1 AHIMS Report

Site 58-5-0844 is located within the road which is a highly disturbed area. Any works which occur will not have any additional impact however stockpiling and machinery laydown areas should not occur.

Site 58-5-0845 is located in the intersection of Brooman road and fire trail CPT 49/2 Road. No laydown, stockpiles or machinery is to enter or be stored at this location.

3.4.2. Impact Assessment

The proposed activity is of low impact according to the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (DECCW 2010). No further assessment is required.

3.4.3. Management and mitigation

Follow the generic due diligence process outlined in the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, 2010)

Step 1. Will the activity disturb the ground surface? Yes

Step 2a. Search the AHIMS database and use any other sources of information of which you are already aware.

Search undertaken for Site 1 and Aboriginal sites were recorded within 200m of the proposed disturbance area, however Site 1 is highly modified and previously disturbed by road construction and existing bridge development. The proposed development is within the existing footprint of the existing bridge and roadway.

Search undertaken and Aboriginal sites or artefacts not recorded within 200m of the proposed disturbance area for Site 2.

Step 2b. Activities in areas where landscape features indicate the presence of Aboriginal objects.

Potentially, Site 1 contains two known sites regarding its locations as high propensity for aboriginal objects. It has been confirmed via the information available that the two recorded sites are not located at the bridge. Due to the disturbed nature and footprint of proposed activities due to the existing road construction and bridge development, likelihood of unearthing a new artifact is low.

No. Site 2 is highly modified and previously disturbed by road construction, existing bridge development.

Step 3 and 4. Can potential disturbance be avoided and/or does visual inspection confirm the presence or likely presence of aboriginal objects. Disturbance cannot be avoided. Surface has been disturbed due to previous roadworks and bridge constructions. Therefore, presence of objects is unlikely.

Recommended procedure for carrying out works:

- Proceed with caution when excavating any soil over the site.
- If while undertaking your activity you find an Aboriginal object you must stop work, notify Council's environmental Officer, OEH and you may need to apply for an AHIP.
- Some works may not be able to resume until you have been granted an AHIP and you follow the conditions of the AHIP.
- Further investigation may be required depending on the type of Aboriginal object that is found. If human skeletal remains are found during the activity, you must stop work immediately, secure the area to prevent unauthorised access and contact NSW Police and OEH (when authorised by NSW Police).

The NPW Act requires that, if a person finds an Aboriginal object on land and the object is not already recorded on AHIMS, they are legally bound under s.89A of the NPW Act to notify OEH as soon as possible of the object's location. This requirement applies to all people and to all situations, including when you are following this code. If a person finds an Aboriginal object which is not recorded on AHIMS, they should contact DECCW as soon as practicable. Refer link below:

https://www.heritage.nsw.gov.au/applications/aboriginal-objects-and-places/

3.5. Non-Aboriginal Heritage

3.5.1. Existing Environment

There are no items of non-Aboriginal heritage in the immediate vicinity of either site. Site 1 is located approximately 1km from a 'general' heritage listed item and therefore it is considered to be of no impact to the heritage item.

Figure 27. Site 1 Non-Aboriginal Heritage Site

3.6. Noise and Vibration

3.6.1. Existing Environment

The existing noise level at the site is consistent with what would be expected for the surrounding area which is predominately forested land.

3.6.2. Impact Assessment

Construction works should ensure that DECC noise guidelines are not exceeded. All vehicles travelling to the site should consider nearby residences when travelling. The proposed construction works will not produce significant noise impacts outside of normal daily operating hours, as work will be carried out during designated construction times (7am-6pm, Monday to Friday; 8am-1pm Saturday). No ongoing noise emissions would occur. No noise monitoring is deemed necessary to evaluate potential noise impacts.

3.6.3. Management and mitigation

As per the Draft Noise Control Guideline – Construction Site Noise (DECC, 2008a), construction related noise should be managed to the following standards:

- Construction period of four weeks or under. The L10 level* measured over a period of not less than 15 minutes (measured at nearest residence) when the construction site is in operation must not exceed the background level by more than 20dB(A).
- Time restrictions. Monday to Friday 7am to 6pm, Saturday 8am to 1pm if audible on residential premises, otherwise 7am to 1pm. No construction work to take place on Sundays or Public Holidays.
- Silencing. All possible steps should be taken to silence construction equipment.

*L10: Noise level exceeded for 10% of a specified time period

In addition to the DECC guidelines, the construction activities should be guided by AS2436- 1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites".

Mitigation measures may be employed to minimise any impacts should these occur:

Vehicle noise and pollution emissions shall be limited by ensuring that all plant and equipment meet WorkCover regulations and are fitted with correct noise reduction devices in accordance with manufacturer's recommendations:

- Regular servicing of construction equipment shall be undertaken by Council and/or the Construction contractor.
- Working hours to be restricted to comply with EPA and Council regulations and these should be confirmed prior to undertaking any of the proposed works.
- Consultation with affected nearby residents and informing them in advance as to the extent and timing of works and responsibly advising when noise levels during such works may be relatively high.
- Where readily available, deploying plant having lower noise emission levels.
- Properly maintaining plant to ensure rated noise emission levels are not exceeded.
- Work only within designated hours.
- Providing a contact telephone number for the public to seek information or make a complaint. A log of complaints will be maintained and actioned by the site superintendent in a responsive manner.
- Undertaking construction activities guided by AS2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites".

Furthermore, construction work is to give due consideration to the amenity of site neighbours and any complaints are to be noted and addressed where possible.

3.7. Air Quality

3.7.1. Existing Environment

The existing air quality at the site is consistent with what would be expected for the surrounding area which is predominately forested land.

3.7.2. Impact Assessment

Construction

Limited dust generation will occur from the proposed works. Any exposed soil from these works should be covered as soon as practicable. It is unlikely soils will require to be imported/exported from the site. Following the completion of construction works, the proposed works would not have any dust impacts on air quality.

Operation

No dust impacts would occur once the bridge is installed.

3.7.3. Management and mitigation

The CEMP for the works should include soil and water management, including consideration of wind-blown dust. This can be managed through the use of covers over truck loads and any stockpiled soils/sand.

The following mitigation measures should be employed to reduce any potentially adverse air quality impact from dust during construction:

- Stockpiles should be kept to a minimum

Excess spoil should be promptly removed from site if required.

3.8. Waste and Chemical Management (non-asbestos)

The following major waste streams are identified and methods for their management provided below. During construction the following waste streams will be produced:

- Bulk earthworks material – excavated material for new abutments will be reused as backfill on site where possible. Excess fill will be transferred to a Council stockpilewith approval from SCC district Engineer for reuse in other areas.
- Existing bridge material – material removed from the existing bridges will be sorted, remove from site and disposed of at a licenced waste facility or stockpiled for reused by SCC.
- General construction waste – construction at the site will generate general construction waste such as paper, plastics, and metal.

3.8.1. Management and mitigation

The following mitigation measures are to be implemented:

- Transport of materials from construction site to sites of reuse or disposal would be done using covered trucks where possible.
- If weeds are identified onsite which pose as a biosecurity risk, they should be disposed of at an approved green waste/recycling facility where mitigation measures such as solar radiation to kill seeds/roots before disposal will occur.
- Securely store other waste on site until it is removed so that it does not become litter. Skip bins or other containers will be used on-site for the collection of general waste which will be taken off-site at end of works to an approved waste disposal/recycling facility.
- In the event of any oil waste occurring on-site, this would be collected and transported to the nearest oil recycling facility.

Chemical and potentially hazardous substances that are likely to be used for the proposed works will be hydrocarbons, including oils, greases, and fuels. No temporary fuel or chemical storage will be required.

A hydrocarbon spill kit would be available at both sites whilst machinery is operating to manage any hydrocarbon spills.

Where refuelling of machinery is undertaken on site, ensure a hydrocarbon spill kit is located in close proximity to the refuelling location and bund all fuel contained on the site. All fuel should be stored, bunded, at least 50m away from waterways.

Undertake any refuelling away from creeks and road drains.

Spill Management

The spill management procedure shall include at a minimum:

- Contact appropriate authorities, if necessary, generally Fire, Council and EPA.
- Isolate spill from transfer to the environment, either through collection, bunding, diversion or other means.
- Undertake necessary clean-up.

3.9. Traffic

Access to the site will be along Brooman Road and The River Road. Impacts on traffic and access will be the result of:

- Partial or full road closures

- Additional vehicle movements associated with machinery and deliveries to site.
- Parking and storage of materials.

3.9.1. Management and mitigation

Council have approved road closure for this site. The construction tender will request contractors to provide a suitable traffic management plan that will be assessed during the tender evaluation process. This REF will then be updated with the specific details once TMP has been approved.

Engagement with stakeholders, including the community, forestry and emergency services in relation to the road closure will occur prior to works as per Council's policy. Signage will be instatlld to provide notification throughout the construction process to enable alternative routes to be taken.

3.10. Visual Amenity/ Landscape

Visual amenity will be temporarily disturbed by construction at the site. Likely impacts will be the result of barrier fencing, temporary signage, machinery, materials stockpiles and earth stockpiles. As works are minor in nature and in length, visual amenity would not be significantly impacted. All waste materials and stockpiles will be removed at the conclusion of the projects.

3.11. Socio-Economic Considerations

Site Hazards

The majority of safety hazards at the site will be the result of construction activities. Contractors will be required to identify and implement management measures for the works sites. These should be included in Safe Work Method Statements (SWMS).

3.11.1. Management and mitigation

Contractors will be required to implement work, health and safety procedures for the works site. These should include, but are not limited to:

- Preventing unauthorised access to work sites
- Details on management of parking for the construction machinery and workers vehicles to minimise impacts on road users of Brooman Road and The River Road.
- Working near a waterway- low risk as long as out of heavy rainfall period.
- Working at heights
- Traffic hazards

3.12. Cumulative Impacts

There are no known additional works happening in the area at the proposed time of construction, therefore it is considered any cumulative impacts to the area to be negligible.

4. Section 171(2) of the EP&A Regulation 2021

Section 171(2) of the EP& A Regulation sets out 16 factors that need to be considered when assessing environmental impact under Part 5 of the EP&A Act.

Table 4: Section 171(2) assessment

Relevant Clause	Impact Assessment (Positive/Negative/Neutral)	Reason
(a) Any environmental impact on a community?	Positive	The new bridge will remove barriers existing to fish passage from the old bridge, imposing a positive environmental impact. The new bridge will improve safer accessibility and resilience to the road users, along with minimising the risk of failure occurring during a natural disaster event such as a bushfire or flood.
(b) Any transformation of a locality?	Neutral	The proposed works will not transform the locality.
(c) Any environmental impact on the ecosystem of the locality?	Positive	The new bridge will remove barriers to fish passage improving the ecosystem.
(d) Any reduction of the aesthetic, recreational, scientific, or other environmental quality or value of a locality?	Neutral	Visual amenity will be temporarily disturbed by construction at the site, however there will be no negative long-term impacts.
(e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific, or social significance or other special value for present or future generations?	Neutral	The proposed works will not cause any negative social or cultural impacts.
(f) Any impact on the habitat of protected animals (within the meaning of the *Biodiversity Conservation Act 2016*)?	Positive/Negative	New bridge will remove barriers to fish passage which serves as a habitat to threatened species such as the Australian Grayling. Short term negative impact may occur to Microbats who may use the underside of the bridge to roost, however a site inspection identified none present. Once the new bridge is installed, this impact will be relieved.
(g) Any endangering of any species of animal, plant or other form of life	Neutral	The proposed works will cause minor temporary disruption during construction; however no long-term impacts are anticipated.

Relevant Clause	Impact Assessment (Positive/Negative/Neutral)	Reason
whether living on land in water or in the air?		
(h) Any long-term effects on the environment?	Positive	The new bridge will remove barriers existing to fish passage from the old bridge, imposing a positive environmental impact.
(i) Any degradation of the quality of the environment?	Neutral	The proposed works will not cause any degradation of the quality of the environment.
(j) Any risk to the safety of the environment?	Neutral	The proposed works does not propose any risk to the safety of the environment.
(k) Any reduction in the range of beneficial uses of the environment?	Neutral	The proposed works will not reduce any beneficial uses of the environment, with the proposed activity use consistent with current use. Dedicated extended river crossings and public roads ensure vehicles do not enter the waterway and vegetated areas, alleviating negative impacts associated.
(l) Any pollution of the environment?	Neutral	The proposed works will not cause any degradation of the quality of the environment. Mitigation measures have been detailed in Section 3.9.
(m) Any environmental problems associated with the disposal of waste?	Neutral	The proposed works will not cause any degradation of the quality of the environment. Mitigation measures have been detailed in Section 3.9.
(n) Any increased demand on resources (natural or otherwise) which are, or are likely to become, in short supply?	Neutral	The proposed works will not increase demand on existing resources.
(o) Any cumulative environmental effect with other existing or likely future activities?	Neutral	The proposed works will not pose a cumulative environment effect.
(p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?	Neutral	The proposed works are not within an area which will be impacted by coastal process and hazards.
(q) Any applicable local strategic planning statements, regional strategic plans or district strategic plans	Neutral	The proposed activity is consistent with Planning Priority 2 (Delivering Infrastructure) of *Shoalhaven 2040 Land-use Planning Statement* https://doc.shoalhaven.nsw.gov.au/displaydoc.aspx?record=D20/437277 The proposed activity is not inconsistent with the *Illawarra Shoalhaven Regional Plan 2041*

Relevant Clause	Impact Assessment (Positive/Negative/Neutral)	Reason
made under the Act, Division 3.1?		https://www.planning.nsw.gov.au/sites/default/files/2023-03/illawarra-shoalhaven-regional-plan-2041.pdf
(r) Any other relevant environmental factors?	Neutral	The proposed works are consistent with the current land use and consider all impacts to threatened flora and fauna which could reside at the sites. Works will improve the infrastructure for the community, providing an increased level of safety, resilience and accessibility for the community, emergency services etc.

5. Environmental Safeguards and Mitigation Measures

Table 6: Environmental Safeguards and Mitigation measures

Impact Type	Description of Potential Impact	Mitigation Measures	Responsibility for Implementation
Soils- Erosion	Any disturbance of ground over presents potential risks for erosion, this van be minimised through implementation of the following safeguards.	• Site management will incorporate best management erosion and sediment control practices such as those found in the Landcom's "Blue Book (4th Edition) on erosion and sediment control. • Linear silt stop fencing to be installed down slope of all affected areas and stockpiles. Silt fencing will be installed before any excavation begins. • Sandbags, straw bales wrapped in geotextile fabric etc. will be used to slow water flow and trap sediment. No hay bales are to be used. • All erosion and silt control devices will be visually inspected weekly to ensure effectiveness as well as after each rainfall event. • The rehabilitation of disturbed areas will be carried out progressively as construction stages are completed, and in accordance with Landcom's "Blue Book (4th Edition) on sediment and erosion control. • Construct temporary drainage structures in accordance with the 'Technical Guideline - Temporary Stormwater Drainage for Road Construction' (TfNSW 2011) • Overburden will be placed in the form of a bund upslope of the site where necessary to reduce surface water entering the site. • Stockpiles will be designed, established, operated and decommissioned in accordance with the TfNSW Stockpile Site Management Guidelines 2015.	Contractor
Contaminated Land/ **Acid Sulfate Soils**	Testing was undertaken to determine the risk of acid sulphate soil being present. The level of sulphates detected are negligible. The pH of the soils is within the	• If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-	

Impact Type	Description of Potential Impact	Mitigation Measures	Responsibility for Implementation
	neutral and acidic range for Site 1 and 2 respectively. Disturbance of acid sulphate soils can generate large amounts of sulphuric acid leachate which can impact the surrounding environment. No records returned on a search of the NSW EPA Public Register in relation to Contaminated Lands. Potential impacts include water quality impacts and impacts on flora and fauna.	specific controls or further actions identified in consultation with relevant government agencies.	
Water Quality/ Hydrology	Disturbance of groundcover, use of chemicals and generation of waste all have the potential to impact the surrounding waterways via runoff.	• Visual monitoring of local water quality (ie turbidity, hydrocarbon spills/slicks) is to be undertaken on a regular basis to identify any potential spills or deficient erosion and sediment controls. • Water quality control measures are to be used to prevent any materials (eg. concrete, grout, sediment etc) entering waterways. • No dirty water may be released into waterways. • Prevent sediment moving off-site and sediment laden water entering any water course. • Reduce water velocity and capture sediment on site. • Divert clean water around the site. • Store fuels, chemical and hazardous materials in secure, bunded areas within temporary construction ancillary facilities, and at least 50m from all waterways. • Capture and dispose of spill and contaminated materials from temporary construction ancillary facilities at a licensed facility. • Provide spill kits around temporary construction ancillary facilities.	Contractor
Biodiversity	There are no mapped EEC's or TEC's for the proposed activity sites. No tree removal is to occur, with minimal under scrubbing required within the disturbed footprint.	General: • As part of the site induction process, provide all site personnel with information on the biodiversity values of the study area, including threatened species, no-go areas and responsibilities under relevant environmental legislation, including but not limited to the EP&A Act, BC Act and EPBC Act and associated management plans for individual species.	Contractor

Impact Type	Description of Potential Impact	Mitigation Measures	Responsibility for Implementation
	There is one threated flora species with the likely possibility of being in the area which is Scrub Turpentine. A targeted survey occurred with concluded that it was no present at either site. Australian Grayling are mapped within close vicinity to the site but not within Boondobah or Bridge creek. Restrictions surrounding construction times will be considered but compliance is not required. Various species of microbats have been identified within a 10km radius of the sites. Due to the scope of works and bridges often being used for roosting by the species, a survey was conducted which concluded that no microbats were present. If a microbat is located, appropriate measures will be implemented to enable careful removal and relocation. Other threatened species located within 1km of the sites includes the Masked Owl, Yellow Bellied Glider and the Southern Greater Glider. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.	• Should unexpected, threatened fauna be located at any time during construction, cease work immediately in the area to prevent further harm to the individual. Contact Council's Environmental Officer and a suitably qualified ecologist to determine if further assessment or management plans are required. • Pre-demolition surveys for microbats shall be conducted. If observed, bats shall be removed by an appropriately experienced wildlife handler prior to demolition. Clearing of Vegetation: Pre-clearing: • Trees that are to be trimmed will be clearly marked. Any vegetation to be protected adjacent to the work area will be protected with exclusion fencing. Clearing of vegetation – general safeguards • Remove minimum required vegetation and minimise disturbance to remaining vegetation • If any damage occurs to vegetation outside of the boundaries of the work site as a result of the implementation of the proposal, the Project Manager will be notified and will establish strategies for mitigation of impacts and site restoration. Loss of threatened species and their habitats: • Minimise removal of native vegetation and fauna habitat. • Implement exclusion zones to protect threatened ecological communities and threatened species habitat. • Works are not to harm threatened fauna. • Works are not to create a barrier to fauna movement. Aquatic habitats and Riparian Zones: • Manage riparian areas in accordance with TfNSW 'Biodiversity Guidelines Guidance Note 10: Aquatic Habitats and Riparian Zones' (TfNSW 2011) • Should alteration of fish passage occur during construction consult with NSW Department of Primary Industries to determine if a permit under Section 219 of the FM Act is required.	

Impact Type	Description of Potential Impact	Mitigation Measures	Responsibility for Implementation
		Invasion of Exotic Species: • Manage vegetation within the road reserve and adjacent to areas of vegetation clearing in accordance with Guide 6 Weed Management and Guide 10 Aquatic Habitats and Riparian Zones of Roads and Maritime's Biodiversity Guidelines (TfNSW, 2011) to reduce invasion of noxious weed species. • Use weed-free topsoil in landscaping and revegetate disturbed sites with locally indigenous species. • Construction machinery should be washed prior to entering and leaving site to ensure weed propagules are not transported. Stockpiling: • Only place stockpiles in low value vegetation, where cleared sites are unavailable. • Stockpiles should be no taller than 2m height. • Use existing stockpiles before creating new ones. Site Restoration: • The rehabilitation of disturbed areas will be carried out progressively as construction stages are completed, and in accordance with: ○ Landcom's "Blue Book (4th Edition) on sediment and erosion control ○ TfNSW Landscape Guidelines; ○ TfNSW Guidelines for Batter Stabilisation Using Vegetation.	
Aboriginal Heritage	Site 1 returned a result showing 2 Aboriginal sites have been recorded within the search area. Site 58-5-0844 is located within the road which is a highly disturbed area and Site 58-5-0845 is located in the intersection of Brooman road and fire trail CPT 49/2 Road.	Awareness: • All personnel working on site will receive training to ensure awareness of location of existing Aboriginal objects within the Study Area and immediate surrounds, and relevant statutory responsibilities. Management of existing (known) items: • No laydown, stockpiles or machinery is to enter or be stored within the location of known sites.	Contractor

Impact Type	Description of Potential Impact	Mitigation Measures	Responsibility for Implementation
	Site 2 returned a result showing 0 Aboriginal sites have been recorded within the search area.	Unexpected Finds: • If Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and Shoalhaven City Council's Environmental Operations Officer shall be contacted immediately.	
Historic Heritage	There are no items of non-Aboriginal heritage in the immediate vicinity of either site. Site 1 is located approximately 1km from a 'general' heritage listed item and therefore it is considered to be of no impact to the heritage item.	Unexpected Finds: • If heritage items are are uncovered during the works, all works in the vicinity of the find must cease and the Shoalhaven City Council's Environmental Operations officer shall be contacted immediately. The procedures outlined in Part 6 of the Heritage Act 1977.	Contractor
Noise and Vibration	Construction works should ensure that DECC noise guidelines are not exceeded. All vehicles travelling to the site should consider nearby residences when travelling. The proposed construction works will not produce significant noise impacts outside of normal daily operating hours. No ongoing noise emissions would occur. No noise monitoring is deemed necessary to evaluate potential noise impacts.	Notification: • All sensitive receivers (e.g local residents) likely to be affected will be notified at least five working days prior to the start of any works associated with the activity that may have an adverse noise or vibration impact. Standard Hours of Operation: • Works to be carried out during normal work hours (i.e. 7am to 6pm Monday to Friday; 8am to 1pm Saturdays). Any work that is performed outside normal work hours or on Sundays or public holidays may not be permitted and should be assessed. Due to the located and no noise sensitive receivers being in close proximity, there is flexibility surrounding this hours with approval from the project manager required.	Contractor
Air Quality	Limited dust generation will occur from the proposed works. Any exposed soil from these works should be covered as soon as practicable. Following the completion of construction works,	• Measures to minimise or prevent air pollution or dust are to be used including watering or covering exposed areas. • Works are not to be carried out during strong winds or in weather conditions where high levels of dust or air borne particulates are likely • Vegetation or other materials are not to be burnt on site.	Contractor

Impact Type	Description of Potential Impact	Mitigation Measures	Responsibility for Implementation
	the proposed works would not have any dust impacts on air quality.	• Vehicles and vessels transporting waste or other materials that may produce odours or dust are to be covered during transportation • Vehicles and equipment are to be maintained in good working order. • Monitor work areas and stockpiles for dust generation and seed/cover/spray to suppress. • Measures (including watering or covering exposed areas) are to be used to minimise or prevent air pollution and dust • Do not leave vehicles idling.	
Waste/ Chemical Management	During construction three major waste streams will be produced. Bulk earthworks materials will be reused as backfill onsite where possible. Excess fill will be transported toa councils' stockpile for reuse in other areas. Existing bridge material will bw sorted, removed from site and either disposed of at a licenced waste facility or stockpiled for reuse. General construction waste will be sorted and disposed of at a licenced waste facility.	• All surplus material, off cuts, and other debris resulting from the work shall be removed from site and disposed of by a licensed contractor to a licensed waste management facility. • Waste material, other than vegetation and tree mulch, is not to be left on site once the works have been completed. • Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day. • Transport of materials will be done using covered trucks where possible. • If weeds are identified onsite which pose as a biosecurity risk, they should be disposed of at an approved green waste/recycling facility where mitigations measures such as solar radiation to kill seeds/roots before disposal will occur. • Securely store other waste onsite until it is removed so it does not become litter.	Contractor
Traffic	The works will include road closures in which alterative access routes will be provided.	• Where possible, current traffic movements and property accesses are to be maintained during the works. Any disturbance is to be minimised to prevent unnecessary traffic delays. • If traffic disturbance is unavoidable, a Traffic Management Plan (TMP) will be prepared in accordance with the TfNSW Traffic Control at Work Sites Manual (TfNSW 2022) and QA Specification G10 Control of Traffic (TfNSW 2010). • Comply with Council requirements regarding traffic control, access and road/ pedestrian access. • Erect signs regarding proposed works, temporary road closures, diversions etc.	Contractor

Impact Type	Description of Potential Impact	Mitigation Measures	Responsibility for Implementation
		• Conduct engagement with stakeholders, residents and other bodies who utilise this road to provide notice of road closures.	
Visual Amenity/ Landscape	Visual amenity will be temporarily disturbed by construction at the site. Likely impacts will be the result of barrier fencing, temporary signage, machinery, materials stockpiles, and earth stockpiles.	• Contain all work within the boundaries designated on the site plan • Restore work sites to as close to their original condition as possible • Minimise spread of stockpiles, waste, and parking	Contractor
Socio-Economic Factors	No impacts are proposed to occur on local businesses, on street parking arrangements, places/items of social value, or change the visibility of any business, farms, or tourist attractions. Pedestrian access will be altered as no access will be available between the bridge being deconstructed and reconstructed. Access to properties will be temporarily altered during road closure, with alternative routes provided.	• Contain all work within the boundaries designated on the site plan • Restore work sites to as close to their original condition as possible • Display public information signs until site restoration is complete • Carry out community and stakeholder consultation before works start • Notify the Works Supervisor and Asset Manager immediately of any complaints or any accidental damage to property • Locate services on DBYD search and peg out no-go areas to avoid service-disruption • All Council staff and contractors will exercise courtesy in dealing with the community	Contractor

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6. Consultation

Chapter 2, Part 2.2, Division 1 of the Transport and Infrastructure SEPP (T&I SEPP) Provides recommendations for consultation with affected stakeholders (Table 7).

Table 5: Infrastructure SEPP consultation requirements

T&ISEPP Clause	Clause Reference	Consultation Required
Section 2.10	**Impacts on council-related infrastructure or services** Consultation is required if the public authority is of the opinion that the development: *(a) will have a substantial impact on stormwater management services provided by a council, or* *(b) is likely to generate traffic to an extent that will strain the capacity of the road system in a local government area, or* *(c) involves connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council, or* *(d) involves connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council, or* *(e) involves the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential, or* *(f) involves excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the Roads Act 1993 (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath).*	No – SCC is the proponent of the proposed activity
Section 2.11	**Impacts on local heritage** Consultation is required if the development: *(a) is likely to have an impact that is not minor or inconsequential on a local heritage item (other than a local heritage item that is also a State heritage item) or a heritage conservation area, and* *(b) is development that this Policy provides may be carried out without consent.*	No – Local heritage items are not being impacted
Section 2.12 and Section 2.13	**Impacts on flood liable land** *In this clause, flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled Floodplain Development Manual: the management of flood liable land published by the New South Wales Government and as in force from time to time.*	No – Location is not flood liable land. Consultation with SCC and NSW State Emergency Services is not required

T&ISEPP Clause	Clause Reference	Consultation Required
Section 2.14	***Consultation with councils – development with impacts on certain land within the coastal zone*** *Consultation is required if the development is:* *(a) On land that is within a coastal vulnerability area and is inconsistent with a certified coastal management program that applies to the land*	No – Location is not within a coastal vulnerability area
Section 2.15	***Consultation with public authorities other than councils*** *Consultation is required if the development is:* *(a) development adjacent to land reserved under the National Parks and Wildlife Act 1974 or to land acquired under Part 11 of that Act— the Office of Environment and Heritage,* *(b) development on land in Zone C1 National Parks and Nature Reserves or in a land use zone that is equivalent to that zone, other than land reserved under the National Parks and Wildlife Act 1974 —the Office of Environment and Heritage,* *(c) Development comprising of a fixed or floating structure in or over navigable waters – transport for NSW* *(d) development that may increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map—the Director of the Observatory,* *Note. The dark sky region is land within 200 kilometres of the sliding spring Observatory.* *(e) development on defence communications facility buffer land within the meaning of clause 5.15 of the Standard Instrument— the Secretary of the Commonwealth Department of Defence* *Note. Defence communications buffer land is located around the defence communications facility near Morundah. See the Defence Communications Facility Buffer Map referred to in clause 5.15 of the Lockhart Environmental Plan 2012, Narrendera Local Environmental Plan 2013 and Urana Local Environmental Plan 2011* *(f) Development on land in a mine subsidence district within the meaning of the Mine Subsidence Compensation Act 1961 – the Mine Subsidence Board.* *(g) Development on, or reasonably likely to have an impact on, a part of the Willandra Lakes Region World Heritage Property – The world Heritage Advisory Committee and Heritage NSW* *(h) Development within a Western City Operational area specified in the Western Parkland City Authority Act 2018, Schedule 2 with a capital investment value of $30 million or more – the Western Parkland City Authority constituted under the Act.* *Note. Clause 18A (2) of State Environmental Planning Policy (Sydney Region Growth Centres) 2006 requires public authorities (or persons acting on their behalf) to consult with the Department of Planning and Infrastructure before carrying out any development comprising the clearing of native vegetation on certain land within a growth centre (within the meaning of that*	No - Location is not subject to any conditions detailed within this section.

T&ISEPP Clause	Clause Reference	Consultation Required
	Policy). The land concerned is land other than the subject land (within the meaning of Part 7 of Schedule 7 to the Threatened Species Conservation Act 1995). The subject land is generally land to which precinct plans apply under that Policy.	
Section 2.16	***Consideration of Planning for Bushfire Protection*** *Development for the following purposes may be carried out without development consent:* *(a) Health service facilities* *(b) Correctional Centres* *(c) Residential accommodation*	No – Works are not covered under the listed development types.

7. Conclusion

An impact assessment of biodiversity was undertaken and there were no threatened ecological communities or migratory species mapped in the vicinity of the proposed activity sites. A site assessment occurred and confirmed no threatened communities are present.

It is considered that the project poses very low risk to biodiversity at both sites as all construction is proposed inside the existing footprint of the bridge and roadway, with minimal disturbance to surrounding vegetation. A target site survey occurred identify Scrub Turpentine is not present.

Due to the location of the proposed activity sites, the noise impact is not a significant issue. However, standard construction times will be abided by, being 7am – 6pm Monday to Friday, 8am – 1pm Saturday and no work to occur on Sunday or Public Holidays.

The highest environmental risk posed by the proposed activity would be an impact to the state and commonwealth listed threatened species, The Australian Grayling *Prototroctes maraena*. Although, according to Fisheries NSW mapping data, Boondobah and Bridge Creek are not classified as Australian Grayling habitat, it is important to consider due to their proximity to the Clyde River which is an Australian Grayling identified habitat. It is considered that any impact would be temporary due to an estimated 8 week construction period. Therefore, it has been confirmed that the sites are not located within the Australian Grayling Habitat and there have been no species recorded within he creeks.

Additionally, threatened Mircrobats also need to be considered given that the underside of bridges are often utilised for roosting. In order to mitigate the risks associated with any negative impact to the species, a survey was undertaken which identified that they are not present. Appropriate measure will be in place to remove bats if identified prior to demolition of the existing bridge.

Additional work required includes:

- Part 7 permit under the NSW Fisheries Management Act 1994 (FM Act) is required.
- Bridge design will form part of the Construction Environmental Management Plan (CEMP) to be provided to NSW Fisheries a minimum of two weeks prior to any works commencing.
- The construction tender will request contractors to provide a suitable traffic management plan that will be assessed during the tender evaluation process. This REF will then be updated with the specific details.
- This REF shall be reviewed once detailed plans have been prepared and prior to the commencement of works.
- The REF shall be published on the NSW Planning Portal prior to the commencement of works.
- Public and stakeholder engagement in relation to temporary closing the road will be required prior to the commencement of works, following councils community engagement policy.

8. REF Determination, Certification and Review

This Review of Environmental Factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It has assessed the likely environmental impacts of the proposal by Shoalhaven City Council for the Boodobah and Bridge Creek Renewal Project which involves the removal of the existing timber bridge and the construction of a modern equivalent. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal. It identifies the likely impacts of the proposal on the environment and details the environmental safeguards and mitigation measures to be implemented to minimise the potential impact to the environment.

In light of the above assessment of the proposed activity, it is considered that the overall impact on the environment is not likely to have a significant impact on the environment and therefore an EIS is not required. The proposed activity will not be carried out in a declared area of outstanding biodiversity value and, through implementation of proposed mitigation measures and construction time restrictions, is not likely to significantly affect threatened species, populations or ecological communities, or their habitats or impact biodiversity values, meaning a SIS and/or BDAR is not required. The long-term benefits of the activity will have a cumulative positive impact on the safety of road users and the activity should proceed accordingly. The proposed mitigation measures within this REF will be adopted and implemented; Implementation of these mitigation measures will reduce the potential environmental impact of the proposed activity.

REF Author

Signature: 

Name: Caitlin Battersby

Title: Project Manager

Date: 9.1.2024

I certify that I have reviewed and endorsed the contents of this REF document and, to the best of my knowledge, it is in accordance with the EP&A Act, the EP&A Regulation and the Guidelines approved under clause 170 of the EP&A Regulation, and the information it contains is neither false nor misleading

Reviewed and endorsed by:

Signature: 

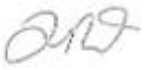
Name: Carley McGregor

Title: Planning and Development Consultant

Date: 9.1.2024

I certify that I have reviewed the contents of this REF document, and, to the best of my knowledge, it is in accordance with the EP&A Act, the EP&A Regulation and the Guidelines approved under clause 170 of the EP&A Regulation, and the information it contains is neither false nor misleading. I therefore determine that the activities outlined within this REF are authorised to occur. This REF is not required to be referred to additional bodies . This REF is required to be published (NSW Planning Portal).

Authorising Manager's approval

Signature: 

Name: Troy Punnett

Title: District Engineer - South

Date: 29/1/2024

Appendix A

Assessments of Significance and Threatened Species Tables, Part 5 Tests of Significance and 7 Part Test of Significance.

Appendix A – Threatened Species Assessments

Likelihood of occurrence table

An assessment of likelihood of occurrence was made for all threatened and migratory species. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the field survey and professional judgement.

Those species where it is considered that impacts may be possible are further considered in the threatened species assessments.

The terms for likelihood of impact occurring are defined below:

- "yes" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site or that proposed actions will influence habitat for the species.
- "None" = habitat on site and in the vicinity is unsuitable for the species.

(E = Endangered, V = Vulnerable, M = Migratory, EEC = endangered ecological community, CEEC = critically endangered ecological community)

Scientific name	Common name	TSC Act	EPBC Act	Habitat present or likelihood of occurrence (in/adjacent to works corridor)	Impacts predicted
LISTED ECOLOGICAL COMMUNITIES					
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland		E		Community may occur within area	None - Not considered to occur in study area

Araluen Scarp Grassy Forest	E		Community likely to occur within area	None - Not considered to occur in study area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	E		Community may occur within the 10km buffer area only	None - Not considered to occur in study area
Lowland Grassy Woodland in the South East Corner Bioregion	CEEC		Community may occur within area	None - Not considered to occur in study area
Illawarra and south coast lowland forest and woodland ecological community	CEEC		Community may occur within area	None - Not considered to occur in study area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	CEEC		Community likely to occur within area	None - Not considered to occur in study area
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion	CEEC		Community likely to occur within the 10km buffer area only	None - Not considered to occur in study area
Natural Temperate Grassland of the South Eastern Highlands	CEEC		Community may occur within the 10km buffer area only	None - Not considered to occur in study area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	E		Community likely to occur within area	None - Not considered to occur in study area

There were no TEC's mapped on the SEED Data base, in the vicinity of the proposed sites. There are no River-Flat Eucalypt forest (BC and EPBC Act's) or Swamp Sclerophyll forest (EPBC act) on coastal floodplains within the footprint of the proposed activities. Site 1 is surrounded by wet sclerophyll forests (shrubby sub formation) in a south coast river flat peppermint and wet gully forest and south coast lowland shrub-grass forest. There are no EEC's within the vicinity of the works. Site 2 is surrounded by wet sclerophyll forests (shrubby sub formation) in a south coast river flat peppermint and wet gully forest. There are no EEC's within the vicinity of the works.

Threatened Flora List

Scientific Name	Common Name	NSW Status	Commonwealth Status	Impact Assessment
Rhodamnia rubescens	Scrub Turpentine	E4A	CE	No species records mapped within the immediate vicinity of either site. Site target survey confirmed not present.
^Genoplesium vernale	East Lynne Midge Orchid	V,P,2	V	No species records mapped within the immediate vicinity of either site. Site target survey confirmed not present.

The search returned a total of 2 species, with the Scrub Turpentine *Rhodamia rubesscens* and the Eastern Underground Orchid Rhizanthella slateri. Due to the nature sites biodiversity, it is unlikely that the Eastern Underground Orchid would be found. A targeted survey occurred, and it was identified that scrub turpentine does not exist at this location. Therefore, it is considered very low risk that any this species will be impacted as all construction is proposed inside existing footprint of the bridge and roadway, with minimal disturbance to surrounding vegetation. No trees are to be removed at either sites.

Threatened Fauna List

Scientific name	Common name	NSW Status	Commonwealth Status	Impact Assessment
^^*Callocephalon fimbriatum*	Gang-gang Cockatoo	V,P,3	E	No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 2.5km northeast from site 1 and 1.5km southwest from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Lathamus discolor	Swift Parrot	E1,P	CE	No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 4km from site 1 and 2.2km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
^^*Ninox strenua*	Powerful Owl	V,P,3		No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 3.2km from site 1 and 3km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
^^*Tyto novaehollandiae*	Masked Owl	V,P,3		Species have been recorded some 150m northeast of Site 1. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
^^*Tyto tenebricosa*	Sooty Owl	V,P,3		No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 1.4km from site 1 and 1km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.

Petroica boodang	Scarlet Robin	V,P		No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 4.5km from site 1 and 2.6km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Dasyurus maculatus	Spotted-tailed Quoll	V,P	E	No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 5km from site 1 and 7km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Petaurus australis	Yellow-bellied Glider	V,P	V	Species have been recorded some 350m upstream of Site 1. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Petaurus norfolcensis	Squirrel Glider	V,P		No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 4km from site 1 and 6km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Petauroides volans	Southern Greater Glider	E1,P	E	Species have been recorded some 200m downstream from Site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V	No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 2km from site 1 and 3km from site 2. It is considered to be an unlikely risk of impact as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs and will be remediated.
Phoniscus papuensis	Golden-tipped Bat	V,P		No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 3.5km southeast from site 1

				and 8.5km northeast from site 2. The underside of bridges are often roosting sites for the bats and therefore there is a possible risk of impact as the works involve demolition of the existing bridge and construction of a new bridge. A survey has been conducted which confirmed that no microbat roosting is occurring at either site. If a microbat is located, appropriate measures and safeguards will be implemented to enable careful removal and relocation.
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P		No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 4km from site 1 and 4.5km from site 2. The underside of bridges are often roosting sites for the bats and therefore there is a possible risk of impact as the works involve demolition of the existing bridge and construction of a new bridge. A survey has been conducted which confirmed that no microbat roosting is occurring at both site. If a microbat is located, appropriate measures and safeguards will be implemented to enable careful removal and relocation.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V,P		No species records mapped within the immediate vicinity of the proposed site. Species have been recorded 5.5km from site 1 and 8km from site 2. The underside of bridges are often roosting sites for the bats and therefore there is a possible risk of impact as the works involve demolition of the existing bridge and construction of a new bridge. A survey has been conducted which confirmed that no microbat roosting is occurring at both sites. If a microbat is located, appropriate measures and safeguards will be implemented to enable careful removal and relocation.
Prototroctes maraena	Australian Grayling	V		Species is known to occur in the area, however Fisheries mapping does not indicate that Boondobah or Bridge Creek are habitat. Due to its close location to the Clyde River, which is mapped as habitat, it is considered to be a potential risk of impact. Therefore, to mitigate any potential impact construction will aim to occur during January to March to avoid the migration and spawning periods for Australian Greyling from the end of March to the beginning of July to the beginning of September to end of December.

The search returned a total of 196 species; however, none were mapped within the immediate vicinity of either proposed site. The Australian Greyling is known in the area and given the nature of the project likely to be the more potentially impacted of the species. However, Boondobah and Bridge Creek are not mapped on the Fisheries data bases as habitat, meaning restrictions surrounding construction times is not applicable. A seven-part test of significance has been conducted as per the Fisheries Management act, which concluded that a significant impact would not be imposed upon the species.

Additionally, threatened Mircrobats also need to be considered given that the underside of bridges are often utilised for roosting. In order to mitigate the risks associated with any negative impact to the species, a survey was undertaken which identified that they are not present. Appropriate measure will be in place to remove bats if identified prior to demolition of the existing bridge along with a five-part test being conducted.

Threatened Migratory Species List

Scientific Name	Common Name	Class	Presence	Threatened Category	Buffer Status	Impact Assessment
Calidris ferruginea	Curlew Sandpiper	Bird	May	CEEC	In feature area	No species records mapped within the immediate vicinity of the proposed site.
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Bird	May	V	In feature area	No species records mapped within the immediate vicinity of the proposed site.
Calidris canutus	Red Knot, Knot	Bird	May	E	In buffer area only	No species records mapped within the immediate vicinity of the proposed site.
Thalassarche eremita	Chatham Albatross	Bird	May	E	In buffer area only	No species records mapped within the immediate vicinity of the proposed site.
Hirundapus caudacutus	White-throated Needletail	Bird	Known	V	In feature area	No species records mapped within the immediate vicinity of the proposed site.
Diomedea sanfordi	Northern Royal Albatross	Bird	May	E	In buffer area only	No species records mapped within the immediate vicinity of the proposed site.
Diomedea epomophora	Southern Royal Albatross	Bird	Likely	V	In buffer area only	No species records mapped within the immediate vicinity of the proposed site.
Thalassarche cauta	Shy Albatross	Bird	Likely	E	In buffer area only	No species records mapped within the immediate vicinity of the proposed site.
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Bird	Likely	CEEC	In feature area	No species records mapped within the immediate vicinity of the proposed site.
Thalassarche steadi	White-capped Albatross	Bird	Known	V	In buffer area only	No species records mapped within the immediate vicinity of the proposed site.
Thalassarche salvini	Salvin's Albatross	Bird	Likely	V	In buffer area only	No species records mapped within the immediate vicinity of the proposed site.

There is considered to be an unlikely risk of impact to these species as they have not been identified onsite, via mapping and site assessment. Additionally, the risk is unlikely as construction is proposed generally within the existing footprint and any disturbance outside these areas will more likely be to ground cover and low-lying shrubs, with no trees proposed to be removed. This impact will be remediated upon completion

Biodiversity Conservation Act 2016 – Part 5 Test of Significance

The Part 5 Test of Significance will be conducted to include the following threatened species who known sightings, as per Bionet, within 1km of the proposed activity sites or have high likelihood due to site factors. The species include:

- Golden Tipped Bat: Sites 1 & 2
- Greater Broad-nosed Bat: Sites 1 & 2
- Large Bent Winged Bat: Sites 1 & 2
- Masked Owl: Site 1
- Yellow Bellied Glider: Site 1
- Southern Greater Glider: Site 2

The assessment will occur against the following criteria:

a) Adverse effects on the lifecycle of a species: In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species, such that a viable local population of the species is likely to be placed at risk of extinction
   [BC Act Section 7 (1)(a)]
b) Adverse effects on ecological communities: In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
   i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction or,
   ii. Is likely to sustainability and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
   [BC Act Section 7(1)(b)]
c) Adverse effects on habitats: In relation to the habitat of a threatened species or ecological community:
   i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
   ii. Weather an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
   iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species or ecological community in the locality.
   [BC Act Section 7(1)(c)]
d) Adverse effect on areas of outstanding biodiversity value: Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).
   [BC Act Section 7(1)(d)].
e) Key threatening processes: Weather the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.
   [BC Act Section 7(1)(e)]

The five-part test for this project is as follows:

a) The proposed activities are not likely to have an adverse effect on the lifecycle of the threatened species. A site assessment was undertaken which confirmed that no threatened ecological communities are present. Prior to demolition, the underside of the bridges will be assessed to ensure that no threatened microbats are utilising it for roosting. Relocation will occur by a professional in the instance they are located and therefore no impact is proposed to occur. Scrub turpentine has not been identified onsite. As there is no tree removal occurring and limited removal of under scrubs within the pre-disturbed road reserve, the impact on threatened species including the Masked Owl, Yellow Bellied Glider, and Southern Greater Glider are limited. Their habitat will not be impacted and therefore no impact should occur to these species.
b) The proposed activities will not place endangered communities at risk of extinction or place its local occurrence at risk of extinction. This is as the scope of works not impacting the surrounding vegetation to an extent that it would affect the identified species. No tree removal will occur and minimal clearing and grubbing of regrowth within and alongside the road reserve means no significant vegetation will be removed.
c) The proposed activity is not removing or modifying the habitat of the identified species to which having a limited/no impact. The habitat areas will not become fragmented or isolated from other areas of habitat as a result of the proposed activity. The vegetation which will be removed is of low/minimal importance to the long-term survival of the identified species.
d) The area has not been declared as an area of outstanding biodiversity value. The extent of vegetation removal occurring will not have an impact on the biodiversity of the area. The works are replacement of bridges which will not alter the composition or usage of the land.
e) The proposed activity is not part of a key threatening process and is not likely to increase the impact of a key threatening process.

Fisheries Management Act 1994 – 7-Part Test of Significance

Species: Australian Grayling

Location: Boondobah Creek and Bridge Creek

The *Australian Greyling* is known in the area and given the nature of the project likely to be the more potentially impacted of the species. However, Boondobah and Bridge Creek are not mapped on the Fisheries data bases as habitat, meaning restrictions surrounding construction times is not applicable. A 7-part test of significance has been conducted as per the Fisheries Management act, which concluded that a significant impact would not be imposed upon the species.

1. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
   Yes ☐ No ☒
   The species are not mapped to be located within the creeks worked will be conducted in and surrounding. These creeks feed into the Clyde River which is mapped as habitat for the Australian Grayling. Works are therefore not required to be completed within the restricted contraction times due to migration. However, to mitigate the risk, works will aim to do so without guarantee.

2. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
   Yes ☐ No ☒
   The species are not mapped to be located within the creeks worked will be conducted in and surrounding. These creeks feed into the Clyde River which is mapped as habitat for the Australian Grayling. Therefore, no impact is proposed to occur on the population to place them at risk of extinction.

3. In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
   i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
   ii. Is likely to substantially and adversely modify the composition of the ecological community such that its occurrence is likely to be placed at risk of extinction

   Yes ☐ No ☒

   No major effect will occur to the community to place them at risk of extinction. The population is not mapped to occur within the subjected area, however is in close proximity to a known habitat River and therefore risks should be managed to mitigate possible impacts.

4. In relation to the habitat of a threatened species, population, or ecological community:
    i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
    ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
    iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality.

    Yes ☐ No ☒

    No habitat will be removed, that will effect the species as a result of the proposed works.

5. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

    Yes ☐ No ☒

    Mitigation measures will be implemented to reduce the effect on the critical habitat, located upstream in the Clyde River. Works are therefore not required to be completed within the restricted contraction times due to migration. However, to mitigate the risk, works will aim to do so without guarantee.

6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

    Yes ☐ No ☐

    N/A

7. Whether the action proposed constitutes or is of a Key threatening process or is likely to result in the operation of, or increase the impact of, a key threating process.

    Yes ☐ No ☐

    N/A

Appendix B

AHIMS Report

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Site 1 200m

Client Service ID : 799790

Carley Mcgregor

125 ravenswood street
Bega New South Wales 2550

Attention: Carley Mcgregor

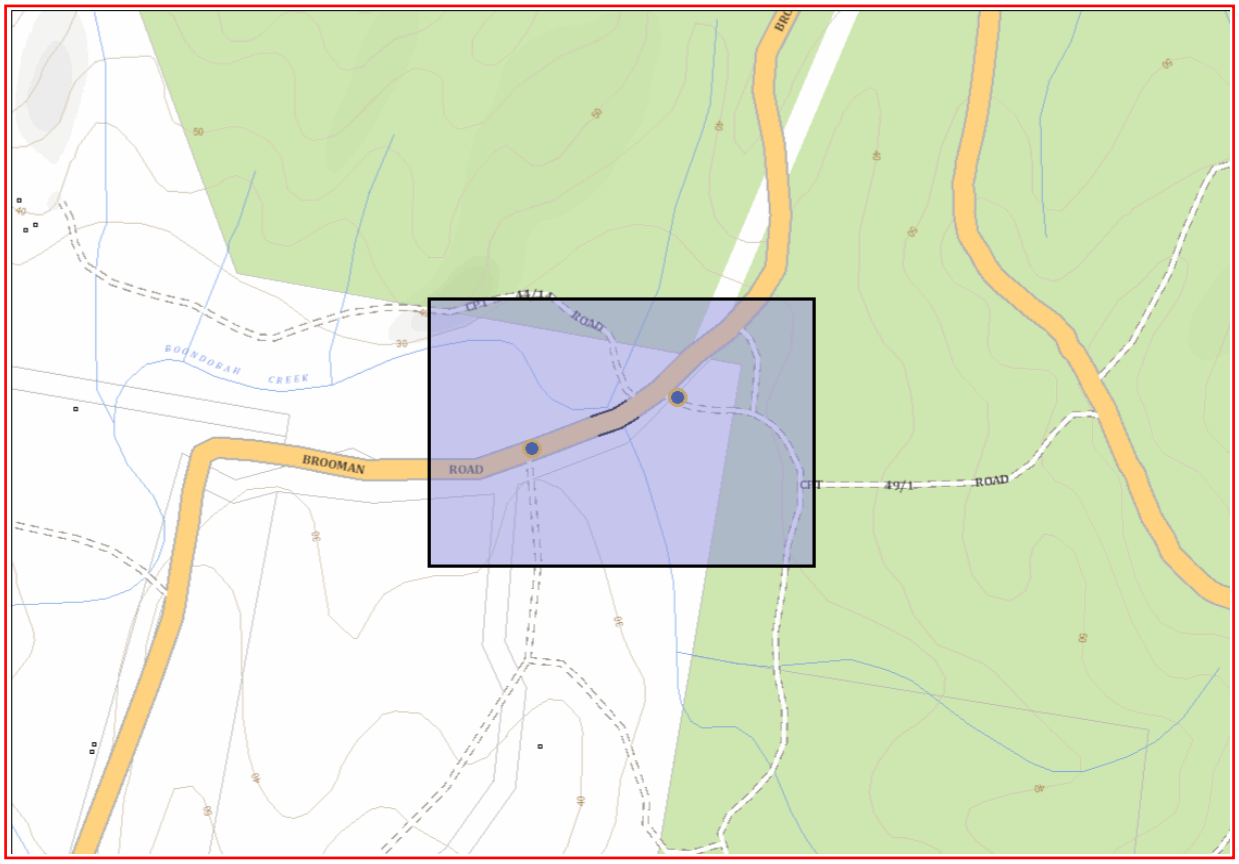
Email: me_carlz@hotmail.com

Date: 12 July 2023

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -35.4616, 150.2466 - Lat, Long To : -35.4594, 150.2504, conducted by Carley Mcgregor on 12 July 2023.

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 Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

2	**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 (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW 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 Heritage NSW 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.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Boondobah Bridge

Client Service ID : 852000

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
58-1-0844	VC 19	AGD	56	250120	6072200	Open site	Valid	Artefact : 1		98358,98359,98360,99058
	Contact	**Recorders**	Philip Boot					**Permits**		
58-1-0845	VC 18	AGD	56	250250	6072250	Open site	Valid	Artefact : 1		98358,98359,98360,99058
	Contact	**Recorders**	Philip Boot					**Permits**		

**** Site Status**

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 04/01/2024 for Caitlin Battersby for the following area at Lat, Long From : -35.4636, 150.2411 - Lat, Long To : -35.4572, 150.2566. Number of Aboriginal sites and Aboriginal objects found is 2

GAZETTEER OF ISOLATED FINDS (STONE ARTEFACTS) RECORDED ON SURVEY ROUTES DURING PHD FIELDWORK CONDUCTED BY PHILIP BOOT FROM OCTOBER 1991 TO FEBRUARY 1993

This is a list of all surface isolated artefact locations (i.e. all isolated finds) recorded on the archaeological survey routes within the South Coast hinterland study area (see Boot 2002: Appendix 1). The list includes the number of the survey route on which each artefact location was recorded as well as the AHIMS site identification number, 1:25,000 AGD grid reference, artefact details and altitude of each recorded artefact location. Maps of survey routes and recorded sites are provided in Appendix 16 of Boot, P.G. 2002 Didthul, Bhundoo, Gulaga and Wadbilliga: An archaeological study of the Aboriginals of the New South Wales south coast hinterland, Unpublished PhD thesis, The Australian National University. Copies of the thesis can be downloaded from http://hdl.handle.net/1885/7461.

An extensive program of archaeological survey was undertaken in the South Coast hinterland. This involved the walking of 10 survey routes and the observation of 1,385,978 m^2 (1.39 km^2) or 0.025% of the ground surface within the 5576 km^2 study area (Boot 2002: Table 5.1 and Appendix 16). These surveys provide information on 414 open artefact scatters, one midden, 289 isolated finds and yielded 8401 artefacts (Boot 2002: Figure 5.1, Appendix 1 and Appendix 16). The results were analysed using the methods described in Boot 2002: Section 3.3.5.

Table 5.1 distribution of artefact locations across study area

os/m	if	art locs	arts	m^2 surv total	m^2/os	m^2/if	m^2/art loc	m^2/art	total study area km^2	km^2 surv total	% study area surveyed
415	289	704	8401	1385978	3340	4796	1969	165	5576.1	1.386	0.025%

Key

os/m - number of open scatters or middens recorded on survey routes
if - number of isolated finds recorded on survey routes
art locs - number of locations at which at least one artefact was recorded (i.e. all open scatter and isolated find locations combined)
arts - number of artefacts recorded on survey routes
m^2 surv total - total area of exposed ground surface observed on survey routes in m^2
m^2/ os - total area of exposed ground surface per open scatter
m^2/ if - total area of exposed ground surface per isolated find
m^2/ art loc - total area of exposed ground surface per artefact location
m^2/ art - total area of exposed ground surface per artefact
total study area km^2 - size of field study area
km^2 surv total - total area of exposed ground surface observed on survey routes in km^2
% study area surveyed - percentage of study area that is comprised of observed exposed ground surface

Survey coverage of individual environmental zones (Boot 2002: Table 5.3) varied between 0.001% of the moist forest/rainforest Landsat vegetation zone (or 0.000322 km^2 of the 23.92 km^2 zone) and 0.7% of the open forest/woodland, north west facing slopes NPWS vegetation zone (or 0.005214 km^2 of the 0.75 km^2 zone).

Survey coverage of geological zones accounted for 0.02% of the study area, as did coverage of the Landsat and CSIRO vegetation zones (Boot 2002: Table 5.3). The smaller NPWS Morton NP vegetation zone was more effectively surveyed with 0.09% coverage. Only a small part, 0.009%, of the Deua-Wadbilliga NP vegetation zone was surveyed.

Summary of basic results

Examination of the data (Boot 2002: Table 5.2) shows that the highest density of artefact locations per square metre of observed ground surface occurs along the Merricumbene survey route (no. 8), followed by the Endrick River (no. 9), Tuross River (no. 10) and Clyde River (no. 7) routes. Site density and isolated find density figures follow similar patterns, although isolated finds were more densely distributed on routes 7 and 9 than on routes 8 and 10.

These four routes are among those with a low mean altitude for site locations (e.g. routes 10 and 7) or a low mean distance to water (e.g. routes 8 and 9), showing that high site densities tend to occur most often in well watered areas at low altitude. This indicates that the greatest site densities tend to occur in major river valleys and on broad well watered ridgelines. Major river valleys also show a much higher overall artefact density than other locations. Survey routes 6 to 10, encompassing significant parts of the Clyde, Buckenbowra, Tuross, Wadbilliga and Endrick Valleys, have far higher artefact densities than survey routes which bypassed major river valleys.

The largest surface site assemblages were found at PK20 in the Buckenbowra Valley, where 808 artefacts were recorded, and BR3 in the Wadbilliga Valley where 1185 artefacts were found. The smallest assemblages occur in sites on the Mount Budawang route (no. 5) and on the high sections of the Merricumbene route, showing that at high altitudes the hinterland was thinly occupied (Boot 2002: Sections 5.2.1 to 5.2.4; Tables 5.12 to 5.15).

Mean site area and mean site artefact density figures show that the most diffuse scatters occur along the Tianjara Fire Trail (no. 2) and Nerriga Road (no. 1) routes, both located on sandstone plateaux, whereas the most densely concentrated scatters occur in the Wadbilliga and Endrick valleys. Sites along the Buckenbowra River also contain high densities of artefacts.

Even though major river valleys and broad forested ridges contain the greatest number of sites, poorly watered and exposed locations were to a lesser extent also occupied. These include the highest recorded artefact scatter found in a saddle below the peak of Mount Budawang at 1070 m asl, and the small artefact scatters located in dry casuarina woodlands on high ridges in the Budawang Ranges, and between the Tuross and Wadbilliga Rivers. Mean annual rainfall rarely exceeds 700 mm in these dry, high altitude locations, whereas on the coast and in the major river valleys mean annual rainfall is over 1200 mm.

Most survey routes follow unsealed roads and tracks which provide the greatest visibility of surface remains but which have not resulted in the destruction of sites. Ten survey routes were chosen (Boot 2002: Table 3.2 and Appendix 16). The routes followed unsurfaced and gravelled roads, forestry trails and fire management trails. In areas where visibility on the

main survey route was significantly reduced or non-existent, adjacent side tracks and clearings were incorporated into the route.

The ten survey routes traverse the field area in several directions and are distributed throughout it (Boot 2002: Section 5.1, Tables 5.2, 5.3 and Appendix 16). Route 1 follows the northern field area boundary along the Nerriga and Turpentine Roads from Nerriga in the west to Tomerong in the east over a distance of 55.7 km. It passes through cleared pastoral land in the west, a central section of heath, woodland and dry forest, and concludes in the wetter forests east of the coastal escarpment. The Nerriga and Turpentine Roads are highly developed gravel roads that are frequently graded. Limited ground surface exposures were available on these roads but road verge areas provided good visibility conditions. In compensation for the reduced ground surface visibility on the main route, side tracks providing access to a powerline that parallels the route, were surveyed between the main road and the powerline. The access tracks predominantly consist of minimally maintained four wheel drive tracks that provide high levels of ground surface visibility. The route covers an area of 356,863 sq. m., of which 240,976 sq. m., or 67.5% of the route area, consists of exposed ground surface.

Survey route 2 commences near the mid point of route 1 at Tianjara Falls on the Nerriga Road and follows a southerly direction along the Twelve Mile Road and Tianjara Fire Trail through the heath, woodland and open forest of the Tianjara and Little Forest Plateaux to the Pointer Gap Road. There it turns east and descends the coastal escarpment through wet forest. Cleared areas occur near its end point at Yatteyattah on the coastal plain. This route extends for 35 km along naturally surfaced park management roads that are little more than four wheel drive tracks. Good ground surface visibility conditions occurred along all of them. Visibility conditions declined markedly along the Pointer Gap Road which is surfaced with bitumen and gravel. Along this section, road verges provided good visibility conditions, as did subsidiary forestry tracks which were surveyed for up to 1 km from their intersection with the main road. Route 2 covers an area of 213,959 sq. m., of which 174,883 sq. m., or 81.7% of the route area, consists of exposed ground surface.

Route 3, the 15.5 km long Wandean Road, commences near the eastern edge of the Tianjara Plateau where it passes east through heath and swamp environments before descending the coastal escarpment along a major forested ridge to the partly cleared coastal hills and plains around Wandandian, at its eastern extent. This minimally developed road afforded good visibility conditions except for several short gravelled sections. Route 3 covers an area of 63,855 sq. m., of which 44,062 sq. m., or 69% of the route area, consists of exposed ground surface.

Further south the coastal escarpment foothills, which had been cross-cut by the east-west sections of routes 1 to 3, were followed from north to south via route 4. This follows the Western Distributor, Fault Line, Boundary, Dingo and Long Gully forestry roads and fire trails from Yadboro to Currowan, through the foothills of the Budawang Range for a distance of 51 km. This route traverses a range of forested environments. Although the Western Distributor Road, a forestry feeder road used by heavy vehicles, has been extensively developed (i.e. cut, filled and gravelled) for much of its length, there were many sections that provided good visibility on road verges. All other roads were less developed and provided good ground surface visibility, although they varied from four wheel drive tracks to single lane, two wheel drive roads. Route 4 covers an area of 240,995 sq. m., of which 179,058 sq. m., or 74.3% of the route area, consists of exposed ground surface.

Route 5, the shortest at 6.3 km, traverses the Mount Budawang Fire Trail from the cleared eastern edge of the Southern Tablelands, through dry open forest, to the peak of Mount

Budawang. The peak is the highest point within the field area (1136 m asl) and is vegetated with heath and open forest. This minimally developed road provided mostly good visibility, however no isolated artefacts were observed. Excellent ground surface visibility was available at the foot of the mountain, along the ridges below the peak and at the peak itself. Route 5 covers an area of 29,000 sq. m., of which 26,100 sq. m., or 90% of the route area, consists of exposed ground surface.

Routes 6 and 7 traverse the central section of the field area, and pass through low and high altitude environments. Route 6 crosses the central section from west to east for a distance of 52.5 km, first via a network of forestry roads that follow the ridges of the Budawang Range from the top of the coastal escarpment at Monga near the Clyde Mountain to the upper reaches of the Buckenbowra River, a major tributary of the Clyde. The mid-section of the Buckenbowra was approached from above via high and dry ridges that parallel the river's narrow upper course. The route then descends into the broad, partly cleared, Buckenbowra Valley and follows it via Quart Pot Road until the route climbs again through coastal hills to Mogo. This route did not enter the coastal plain which is almost nonexistent in this area; characterised by hilly terrain and a rocky, cliffed coastline. All roads along this route are minimally developed and naturally surfaced, providing excellent visibility conditions. Route 6 covers an area of 189,054 sq. m., of which 136,693 sq. m., or 72.3% of the route area, consists of exposed ground surface.

Route 7 follows much of the length of the largest river valley within the field area, that of the Clyde, for 53 km. It commences near the junction of the Clyde estuary and Nelligen Creek and proceeds north along the western bank of the river via the River Road to the tidal limit at Shallow Crossing. There the route crosses to the eastern bank and proceeds north through rolling hills of open forest along a series of forestry roads to Yadboro where it intersects with route 4. Route 7 provided good visibility along the main roads and intersecting forestry tracks, which were followed for up to 1 km from the main road. Although parts of the main roads had been heavily developed, road verges and adjacent tracks provided high levels of ground surface visibility. This route had been previously surveyed by ANU students over several years and under varying conditions. Data from these surveys were used to supplement new data obtained during the survey conducted for the current research. Route 7 covers an area of 371,949 sq. m., of which 303,799 sq. m., or 81.7% of the route area, consists of exposed ground surface.

Further south route 8 traversed the foothills of the coastal escarpment over 82 km and was the longest survey route. It bisects the valleys of two major rivers, the Tuross and the Wadbilliga. Commencing near Merricumbene Mountain in Deua NP, the route proceeds south via a series of trails and roads through dry ridge and wet riverine vegetation to Bourke's Road in Wadbilliga NP. It also traverses small cleared areas at Belowra and Wadbilliga. The route concludes just south of the Wadbilliga River at the location of the Bourke's Road 2 (BR2) rockshelter. The entire route followed four wheel drive tracks, forestry and park management roads, all of which are naturally surfaced, providing good visibility conditions. Several follow steep ridges, the narrow crests of which had been entirely removed during road construction, thus providing little ground surface visibility. Route 8 covers an area of 239,008 sq. m., of which 147,522 sq. m., or 61.7% of the route area, consists of exposed ground surface.

Routes 9 and 10 follow river valleys for much of their length. Route 9 follows the Endrick River Valley for 38 km, near the northern boundary of the field area. Route 10 follows 35 km of the middle reaches of the Tuross River in the southern part of the field area. Route 9 commences at its junction with route 1 near Sassafras and proceeds in a southwesterly direction along the Newhaven Gap Road through the heath, swamp, woodland and open forest mosaic of Morton NP to an area of rainforest and wet forest within the small valley of Vines Creek, a tributary of the Endrick River. The route then follows the Endrick River Trail

for some distance through valley woodland and heath until cleared grazing land is encountered at the park boundary. Continuing west the route follows the Endrick River Road through cleared land and open forest to Nerriga where it again intersects with route 1. Most of route 9 consists of four wheel drive and foot tracks which provided good visibility. The western end of the route follows public roads through flat terrain, and although they are occasionally graded, good visibility conditions were maintained. Route 9 covers an area of 114,301 sq. m., of which 74,389 sq. m., or 65.1% of the route area, consists of exposed ground surface.

Route 10, near the southern boundary of the field area, follows the middle reaches of the Tuross River from Belowra (the most westerly point along the Tuross that can be accessed by vehicle) eastwards to Cadgee, where private properties prevent access to the river. The route follows a series of minimally graded unsurfaced forestry roads that run in a southerly direction down ridgelines to the river from an east-west ridge that parallels the river's course. This ridge is traversed by Belowra Road which has been heavily developed and provides lower visibility conditions than the forestry tracks, other than on it's wide verge. The route passes through dry forest along the higher ridges, wetter forest at lower altitudes, and riverine vegetation. At each end the route passes through cleared grazing land. Route 10 covers an area of 88,086 sq. m., of which 47,570 sq. m., or 54% of the route area, consists of exposed ground surface.

route no.	AHIMS no.	name	easting	northing	artefact details all dimensions mm	m asl
1	58-1-0739	MB1	237400	6112990	pink silcrete retouched fl. 18x17x4	545
	58-1-0740	PB2	240920	6112990	grey quartzite core 1 platform 5 fl. scars 45x41x16	750
	58-1-0741	MB3	241050	6114150	grey quartzite fl. piece 30% pebble cortex 41x27x15	760
	58-1-0742	MB5	246450	6114950	grey silcrete core 2 platforms 8 fl. scars 51x62x33	725
	58-1-0743	MB6	246230	6114940	red silcrete core 1 platform 6 fl. scars 10% quarry cortex 37x30x25	725
	58-1-0744	MB7	245530	6114860	grey quartzite fl. piece 10% pebble cortex 46x40x14	715
	58-1-0745	PB6	257850	6110500	grey silcrete fl. piece 20x18x7	510
	58-1-0746	PB8	260580	6113270	grey volcanic fl. piece 45x31x28	460
	58-1-0747	PB9	260400	6113160	pink/brown quartzite fl. 26x25x6	510
	58-1-0748	PB10	264100	6115720	grey/red silcrete bkn backed blade 26x16x5	350
	58-1-0749	PB11	271130	6120010	grey silcrete bkn fl. 21x28x6	180
	58-1-0750	PB12	271560	6119090	lt grey silcrete bkn fl. 26x27x3	190
	58-1-0751	PB13	271660	6118980	grey silcrete core platform rejuvenation fl. 29x13x13	190
	58-2-0360	TR1	272890	6119540	quartz fl. 16x6x4	195
	58-2-0361	PB14	272350	6118270	red/grey quartzite fl. 20x18x4	195
	58-2-0362	PB15	272600	6118520	grey quartzite fl. piece 23x13x6	200
	58-2-0363	PB16	272660	6118600	grey quartzite bkn fl. 22x20x6	200
	58-2-0364	PB19	277950	6118650	grey porphyry fl. 23x17x5	90
	58-2-0365	PB17	278990	6118390	quartz bkn fl. 13x9x3	20
2	58-1-0752	PB20	256620	6108750	dk grey porphyry fl. piece 18x18x7	520
	58-1-0753	TR3	255550	6106020	purple porphyry fl. piece 25x16x8	610
	58-1-0754	TR2	255120	6105920	lt brown quartzite fl. 30x30x9	610
	58-1-0755	TR4	255020	6105950	brown quartzite core 1 platform 11 fl.	610

					scars 25% pebble cortex 57x45x29	
	58-1-0756	PB25	254440	6105470	crystal quartz retouched fl. 9mm retouch on one margin 17x12x4	660
	58-1-0757	PB24	254050	6104700	crystal quartz bkn fl. 19x13x5	670
	58-1-0758	PB23	254060	6104620	dk grey silcrete fl. piece 17x11x9	670
	58-1-0759	TR7	254100	6104500	grey porphyry fl. 39x34x18	670
	58-1-0760	PB28	253540	6103390	lt grey weathered porphyry core 2 platforms 9 fl. scars 51x42x32	660
	58-1-0761	PB30	253790	6103950	lt grey porphyry fl. 23x43x9	650
	58-1-0762	PB30A	252720	6104000	lt grey quartzite core 2 platforms 6 fl. scars 51x47x20	650
	58-1-0763	TR9	253500	6103300	lt brown quartzite fl. piece 20% pebble cortex 37x27x18	650
	58-1-0764	TR11	253570	6102720	lt grey quartzite retouched fl. 28x16x3	640
	58-1-0765	PB35	255870	6100600	lt grey silcrete fl. piece 30% pebble cortex 18x14x5	540
	58-1-0766	PB34	255870	6100510	grey rhyolite bkn fl. 28x23x9	540
	58-1-0767	PB33	255700	6099920	grey quartzite retouched fl. 75% margin retouched 43x38x10	550
	58-1-0768	PB32	255690	6099860	grey quartzite fl. 32x30x6	540
	58-1-0769	TR13	256050	6098950	grey porphyry fl. piece 30% pebble cortex 36x18x13	530
	58-1-0770	TR17	256190	6096980	lt grey porphyry fl. piece 27x16x9	570
	58-1-0771	TR15	256170	6096760	lt grey porphyry fl. piece 32x22x18	570
	58-1-0772	PB39	257650	6096550	grey porphyry retouched fl. 50% margin retouched 36x34x17	500
	58-1-0773	PB41	258420	6095670	grey rhyolite bkn fl. 17x16x6	490
	58-1-0774	PB42	258470	6096590	grey rhyolite fl. 11x19x4	490
	58-1-0775	PB43	258500	6095490	grey quartzite fl. piece 84x57x27	490
	58-1-0776	PB40	258490	6095350	lt grey weathered porphyry fl. piece 5% pebble cortex 40x29x15	490
	58-1-0777	PB50	258190	6094690	lt grey porphyry fl. piece 17x13x4	490
	58-1-0778	PB51	258200	6094520	grey/brown porphyry bkn fl. 18x15x11	490
	58-1-0779	PW4	258240	6092920	lt grey porphyry bkn fl. 37x24x6	510
	58-1-0780	PB52	258030	6092670	crystal quartz bkn fl. 25x19x5	500
	58-1-0781	PB46	258610	6095920	lt grey porphyry fl. piece 27x23x6	460
	58-1-0782	PB45	258920	6094950	lt grey porphyry fl. 32x22x11	460
	58-1-0783	TR19	262920	6096950	lt grey porphyry bkn fl. 32x20x6	110
	58-1-0784	TR18	263710	6097850	dk grey porphyry fl. piece 36x30x10	20
	58-1-0785	PB49	263150	6096440	lt grey quartzite bkn fl. 12x14x4	60
	58-1-0786	AH1	256270	6098600	lt grey quarzite fl. 33x32x13	520
3	58-1-0787	PB53	262210	6112820	lt grey volcanic fl. piece40x28x28	420
	58-1-0788	PB54	263400	6112740	dk grey quartzite bkn fl. 18x17x4	380
	58-1-0789	PW5	263790	6112560	lt grey chalcedony fl. 20% pebble cort. 44x30x8	330
	58-1-0790	PB56B	265270	6112030	lt grey porphyry fl. piece 23x20x5	180
	58-1-0791	PB58	266850	6111450	dk grey porphyry bkn fl. 22x14x5	90
	58-1-0792	PB60	269220	6112850	grey quartzite bkn fl. 30% pebble cort. 27x20x6	30
	58-1-0793	PW8	270310	6114420	brown chert ret. fl. 20% of margin retouched 28x21x6	10
4	58-4-0923	BE3	233370	6058140	lt grey porphyry bkn fl. 16x14x3	170
	58-4-0924	BE5	233210	6058870	grey porphyry fl. piece 45x21x4	60
	58-4-0925	PB61	232200	6060200	black porphyry bkn fl. 28x18x5	170

	58-4-0926	BE6	232170	6060260	red porphyry bkn fl. 35x27x9	170
	58-4-0927	PB62	230970	6061210	lt grey silcrete bkn fl. 22x20x9	290
	58-4-0928	BE8	229720	6062220	dk grey porphyry fl. 27x25x9	300
	58-4-0929	BE9	229450	6062170	red volcanic fl. 31x28x7	260
	58-4-0930	PW11	230420	6063170	grey weathered siltstone bkn fl. 17x17x2	420
	58-4-0931	PB63	230040	6064290	lt grey porphyry fl. piece 23x13x6	420
	58-4-0932	BE13	231250	6066000	dk grey porphyry fl. 30x20x7	310
	58-1-0794	BE15A	231150	6068360	lt grey porphyry fl.18x28x3	600
	58-1-0795	BE16	231160	6068360	lt grey porphyry bkn fl. 26x11x4	600
	58-1-0796	BE17	231300	6068850	dk grey porphyry fl. piece 22x12x10	540
	58-1-0797	PW15	235260	6070970	red porphyry bkn fl. 33x29x11	210
	58-1-0798	PB67	236060	6073150	lt grey quartzite fl. piece 14x11x4	390
	58-1-0799	PW16	236220	6074140	lt grey porphyry bkn fl. 21x16x3	420
	58-1-0800	BE20	236390	6074540	pebble hammerstone 100% cort. impact pitting around margin particularly at one end 67x62x16	480
	58-1-0801	PB70	235240	6075260	dk grey rhyolite core 2 platforms 16 fl. scars 53x49x28	500
	58-1-0802	BE23A	235000	6075460	lt grey silcrete bkn fl. 17x11x3	550
	58-1-0803	PW17	235200	6075690	dk grey porphyry fl. piece 13x13x3	510
	58-1-0804	PW19	237460	6074980	lt grey porphyry bkn fl. 17x20x5	530
	58-1-0805	BE25	238050	6074390	pebble hammerstone 100% cort. impact pitting at one end 67x53x25	460
	58-1-0806	PB73	240190	6079060	purple porphyry fl. piece 30x23x10	460
	58-1-0807	PW23	240270	6079110	purple porphyry bkn fl. 31x19x8	460
	58-1-0808	BE28	240310	6079660	dk grey porphyry bkn blade 48x16x7	450
	58-1-0809	PW24	240240	6080200	purple porphyry core 2 platforms 8 fl. scars 22x31x18	500
	58-1-0810	PB75	240570	6080640	dk grey porphyry fl. piece 27x14x6	490
	58-1-0811	PW27	240120	6081890	purple rhyolite bkn fl. 12x16x5	480
	58-1-0812	PB77	240650	6083640	purple porphyry fl. 26x23x10	390
	58-1-0813	PW29	240620	6083720	purple porphyry fl. piece 22x18x10	380
	58-1-0814	PB80	241320	6084710	purple rhyolite core 2 platforms 7 fl. scars 36x30x25	350
	58-1-0815	BE31	241910	6085700	purple porphyry fl. piece 26x20x5	270
	58-1-0816	PB83	243890	6087240	lt grey quartzite fl. 43x41x8	160
	58-1-0817	PW32	243310	6087950	purple porphyry fl. piece 15x14x6	160
	58-1-0818	PB84	244150	6087540	grey quartzite unmodified river pebble manuport 97x72x38	130
	58-1-0819	PW34	244920	6086750	grey quartzite core 1 platform 9 fl. scars 39x50x39	170
	58-1-0820	PW36	247050	6085910	lt grey porphyry core 2 platforms 10 fl. scars	70
6	57-6-0417	TR22	770350	6052220	quartz fl. piece 19x12x2	170
	58-4-0964	PB91	778390	6059790	brown porphyry fl. piece 47x25x20	420
	58-4-0966	PK7	228390	6059790	grey rhyolite bkn fl. 16x22x7	280
	58-4-0967	PB95A	240920	6040910	red chert fl. piece 25x21x12	20
	58-4-0968	PK9	240100	6039990	grey silcrete core 1 platform 5 fl. scars 23x18x13	50
	58-4-0969	PK12	239570	6039920	grey silcrete fl. piece 20x12x7	85
	58-4-0970	PB96	239210	6040010	grey/brown silcrete fl. piece 23x18x6	110
	58-4-0971	PB97	238700	6040750	purple porphyry fl. 25x20x6	140
	58-4-0972	PK13	238200	6040320	grey silcrete fl. 15x12x5	140
	58-4-0973	PB98	237620	6040210	purple/grey silcrete fl. piece 34x27x8	130
	58-4-0974	PB99	237450	6039910	grey volcanic split pebble 70% cortex	130

					60% of margin retouched 90x68x22	
	58-4-0975	PK14	237410	6039690	blue/grey volcanic split pebble 3 fl. scars 40% cortex 90x50x35	130
	58-4-0976	PK16	237270	6039070	dk grey rhyolite fl. 42x34x15	150
	58-4-0977	PK17	237100	6039090	purple rhyolite fl. 30x20x5	160
	58-4-0978	PB100	236820	6039110	purple porphyry bkn fl. 22x20x4	170
	58-4-0979	PB101	236500	6039270	grey porphyry fl.15x22x5	220
	58-4-0980	PB102	235710	6040980	grey porphyry bkn fl. 11x15x6	60
	58-4-0981	PB103	235620	6041020	dk grey porphyry bkn fl. 18x20x8	60
	58-4-0982	PB104	235560	6041090	grey chert fl. piece 25% pebble cortex 35x22x11	60
	58-4-0983	PB105	235500	6041300	lt grey silcrete bkn fl. 18x21x7	40
	58-4-0984	PK19	233570	6042040	grey porphyry fl. 27x29x8	90
	58-4-0985	PB109	230050	6045200	lt grey porphyry bkn fl. 15x14x7	120
	58-4-0986	PB110	229300	6045100	purple porphyry bkn fl. 18x12x5	80
	57-6-0418	PB113	769440	6048540	purple porphyry fl. piece 27x20x11	290
	57-6-0419	PB114	768620	6049340	dk grey porphyry fl. 29x33x13	390
	57-6-0420	PB115	769150	6051520	dk grey porphyry bkn fl. 15x20x7	330
	57-6-0421	PB118	767400	6051360	dk grey porphyry fl. 22x18x9	350
	57-6-0422	PB121	766950	6051600	dk grey silcrete core 1 platform 5 fl. scars 41x44x20	350
	57-6-0423	PB122	766650	6051740	dk grey porphyry bkn fl. 17x38x11	390
	57-6-0424	PB123	766120	6051660	lt grey porphyry bkn blade 21x11x6	490
	57-6-0425	PB124	766070	6051660	lt grey silcrete bkn fl. 22x13x4	490
	57-6-0426	PB125	765960	6051670	dk grey chert bkn fl. 14x14x5	490
	57-6-0427	PB126	765240	6052240	dk grey porphyry fl. piece 40% quarry cort. 32x22x18	590
	57-6-0428	PB129	763960	6053700	lt grey silcrete fl. 20x9x5	740
7	58-4-0987	TR23	241350	6055110	grey rhyolite fl. piece 25x14x3	10
	58-4-0988	PB132	241320	6056560	dk grey rhyolite fl. piece 33x26x12	10
	58-4-0989	TR24	241250	6057120	grey silcrete fl. 27x21x8	40
	58-4-0990	TR25	241410	6057060	lt grey volcanic fl. 10% pebble cort. 60x53x20	30
	58-4-0991	PB135	241890	6058220	lt grey porphyry fl. piece 40x29x20	20
	58-4-0992	PB136	242450	6059050	dk grey silcrete fl. piece 32x29x6	50
	58-4-0993	PB137	242270	6059690	lt grey porphyry fl. piece 74x46x25	10
	58-4-0994	PB138	242870	6061420	grey/brown porphyry fl. piece 30x20x12	80
	58-4-0995	PB139	242520	6061950	purple porphyry fl. 28x32x10	90
	58-4-0996	PB142	243900	6062150	dk grey porphyry fl. piece 26x15x8	10
	58-4-0997	PB145	244150	6062050	dk grey porphyry fl. 19x14x5	10
	58-4-0998	TR30	245530	6063690	dk grey rhyolite bkn fl. 60x32x12	30
	58-4-0999	TR31	245390	6064140	dk grey rhyolite fl. piece 20x14x3	70
	58-1-0839	TR34	249460	6069200	dk grey rhyolite bkn fl. 23x15x6	20
	58-1-0840	TR35	249600	6069310	dk grey volcanic bkn fl. 17x31x8	20
	58-1-0841	PB147	249740	6069560	lt grey porphyry fl. piece 19x15x8	30
	58-1-0842	TR36	250340	6072760	purple porphyry bkn fl. 16x19x6	50
	58-4-1000	PB152	248250	6067040	lt grey porphyry fl. piece 37x22x13	20
	58-4-1001	EA11	246470	6065050	grey volcanic fl. piece 34x20x15	50
	58-4-1002	CW15	246450	6065400	dk grey volcanic flaked hatchet preform no ground edge 135x75x35	30
	58-4-1003	EA9	246630	6065080	grey volcanic flaked pebble 78x59x56	50
	58-4-1004	EA14	246830	6065750	grey volcanic flaked hatchet preform no ground edge 130x20x40	30

58-4-1005	EA15	246950	6065220	cream silcrete core 45x38x20	30
58-4-1006	EA19	247620	6066420	grey quartzite flaked pebble 50x44x32	70
58-4-1007	AB9	246820	6066550	purple volcanic fl. 21x16x11	50
58-1-0843	VC20	249450	6071270	pink quartzite fl. piece 40x61x28	20
58-1-0844	VC19	250120	6072200	grey basalt flake 31x39x13	20
58-1-0845	VC18	250250	6072250	grey basalt hammerstone 101x 19x25	20
58-1-0846	VC11	249370	6073050	red brown volcanic fl. 39x31x8	70
58-1-0847	VC12	248650	6072950	purple volcanic fl. piece 50x27x11	80
58-1-0848	VC14	247640	6072500	grey silcrete fl. 36x23x8	50
58-1-0849	VC15	247700	6072870	brown silcrete fl. 18x3x2	30
58-1-0850	JT21	250690	6074430	grey silcrete fl. 21x16x4	30
58-1-0851	BE11	250920	6074720	quartzite core 34x30x16	30
58-1-0852	HD7	251200	6075200	dk grey volcanic fl. 15x11x4	60
58-1-0853	HD11	250800	6075050	grey volcanic fl. piece 20x30x20	90
58-1-0854	HD4	250610	6075000	grey volcanic hammerstone 125x75x40	110
58-1-0855	TK7	250600	6074800	grey silcrete core 160x130x12	110
58-1-0856	TK2	250600	6075000	grey volcanic core 65x52x30	120
58-1-0857	TK3	250500	6075000	grey volcanic core 40x30x25	120
58-1-0858	HD10	250100	6074950	grey volcanic fl. piece 20x18x20	40
58-1-0859	TK8	251000	6075100	grey silcrete core 105x60x70	50
58-1-0860	HD12	250700	6075100	grey volcanic fl. 25x18x2	70
58-1-0861	TK4	250500	6075400	purple volcanic fl. piece 47x25x15	50
58-1-0862	HD13	250520	6075800	pink volcanic fl. piece 80x50x30	40
58-1-0863	TK14	249500	6076450	pink volcanic split pebble 50% cortex 70x30x15	80
58-1-0864	HD16	249050	6076600	grey silcrete fl. 50x25x10	70
58-1-0865	HD17	248950	6076500	purple volcanic flaked pebble 190x110x70	70
58-1-0866	HD18	248920	6076400	purple volcanic fl. 50x22x10	50
58-1-0867	TK15	248900	6076500	grey sedimentary split pebble 50% cortex 70x30x15	60
58-1-0868	TK16	248800	6076600	grey sedimentary flake 50% pebble cortex 50x38x5	50
58-1-0869	TK18	249210	6076600	purple silcrete fl. 30x22x12	60
58-1-0870	AG3	249630	6078260	grey silcrete fl. 18x20x3	110
58-1-0871	IF76 (1986)	249390	6078780	silcrete core	110
58-1-0872	AG9	248870	6078250	brown volcanic fl. 32x22x10	90
58-1-0873	IF74 (1986)	248380	6078210	silcrete fl. piece	60
58-1-0874	AG11	248960	6077740	grey volcanic flaked pebble 63x79x55	60
58-1-0875	AG12	248890	6077690	brown volcanic flake 32x22x10	70
58-1-0876	IF79 (1986)	249950	6078640	grey silcrete fl.	100
58-1-0877	IF64 (1986)	257330	6077630	silcrete fl.	110
58-1-0701/ 58-1-0878	Crisp 9/ CR9	250600	6078830	silcrete fl.	110
58-1-0879	IF161 (1986)	250400	6078850	grey silcrete fl.	100
58-1-0880	IF163 (1986)	252350	6078900	dk grey core	120
58-1-0881	HD19	251700	6080700	grey volcanic fl. piece 35x60x10	150

	58-1-0882	HD20	251100	6080950	grey volcanic pebble core 50x35x15	80
	58-1-0883	HD25	249950	6080950	grey silcrete core 40x20x15	140
	58-1-0884	TK31	249650	6080500	grey silcrete pebble core 70x55x30	150
	58-1-0885	HD24	249600	6080100	purple silcrete fl. 23x16x5	150
	58-1-0886	TK29	249300	6079580	grey silcrete flaked pebble 60x50x25	150
	58-1-0887	TK27	249070	6079600	grey silcrete core 65x65x25	80
	58-1-0888	TK36	249510	6081220	silcrete fl.	130
	58-1-0889	TK35	249500	6081200	grey silcrete core 50x30x20	130
	58-1-0890	TK34	249300	6081150	white quartz fl. 15x15x3	120
	58-1-0891	HD27	248500	6081400	purple silcrete fl. piece 65x30x25	80
	58-1-0892	IF56 (1986)	246900	6082100	silcrete blade core	120
	58-1-0893	IF49 (1986)	246700	6083800	silcrete fl.	130
	58-1-0894	IF218 (1986)	247070	6083950	silcrete fl. piece	150
	58-1-0895	IF217 (1986)	247020	6084020	silcrete fl. piece	150
	58-1-0896	IF216 (1986)	246930	6084230	silcrete fl. piece	140
	58-1-0897	IF215 (1986)	246820	6084380	silcrete fl. piece	130
	58-1-0898	IF214 (1986)	246780	6084420	silcrete fl. piece	120
	58-1-0258/ 58-1-0899	ANU site 44/ IF44 (1986)	247860	6086370	2 silcrete cores	80
	58-1-0900	IF70 (1986)	247880	6087080	grey silcrete fl.	70
	58-1-0901	IF71 (1986)	247800	6087180	grey silcrete fl.	60
	58-1-0902	IF72 (1986)	247820	6087200	red silcrete fl.	50
	58-1-0903	IF73 (1986)	247780	6087220	silcrete fl. piece	70
8	57-6-0429	PH4	759100	6029540	chert fl. 43x32x6	840
	57-6-0430	PBM3	757700	6027210	dk grey chert blade 6mm retouch on margin 20x10x3	790
	57-6-0431	PH5	756700	6027290	chert fl. 32x23x6	670
	57-6-0432	PH6	756360	6028360	chert fl. piece 33x18x7	670
	57-6-0433	PBM1	755000	6026520	white quartz bkn fl. 11x9x2	960
	57-6-0434	AG6	754050	6023440	white quartz manuport (possible core) 82x54x53	870
	57-6-0435	AG5	753690	6023150	dk grey chert fl. piece 33x24x15	840
	57-6-0436	TK6	753550	6021620	grey chert fl. piece 21x16x11	940
	57-6-0437	TK3	753300	6021350	grey chert chip <10mm	970
	57-6-0438	AG4	752320	6020010	dk grey volcanic fl. piece 24x30x11	940
	57-6-0439	TK2	752270	6018670	grey chert fl. piece 9x13x4	930
	57-6-0440	JT3	753140	6016610	lt grey chert chip <10mm	860
	57-6-0441	JT4	753150	6016510	white quartz fl. 4x21x3	740
	57-6-0442	DL4	753300	6016170	lt grey silcrete bkn fl. 22x31x6	750
	57-6-0443	DL6	754420	6015240	lt grey chert fl. piece 18x16x5	780
	62-3-0584	PBM6	759970	6010420	purple rhyolite fl. 34x40x16	760
	62-3-0585	DL10	759420	6009570	purple porphyry fl. 26x25x12	670
	62-3-0586	DL11	756210	6007910	white quartz fl. 17x18x3	770
	62-3-0587	JT12	755240	6007520	grey silcrete fl. piece 29x19x11	730

	62-3-0588	AG8	752410	6006270	dk grey chert fl. piece 16x10x4	720
	62-3-0589	PBM9	749340	6002460	crystal quartz bkn fl. 10x11x3	560
	62-3-0590	PBM11	748010	5998980	lt grey volcanic bkn pebble hammerstone impact pitting on end opposite bkn end 27x32x29	440
	62-3-0591	JT16	747140	5999500	white quartz fl. 22x14x7	280
	62-3-0592	TK22	745340	5997610	white quartz bkn backed blade 22x19x6	440
	62-3-0593	TK21	745540	5997460	white quartz retouched fl. (scraper) 9mm of edge retouched 18x12x5	390
	62-3-0594	TK17	744820	5996340	white quartz fl. 20x17x8	160
	62-3-0595	PH17	744790	5996160	lt grey volcanic fl. 16x40x7	150
	62-3-0596	JT26	745260	5995620	white quartz fl. 18x17x4	250
	62-3-0597	PBM17	745600	5994660	white quartz bipolar core 6 fl. scars 17x11x7	440
	62-3-0598	PH14	746220	5993600	dk grey volcanic bkn pebble hammerstone impact pitting on end opposite bkn end 100x72x52	420
	62-3-0599	PBM13	746220	5993200	dk grey chert fl. piece 21x21x9	370
	62-3-0600	PH13	746170	5993120	white quartz core 2 platforms 8 fl. scars 29x26x28	370
	62-3-0601	DL19	746250	5992820	grey chert fl. piece 21x16x11	410
	62-3-0602	PH9	745740	5991360	white quartz fl. piece 27x16x11	290
	62-3-0603	JT17	745340	5991250	pink quartzite fl. piece 70% pebble cortex 47x21x13	210
9	58-1-0904	PBE1	249870	6111160	lt grey silcrete fl. piece 29x20x10	750
	58-1-0905	TRE1	249900	6111070	white quartz bkn fl. 13x16x4	750
	58-1-0906	PBE2	249820	6110570	lt grey silcrete fl. piece 15x10x7	730
	58-1-0907	BSE1	249990	6109030	brown siltstone fl. piece 34x17x11	720
	58-1-0908	GTE1	248620	6102200	grey quartzite fl. piece 27x30x6	730
	58-1-0909	BSE2	248570	6102150	lt grey quartzite bkn fl. 27x30x6	730
	58-1-0910	GTE4	247750	6100820	grey quartzite bkn retouched fl. 2 margins retouched	690
	58-1-0911	GTE 6	246420	6100590	white quartz fl. piece 25x19x7	690
	58-1-0912	PBE8	245560	6102790	white quartz fl. 8x12x4	620
	58-1-0913	PBE9	245540	6102870	white quartz fl. 12x16x6	620
	58-1-0914	PBE10	245270	6103270	crystal quartz fl. 10x10x2	610
	58-1-0915	PBE11	245190	6103450	dk grey porphyry bkn fl. 16x11x4	610
	58-1-0916	PBE12	245150	6103720	lt grey silcrete fl. 23x21x8	610
	58-1-0917	PBE6	244420	6104000	grey quartzite fl. piece 25% pebble cortex 45x36x15	610
	58-1-0918	PBE7	243910	6104240	lt grey quartzite core 2 platforms 7 fl. scars 20x20x26	610
	58-1-0919	PGE2	243570	6104440	grey silcrete fl. piece 25x20x6	600
	58-1-0920	PGE4	242840	6104390	lt grey quartzite core 1 platform 8 fl. scars 63x35x30	620
	58-1-0921	PGE5	242660	6104530	lt grey quartzite core 2 platforms 7 fl. scars 86x75x49	610
	58-1-0922	PGE11	241010	6106150	lt grey silcrete retouched fl. 22mm of 1 margin retouched 18x27x8	600
	58-1-0923	GTE9	239410	6106000	grey chert core 1 platform 4 fl. scars 24x12x12	560
	58-1-0924	PGE1A	238720	6106300	lt grey silcrete fl. piece 15x14x4	570
	58-1-0925	PGE2A	238520	6106120	lt grey silcrete fl. piece 23x13x7	580
	58-1-0926	PGE8A	236250	6107270	white quartz fl. 29x18x6	620
	58-1-0927	PGE9A	236150	6107440	grey silcrete fl. piece 13x12x8	620
	58-1-0928	PGE10A	235950	6107470	grey silcrete fl. 21x14x5	630

10	62-3-0604	PCT1	750040	5992320	black chert fl. piece 26x19x10	250
	62-3-0605	PCT3	752610	5991740	white quartz fl. 12x13x4	290
	62-3-0606	PBT10	754510	5992940	white quartz core 1 platform 6 fl. scars29x23x11	490
	62-3-0607	PBT11	754960	5991740	white quartz fl. 10x12x4	390
	62-3-0608	PBT12	755940	5989620	lt grey silcrete fl. lt grey silcrete fl.27x37x8	180
	62-3-0609	PCT5	755820	5989490	grey volcanic bkn flaked pebble 90% cortex 175x111x55	150
	62-3-0610	PCT4	755700	5989200	grey chert fl. piece 38x33x12	110
	62-3-0611	PBT22	758100	5990400	lt grey volcanic flaked pebble hatchet preform margin flaked both faces 70% cortex 1 end snapped off 104x68x34	230
	62-3-0612	PBT32	759670	5992600	lt grey chert fl. 26x14x7	250
	62-3-0613	PBT34	750290	5992410	lt grey volcanic fl. piece 21x13x7	200
	62-3-0614	PCT11	761370	5992360	grey volcanic fl. piece 42x27x11	110

Key

survey route number - number of the survey route on which the open scatter or isolated find was recorded.
site number - site identification number assigned in the field by the site recorder - site number initials identify the recorder.
easting - 1:25,000 AGD grid reference easting.
northing - 1:25,000 AGD grid reference northing.
artefact nos - isolated finds are denoted by the number 1.
altitude (m asl) - altitude above mean sea level of the isolated find.

GAZETTEER OF ISOLATED FINDS (STONE ARTEFACTS) RECORDED ON SURVEY ROUTES DURING PHD FIELDWORK CONDUCTED BY PHILIP BOOT FROM OCTOBER 1991 TO FEBRUARY 1993

This is a list of all surface isolated artefact locations (i.e. all isolated finds) recorded on the archaeological survey routes within the South Coast hinterland study area (see Boot 2002: Appendix 1). The list includes the number of the survey route on which each artefact location was recorded as well as the AHIMS site identification number, 1:25,000 AGD grid reference, artefact details and altitude of each recorded artefact location. Maps of survey routes and recorded sites are provided in Appendix 16 of Boot, P.G. 2002 Didthul, Bhundoo, Gulaga and Wadbilliga: An archaeological study of the Aboriginals of the New South Wales south coast hinterland, Unpublished PhD thesis, The Australian National University. Copies of the thesis can be downloaded from http://hdl.handle.net/1885/7461.

An extensive program of archaeological survey was undertaken in the South Coast hinterland. This involved the walking of 10 survey routes and the observation of 1,385,978 m^2 (1.39 km^2) or 0.025% of the ground surface within the 5576 km^2 study area (Boot 2002: Table 5.1 and Appendix 16). These surveys provide information on 414 open artefact scatters, one midden, 289 isolated finds and yielded 8401 artefacts (Boot 2002: Figure 5.1, Appendix 1 and Appendix 16). The results were analysed using the methods described in Boot 2002: Section 3.3.5.

Table 5.1 distribution of artefact locations across study area

os/m	if	art locs	arts	m^2 surv total	m^2/os	m^2/if	m^2/art loc	m^2/art	total study area km^2	km^2 surv total	% study area surveyed
415	289	704	8401	1385978	3340	4796	1969	165	5576.1	1.386	0.025%

Key

os/m - number of open scatters or middens recorded on survey routes
if - number of isolated finds recorded on survey routes
art locs - number of locations at which at least one artefact was recorded (i.e. all open scatter and isolated find locations combined)
arts - number of artefacts recorded on survey routes
m^2 surv total - total area of exposed ground surface observed on survey routes in m^2
m^2/ os - total area of exposed ground surface per open scatter
m^2/ if - total area of exposed ground surface per isolated find
m^2/ art loc - total area of exposed ground surface per artefact location
m^2/ art - total area of exposed ground surface per artefact
total study area km^2 - size of field study area
km^2 surv total - total area of exposed ground surface observed on survey routes in km^2
% study area surveyed - percentage of study area that is comprised of observed exposed ground surface

Survey coverage of individual environmental zones (Boot 2002: Table 5.3) varied between 0.001% of the moist forest/rainforest Landsat vegetation zone (or 0.000322 km^2 of the 23.92 km^2 zone) and 0.7% of the open forest/woodland, north west facing slopes NPWS vegetation zone (or 0.005214 km^2 of the 0.75 km^2 zone).

Survey coverage of geological zones accounted for 0.02% of the study area, as did coverage of the Landsat and CSIRO vegetation zones (Boot 2002: Table 5.3). The smaller NPWS Morton NP vegetation zone was more effectively surveyed with 0.09% coverage. Only a small part, 0.009%, of the Deua-Wadbilliga NP vegetation zone was surveyed.

Summary of basic results

Examination of the data (Boot 2002: Table 5.2) shows that the highest density of artefact locations per square metre of observed ground surface occurs along the Merricumbene survey route (no. 8), followed by the Endrick River (no. 9), Tuross River (no. 10) and Clyde River (no. 7) routes. Site density and isolated find density figures follow similar patterns, although isolated finds were more densely distributed on routes 7 and 9 than on routes 8 and 10.

These four routes are among those with a low mean altitude for site locations (e.g. routes 10 and 7) or a low mean distance to water (e.g. routes 8 and 9), showing that high site densities tend to occur most often in well watered areas at low altitude. This indicates that the greatest site densities tend to occur in major river valleys and on broad well watered ridgelines. Major river valleys also show a much higher overall artefact density than other locations. Survey routes 6 to 10, encompassing significant parts of the Clyde, Buckenbowra, Tuross, Wadbilliga and Endrick Valleys, have far higher artefact densities than survey routes which bypassed major river valleys.

The largest surface site assemblages were found at PK20 in the Buckenbowra Valley, where 808 artefacts were recorded, and BR3 in the Wadbilliga Valley where 1185 artefacts were found. The smallest assemblages occur in sites on the Mount Budawang route (no. 5) and on the high sections of the Merricumbene route, showing that at high altitudes the hinterland was thinly occupied (Boot 2002: Sections 5.2.1 to 5.2.4; Tables 5.12 to 5.15).

Mean site area and mean site artefact density figures show that the most diffuse scatters occur along the Tianjara Fire Trail (no. 2) and Nerriga Road (no. 1) routes, both located on sandstone plateaux, whereas the most densely concentrated scatters occur in the Wadbilliga and Endrick valleys. Sites along the Buckenbowra River also contain high densities of artefacts.

Even though major river valleys and broad forested ridges contain the greatest number of sites, poorly watered and exposed locations were to a lesser extent also occupied. These include the highest recorded artefact scatter found in a saddle below the peak of Mount Budawang at 1070 m asl, and the small artefact scatters located in dry casuarina woodlands on high ridges in the Budawang Ranges, and between the Tuross and Wadbilliga Rivers. Mean annual rainfall rarely exceeds 700 mm in these dry, high altitude locations, whereas on the coast and in the major river valleys mean annual rainfall is over 1200 mm.

Most survey routes follow unsealed roads and tracks which provide the greatest visibility of surface remains but which have not resulted in the destruction of sites. Ten survey routes were chosen (Boot 2002: Table 3.2 and Appendix 16). The routes followed unsurfaced and gravelled roads, forestry trails and fire management trails. In areas where visibility on the

main survey route was significantly reduced or non-existent, adjacent side tracks and clearings were incorporated into the route.

The ten survey routes traverse the field area in several directions and are distributed throughout it (Boot 2002: Section 5.1, Tables 5.2, 5.3 and Appendix 16). Route 1 follows the northern field area boundary along the Nerriga and Turpentine Roads from Nerriga in the west to Tomerong in the east over a distance of 55.7 km. It passes through cleared pastoral land in the west, a central section of heath, woodland and dry forest, and concludes in the wetter forests east of the coastal escarpment. The Nerriga and Turpentine Roads are highly developed gravel roads that are frequently graded. Limited ground surface exposures were available on these roads but road verge areas provided good visibility conditions. In compensation for the reduced ground surface visibility on the main route, side tracks providing access to a powerline that parallels the route, were surveyed between the main road and the powerline. The access tracks predominantly consist of minimally maintained four wheel drive tracks that provide high levels of ground surface visibility. The route covers an area of 356,863 sq. m., of which 240,976 sq. m., or 67.5% of the route area, consists of exposed ground surface.

Survey route 2 commences near the mid point of route 1 at Tianjara Falls on the Nerriga Road and follows a southerly direction along the Twelve Mile Road and Tianjara Fire Trail through the heath, woodland and open forest of the Tianjara and Little Forest Plateaux to the Pointer Gap Road. There it turns east and descends the coastal escarpment through wet forest. Cleared areas occur near its end point at Yatteyattah on the coastal plain. This route extends for 35 km along naturally surfaced park management roads that are little more than four wheel drive tracks. Good ground surface visibility conditions occurred along all of them. Visibility conditions declined markedly along the Pointer Gap Road which is surfaced with bitumen and gravel. Along this section, road verges provided good visibility conditions, as did subsidiary forestry tracks which were surveyed for up to 1 km from their intersection with the main road. Route 2 covers an area of 213,959 sq. m., of which 174,883 sq. m., or 81.7% of the route area, consists of exposed ground surface.

Route 3, the 15.5 km long Wandean Road, commences near the eastern edge of the Tianjara Plateau where it passes east through heath and swamp environments before descending the coastal escarpment along a major forested ridge to the partly cleared coastal hills and plains around Wandandian, at its eastern extent. This minimally developed road afforded good visibility conditions except for several short gravelled sections. Route 3 covers an area of 63,855 sq. m., of which 44,062 sq. m., or 69% of the route area, consists of exposed ground surface.

Further south the coastal escarpment foothills, which had been cross-cut by the east-west sections of routes 1 to 3, were followed from north to south via route 4. This follows the Western Distributor, Fault Line, Boundary, Dingo and Long Gully forestry roads and fire trails from Yadboro to Currowan, through the foothills of the Budawang Range for a distance of 51 km. This route traverses a range of forested environments. Although the Western Distributor Road, a forestry feeder road used by heavy vehicles, has been extensively developed (i.e. cut, filled and gravelled) for much of its length, there were many sections that provided good visibility on road verges. All other roads were less developed and provided good ground surface visibility, although they varied from four wheel drive tracks to single lane, two wheel drive roads. Route 4 covers an area of 240,995 sq. m., of which 179,058 sq. m., or 74.3% of the route area, consists of exposed ground surface.

Route 5, the shortest at 6.3 km, traverses the Mount Budawang Fire Trail from the cleared eastern edge of the Southern Tablelands, through dry open forest, to the peak of Mount

Budawang. The peak is the highest point within the field area (1136 m asl) and is vegetated with heath and open forest. This minimally developed road provided mostly good visibility, however no isolated artefacts were observed. Excellent ground surface visibility was available at the foot of the mountain, along the ridges below the peak and at the peak itself. Route 5 covers an area of 29,000 sq. m., of which 26,100 sq. m., or 90% of the route area, consists of exposed ground surface.

Routes 6 and 7 traverse the central section of the field area, and pass through low and high altitude environments. Route 6 crosses the central section from west to east for a distance of 52.5 km, first via a network of forestry roads that follow the ridges of the Budawang Range from the top of the coastal escarpment at Monga near the Clyde Mountain to the upper reaches of the Buckenbowra River, a major tributary of the Clyde. The mid-section of the Buckenbowra was approached from above via high and dry ridges that parallel the river's narrow upper course. The route then descends into the broad, partly cleared, Buckenbowra Valley and follows it via Quart Pot Road until the route climbs again through coastal hills to Mogo. This route did not enter the coastal plain which is almost nonexistent in this area; characterised by hilly terrain and a rocky, cliffed coastline. All roads along this route are minimally developed and naturally surfaced, providing excellent visibility conditions. Route 6 covers an area of 189,054 sq. m., of which 136,693 sq. m., or 72.3% of the route area, consists of exposed ground surface.

Route 7 follows much of the length of the largest river valley within the field area, that of the Clyde, for 53 km. It commences near the junction of the Clyde estuary and Nelligen Creek and proceeds north along the western bank of the river via the River Road to the tidal limit at Shallow Crossing. There the route crosses to the eastern bank and proceeds north through rolling hills of open forest along a series of forestry roads to Yadboro where it intersects with route 4. Route 7 provided good visibility along the main roads and intersecting forestry tracks, which were followed for up to 1 km from the main road. Although parts of the main roads had been heavily developed, road verges and adjacent tracks provided high levels of ground surface visibility. This route had been previously surveyed by ANU students over several years and under varying conditions. Data from these surveys were used to supplement new data obtained during the survey conducted for the current research. Route 7 covers an area of 371,949 sq. m., of which 303,799 sq. m., or 81.7% of the route area, consists of exposed ground surface.

Further south route 8 traversed the foothills of the coastal escarpment over 82 km and was the longest survey route. It bisects the valleys of two major rivers, the Tuross and the Wadbilliga. Commencing near Merricumbene Mountain in Deua NP, the route proceeds south via a series of trails and roads through dry ridge and wet riverine vegetation to Bourke's Road in Wadbilliga NP. It also traverses small cleared areas at Belowra and Wadbilliga. The route concludes just south of the Wadbilliga River at the location of the Bourke's Road 2 (BR2) rockshelter. The entire route followed four wheel drive tracks, forestry and park management roads, all of which are naturally surfaced, providing good visibility conditions. Several follow steep ridges, the narrow crests of which had been entirely removed during road construction, thus providing little ground surface visibility. Route 8 covers an area of 239,008 sq. m., of which 147,522 sq. m., or 61.7% of the route area, consists of exposed ground surface.

Routes 9 and 10 follow river valleys for much of their length. Route 9 follows the Endrick River Valley for 38 km, near the northern boundary of the field area. Route 10 follows 35 km of the middle reaches of the Tuross River in the southern part of the field area. Route 9 commences at its junction with route 1 near Sassafras and proceeds in a southwesterly direction along the Newhaven Gap Road through the heath, swamp, woodland and open forest mosaic of Morton NP to an area of rainforest and wet forest within the small valley of Vines Creek, a tributary of the Endrick River. The route then follows the Endrick River Trail

for some distance through valley woodland and heath until cleared grazing land is encountered at the park boundary. Continuing west the route follows the Endrick River Road through cleared land and open forest to Nerriga where it again intersects with route 1. Most of route 9 consists of four wheel drive and foot tracks which provided good visibility. The western end of the route follows public roads through flat terrain, and although they are occasionally graded, good visibility conditions were maintained. Route 9 covers an area of 114,301 sq. m., of which 74,389 sq. m., or 65.1% of the route area, consists of exposed ground surface.

Route 10, near the southern boundary of the field area, follows the middle reaches of the Tuross River from Belowra (the most westerly point along the Tuross that can be accessed by vehicle) eastwards to Cadgee, where private properties prevent access to the river. The route follows a series of minimally graded unsurfaced forestry roads that run in a southerly direction down ridgelines to the river from an east-west ridge that parallels the river's course. This ridge is traversed by Belowra Road which has been heavily developed and provides lower visibility conditions than the forestry tracks, other than on it's wide verge. The route passes through dry forest along the higher ridges, wetter forest at lower altitudes, and riverine vegetation. At each end the route passes through cleared grazing land. Route 10 covers an area of 88,086 sq. m., of which 47,570 sq. m., or 54% of the route area, consists of exposed ground surface.

route no.	AHIMS no.	name	easting	northing	artefact details all dimensions mm	m asl
1	58-1-0739	MB1	237400	6112990	pink silcrete retouched fl. 18x17x4	545
	58-1-0740	PB2	240920	6112990	grey quartzite core 1 platform 5 fl. scars 45x41x16	750
	58-1-0741	MB3	241050	6114150	grey quartzite fl. piece 30% pebble cortex 41x27x15	760
	58-1-0742	MB5	246450	6114950	grey silcrete core 2 platforms 8 fl. scars 51x62x33	725
	58-1-0743	MB6	246230	6114940	red silcrete core 1 platform 6 fl. scars 10% quarry cortex 37x30x25	725
	58-1-0744	MB7	245530	6114860	grey quartzite fl. piece 10% pebble cortex 46x40x14	715
	58-1-0745	PB6	257850	6110500	grey silcrete fl. piece 20x18x7	510
	58-1-0746	PB8	260580	6113270	grey volcanic fl. piece 45x31x28	460
	58-1-0747	PB9	260400	6113160	pink/brown quartzite fl. 26x25x6	510
	58-1-0748	PB10	264100	6115720	grey/red silcrete bkn backed blade 26x16x5	350
	58-1-0749	PB11	271130	6120010	grey silcrete bkn fl. 21x28x6	180
	58-1-0750	PB12	271560	6119090	lt grey silcrete bkn fl. 26x27x3	190
	58-1-0751	PB13	271660	6118980	grey silcrete core platform rejuvenation fl. 29x13x13	190
	58-2-0360	TR1	272890	6119540	quartz fl. 16x6x4	195
	58-2-0361	PB14	272350	6118270	red/grey quartzite fl. 20x18x4	195
	58-2-0362	PB15	272600	6118520	grey quartzite fl. piece 23x13x6	200
	58-2-0363	PB16	272660	6118600	grey quartzite bkn fl. 22x20x6	200
	58-2-0364	PB19	277950	6118650	grey porphyry fl. 23x17x5	90
	58-2-0365	PB17	278990	6118390	quartz bkn fl. 13x9x3	20
2	58-1-0752	PB20	256620	6108750	dk grey porphyry fl. piece 18x18x7	520
	58-1-0753	TR3	255550	6106020	purple porphyry fl. piece 25x16x8	610
	58-1-0754	TR2	255120	6105920	lt brown quartzite fl. 30x30x9	610
	58-1-0755	TR4	255020	6105950	brown quartzite core 1 platform 11 fl.	610

					scars 25% pebble cortex 57x45x29	
	58-1-0756	PB25	254440	6105470	crystal quartz retouched fl. 9mm retouch on one margin 17x12x4	660
	58-1-0757	PB24	254050	6104700	crystal quartz bkn fl. 19x13x5	670
	58-1-0758	PB23	254060	6104620	dk grey silcrete fl. piece 17x11x9	670
	58-1-0759	TR7	254100	6104500	grey porphyry fl. 39x34x18	670
	58-1-0760	PB28	253540	6103390	lt grey weathered porphyry core 2 platforms 9 fl. scars 51x42x32	660
	58-1-0761	PB30	253790	6103950	lt grey porphyry fl. 23x43x9	650
	58-1-0762	PB30A	252720	6104000	lt grey quartzite core 2 platforms 6 fl. scars 51x47x20	650
	58-1-0763	TR9	253500	6103300	lt brown quartzite fl. piece 20% pebble cortex 37x27x18	650
	58-1-0764	TR11	253570	6102720	lt grey quartzite retouched fl. 28x16x3	640
	58-1-0765	PB35	255870	6100600	lt grey silcrete fl. piece 30% pebble cortex 18x14x5	540
	58-1-0766	PB34	255870	6100510	grey rhyolite bkn fl. 28x23x9	540
	58-1-0767	PB33	255700	6099920	grey quartzite retouched fl. 75% margin retouched 43x38x10	550
	58-1-0768	PB32	255690	6099860	grey quartzite fl. 32x30x6	540
	58-1-0769	TR13	256050	6098950	grey porphyry fl. piece 30% pebble cortex 36x18x13	530
	58-1-0770	TR17	256190	6096980	lt grey porphyry fl. piece 27x16x9	570
	58-1-0771	TR15	256170	6096760	lt grey porphyry fl. piece 32x22x18	570
	58-1-0772	PB39	257650	6096550	grey porphyry retouched fl. 50% margin retouched 36x34x17	500
	58-1-0773	PB41	258420	6095670	grey rhyolite bkn fl. 17x16x6	490
	58-1-0774	PB42	258470	6096590	grey rhyolite fl. 11x19x4	490
	58-1-0775	PB43	258500	6095490	grey quartzite fl. piece 84x57x27	490
	58-1-0776	PB40	258490	6095350	lt grey weathered porphyry fl. piece 5% pebble cortex 40x29x15	490
	58-1-0777	PB50	258190	6094690	lt grey porphyry fl. piece 17x13x4	490
	58-1-0778	PB51	258200	6094520	grey/brown porphyry bkn fl. 18x15x11	490
	58-1-0779	PW4	258240	6092920	lt grey porphyry bkn fl. 37x24x6	510
	58-1-0780	PB52	258030	6092670	crystal quartz bkn fl. 25x19x5	500
	58-1-0781	PB46	258610	6095920	lt grey porphyry fl. piece 27x23x6	460
	58-1-0782	PB45	258920	6094950	lt grey porphyry fl. 32x22x11	460
	58-1-0783	TR19	262920	6096950	lt grey porphyry bkn fl. 32x20x6	110
	58-1-0784	TR18	263710	6097850	dk grey porphyry fl. piece 36x30x10	20
	58-1-0785	PB49	263150	6096440	lt grey quartzite bkn fl. 12x14x4	60
	58-1-0786	AH1	256270	6098600	lt grey quarzite fl. 33x32x13	520
3	58-1-0787	PB53	262210	6112820	lt grey volcanic fl. piece40x28x28	420
	58-1-0788	PB54	263400	6112740	dk grey quartzite bkn fl. 18x17x4	380
	58-1-0789	PW5	263790	6112560	lt grey chalcedony fl. 20% pebble cort. 44x30x8	330
	58-1-0790	PB56B	265270	6112030	lt grey porphyry fl. piece 23x20x5	180
	58-1-0791	PB58	266850	6111450	dk grey porphyry bkn fl. 22x14x5	90
	58-1-0792	PB60	269220	6112850	grey quartzite bkn fl. 30% pebble cort. 27x20x6	30
	58-1-0793	PW8	270310	6114420	brown chert ret. fl. 20% of margin retouched 28x21x6	10
4	58-4-0923	BE3	233370	6058140	lt grey porphyry bkn fl. 16x14x3	170
	58-4-0924	BE5	233210	6058870	grey porphyry fl. piece 45x21x4	60
	58-4-0925	PB61	232200	6060200	black porphyry bkn fl. 28x18x5	170

	58-4-0926	BE6	232170	6060260	red porphyry bkn fl. 35x27x9	170
	58-4-0927	PB62	230970	6061210	lt grey silcrete bkn fl. 22x20x9	290
	58-4-0928	BE8	229720	6062220	dk grey porphyry fl. 27x25x9	300
	58-4-0929	BE9	229450	6062170	red volcanic fl. 31x28x7	260
	58-4-0930	PW11	230420	6063170	grey weathered siltstone bkn fl. 17x17x2	420
	58-4-0931	PB63	230040	6064290	lt grey porphyry fl. piece 23x13x6	420
	58-4-0932	BE13	231250	6066000	dk grey porphyry fl. 30x20x7	310
	58-1-0794	BE15A	231150	6068360	lt grey porphyry fl.18x28x3	600
	58-1-0795	BE16	231160	6068360	lt grey porphyry bkn fl. 26x11x4	600
	58-1-0796	BE17	231300	6068850	dk grey porphyry fl. piece 22x12x10	540
	58-1-0797	PW15	235260	6070970	red porphyry bkn fl. 33x29x11	210
	58-1-0798	PB67	236060	6073150	lt grey quartzite fl. piece 14x11x4	390
	58-1-0799	PW16	236220	6074140	lt grey porphyry bkn fl. 21x16x3	420
	58-1-0800	BE20	236390	6074540	pebble hammerstone 100% cort. impact pitting around margin particularly at one end 67x62x16	480
	58-1-0801	PB70	235240	6075260	dk grey rhyolite core 2 platforms 16 fl. scars 53x49x28	500
	58-1-0802	BE23A	235000	6075460	lt grey silcrete bkn fl. 17x11x3	550
	58-1-0803	PW17	235200	6075690	dk grey porphyry fl. piece 13x13x3	510
	58-1-0804	PW19	237460	6074980	lt grey porphyry bkn fl. 17x20x5	530
	58-1-0805	BE25	238050	6074390	pebble hammerstone 100% cort. impact pitting at one end 67x53x25	460
	58-1-0806	PB73	240190	6079060	purple porphyry fl. piece 30x23x10	460
	58-1-0807	PW23	240270	6079110	purple porphyry bkn fl. 31x19x8	460
	58-1-0808	BE28	240310	6079660	dk grey porphyry bkn blade 48x16x7	450
	58-1-0809	PW24	240240	6080200	purple porphyry core 2 platforms 8 fl. scars 22x31x18	500
	58-1-0810	PB75	240570	6080640	dk grey porphyry fl. piece 27x14x6	490
	58-1-0811	PW27	240120	6081890	purple rhyolite bkn fl. 12x16x5	480
	58-1-0812	PB77	240650	6083640	purple porphyry fl. 26x23x10	390
	58-1-0813	PW29	240620	6083720	purple porphyry fl. piece 22x18x10	380
	58-1-0814	PB80	241320	6084710	purple rhyolite core 2 platforms 7 fl. scars 36x30x25	350
	58-1-0815	BE31	241910	6085700	purple porphyry fl. piece 26x20x5	270
	58-1-0816	PB83	243890	6087240	lt grey quartzite fl. 43x41x8	160
	58-1-0817	PW32	243310	6087950	purple porphyry fl. piece 15x14x6	160
	58-1-0818	PB84	244150	6087540	grey quartzite unmodified river pebble manuport 97x72x38	130
	58-1-0819	PW34	244920	6086750	grey quartzite core 1 platform 9 fl. scars 39x50x39	170
	58-1-0820	PW36	247050	6085910	lt grey porphyry core 2 platforms 10 fl. scars	70
6	57-6-0417	TR22	770350	6052220	quartz fl. piece 19x12x2	170
	58-4-0964	PB91	778390	6059790	brown porphyry fl. piece 47x25x20	420
	58-4-0966	PK7	228390	6059790	grey rhyolite bkn fl. 16x22x7	280
	58-4-0967	PB95A	240920	6040910	red chert fl. piece 25x21x12	20
	58-4-0968	PK9	240100	6039990	grey silcrete core 1 platform 5 fl. scars 23x18x13	50
	58-4-0969	PK12	239570	6039920	grey silcrete fl. piece 20x12x7	85
	58-4-0970	PB96	239210	6040010	grey/brown silcrete fl. piece 23x18x6	110
	58-4-0971	PB97	238700	6040750	purple porphyry fl. 25x20x6	140
	58-4-0972	PK13	238200	6040320	grey silcrete fl. 15x12x5	140
	58-4-0973	PB98	237620	6040210	purple/grey silcrete fl. piece 34x27x8	130
	58-4-0974	PB99	237450	6039910	grey volcanic split pebble 70% cortex	130

					60% of margin retouched 90x68x22	
	58-4-0975	PK14	237410	6039690	blue/grey volcanic split pebble 3 fl. scars 40% cortex 90x50x35	130
	58-4-0976	PK16	237270	6039070	dk grey rhyolite fl. 42x34x15	150
	58-4-0977	PK17	237100	6039090	purple rhyolite fl. 30x20x5	160
	58-4-0978	PB100	236820	6039110	purple porphyry bkn fl. 22x20x4	170
	58-4-0979	PB101	236500	6039270	grey porphyry fl.15x22x5	220
	58-4-0980	PB102	235710	6040980	grey porphyry bkn fl. 11x15x6	60
	58-4-0981	PB103	235620	6041020	dk grey porphyry bkn fl. 18x20x8	60
	58-4-0982	PB104	235560	6041090	grey chert fl. piece 25% pebble cortex 35x22x11	60
	58-4-0983	PB105	235500	6041300	lt grey silcrete bkn fl. 18x21x7	40
	58-4-0984	PK19	233570	6042040	grey porphyry fl. 27x29x8	90
	58-4-0985	PB109	230050	6045200	lt grey porphyry bkn fl. 15x14x7	120
	58-4-0986	PB110	229300	6045100	purple porphyry bkn fl. 18x12x5	80
	57-6-0418	PB113	769440	6048540	purple porphyry fl. piece 27x20x11	290
	57-6-0419	PB114	768620	6049340	dk grey porphyry fl. 29x33x13	390
	57-6-0420	PB115	769150	6051520	dk grey porphyry bkn fl. 15x20x7	330
	57-6-0421	PB118	767400	6051360	dk grey porphyry fl. 22x18x9	350
	57-6-0422	PB121	766950	6051600	dk grey silcrete core 1 platform 5 fl. scars 41x44x20	350
	57-6-0423	PB122	766650	6051740	dk grey porphyry bkn fl. 17x38x11	390
	57-6-0424	PB123	766120	6051660	lt grey porphyry bkn blade 21x11x6	490
	57-6-0425	PB124	766070	6051660	lt grey silcrete bkn fl. 22x13x4	490
	57-6-0426	PB125	765960	6051670	dk grey chert bkn fl. 14x14x5	490
	57-6-0427	PB126	765240	6052240	dk grey porphyry fl. piece 40% quarry cort. 32x22x18	590
	57-6-0428	PB129	763960	6053700	lt grey silcrete fl. 20x9x5	740
7	58-4-0987	TR23	241350	6055110	grey rhyolite fl. piece 25x14x3	10
	58-4-0988	PB132	241320	6056560	dk grey rhyolite fl. piece 33x26x12	10
	58-4-0989	TR24	241250	6057120	grey silcrete fl. 27x21x8	40
	58-4-0990	TR25	241410	6057060	lt grey volcanic fl. 10% pebble cort. 60x53x20	30
	58-4-0991	PB135	241890	6058220	lt grey porphyry fl. piece 40x29x20	20
	58-4-0992	PB136	242450	6059050	dk grey silcrete fl. piece 32x29x6	50
	58-4-0993	PB137	242270	6059690	lt grey porphyry fl. piece 74x46x25	10
	58-4-0994	PB138	242870	6061420	grey/brown porphyry fl. piece 30x20x12	80
	58-4-0995	PB139	242520	6061950	purple porphyry fl. 28x32x10	90
	58-4-0996	PB142	243900	6062150	dk grey porphyry fl. piece 26x15x8	10
	58-4-0997	PB145	244150	6062050	dk grey porphyry fl. 19x14x5	10
	58-4-0998	TR30	245530	6063690	dk grey rhyolite bkn fl. 60x32x12	30
	58-4-0999	TR31	245390	6064140	dk grey rhyolite fl. piece 20x14x3	70
	58-1-0839	TR34	249460	6069200	dk grey rhyolite bkn fl. 23x15x6	20
	58-1-0840	TR35	249600	6069310	dk grey volcanic bkn fl. 17x31x8	20
	58-1-0841	PB147	249740	6069560	lt grey porphyry fl. piece 19x15x8	30
	58-1-0842	TR36	250340	6072760	purple porphyry bkn fl. 16x19x6	50
	58-4-1000	PB152	248250	6067040	lt grey porphyry fl. piece 37x22x13	20
	58-4-1001	EA11	246470	6065050	grey volcanic fl. piece 34x20x15	50
	58-4-1002	CW15	246450	6065400	dk grey volcanic flaked hatchet preform no ground edge 135x75x35	30
	58-4-1003	EA9	246630	6065080	grey volcanic flaked pebble 78x59x56	50
	58-4-1004	EA14	246830	6065750	grey volcanic flaked hatchet preform no ground edge 130x20x40	30

58-4-1005	EA15	246950	6065220	cream silcrete core 45x38x20	30
58-4-1006	EA19	247620	6066420	grey quartzite flaked pebble 50x44x32	70
58-4-1007	AB9	246820	6066550	purple volcanic fl. 21x16x11	50
58-1-0843	VC20	249450	6071270	pink quartzite fl. piece 40x61x28	20
58-1-0844	VC19	250120	6072200	grey basalt flake 31x39x13	20
58-1-0845	VC18	250250	6072250	grey basalt hammerstone 101x 19x25	20
58-1-0846	VC11	249370	6073050	red brown volcanic fl. 39x31x8	70
58-1-0847	VC12	248650	6072950	purple volcanic fl. piece 50x27x11	80
58-1-0848	VC14	247640	6072500	grey silcrete fl. 36x23x8	50
58-1-0849	VC15	247700	6072870	brown silcrete fl. 18x3x2	30
58-1-0850	JT21	250690	6074430	grey silcrete fl. 21x16x4	30
58-1-0851	BE11	250920	6074720	quartzite core 34x30x16	30
58-1-0852	HD7	251200	6075200	dk grey volcanic fl. 15x11x4	60
58-1-0853	HD11	250800	6075050	grey volcanic fl. piece 20x30x20	90
58-1-0854	HD4	250610	6075000	grey volcanic hammerstone 125x75x40	110
58-1-0855	TK7	250600	6074800	grey silcrete core 160x130x12	110
58-1-0856	TK2	250600	6075000	grey volcanic core 65x52x30	120
58-1-0857	TK3	250500	6075000	grey volcanic core 40x30x25	120
58-1-0858	HD10	250100	6074950	grey volcanic fl. piece 20x18x20	40
58-1-0859	TK8	251000	6075100	grey silcrete core 105x60x70	50
58-1-0860	HD12	250700	6075100	grey volcanic fl. 25x18x2	70
58-1-0861	TK4	250500	6075400	purple volcanic fl. piece 47x25x15	50
58-1-0862	HD13	250520	6075800	pink volcanic fl. piece 80x50x30	40
58-1-0863	TK14	249500	6076450	pink volcanic split pebble 50% cortex 70x30x15	80
58-1-0864	HD16	249050	6076600	grey silcrete fl. 50x25x10	70
58-1-0865	HD17	248950	6076500	purple volcanic flaked pebble 190x110x70	70
58-1-0866	HD18	248920	6076400	purple volcanic fl. 50x22x10	50
58-1-0867	TK15	248900	6076500	grey sedimentary split pebble 50% cortex 70x30x15	60
58-1-0868	TK16	248800	6076600	grey sedimentary flake 50% pebble cortex 50x38x5	50
58-1-0869	TK18	249210	6076600	purple silcrete fl. 30x22x12	60
58-1-0870	AG3	249630	6078260	grey silcrete fl. 18x20x3	110
58-1-0871	IF76 (1986)	249390	6078780	silcrete core	110
58-1-0872	AG9	248870	6078250	brown volcanic fl. 32x22x10	90
58-1-0873	IF74 (1986)	248380	6078210	silcrete fl. piece	60
58-1-0874	AG11	248960	6077740	grey volcanic flaked pebble 63x79x55	60
58-1-0875	AG12	248890	6077690	brown volcanic flake 32x22x10	70
58-1-0876	IF79 (1986)	249950	6078640	grey silcrete fl.	100
58-1-0877	IF64 (1986)	257330	6077630	silcrete fl.	110
58-1-0701/ 58-1-0878	Crisp 9/ CR9	250600	6078830	silcrete fl.	110
58-1-0879	IF161 (1986)	250400	6078850	grey silcrete fl.	100
58-1-0880	IF163 (1986)	252350	6078900	dk grey core	120
58-1-0881	HD19	251700	6080700	grey volcanic fl. piece 35x60x10	150

	58-1-0882	HD20	251100	6080950	grey volcanic pebble core 50x35x15	80
	58-1-0883	HD25	249950	6080950	grey silcrete core 40x20x15	140
	58-1-0884	TK31	249650	6080500	grey silcrete pebble core 70x55x30	150
	58-1-0885	HD24	249600	6080100	purple silcrete fl. 23x16x5	150
	58-1-0886	TK29	249300	6079580	grey silcrete flaked pebble 60x50x25	150
	58-1-0887	TK27	249070	6079600	grey silcrete core 65x65x25	80
	58-1-0888	TK36	249510	6081220	silcrete fl.	130
	58-1-0889	TK35	249500	6081200	grey silcrete core 50x30x20	130
	58-1-0890	TK34	249300	6081150	white quartz fl. 15x15x3	120
	58-1-0891	HD27	248500	6081400	purple silcrete fl. piece 65x30x25	80
	58-1-0892	IF56 (1986)	246900	6082100	silcrete blade core	120
	58-1-0893	IF49 (1986)	246700	6083800	silcrete fl.	130
	58-1-0894	IF218 (1986)	247070	6083950	silcrete fl. piece	150
	58-1-0895	IF217 (1986)	247020	6084020	silcrete fl. piece	150
	58-1-0896	IF216 (1986)	246930	6084230	silcrete fl. piece	140
	58-1-0897	IF215 (1986)	246820	6084380	silcrete fl. piece	130
	58-1-0898	IF214 (1986)	246780	6084420	silcrete fl. piece	120
	58-1-0258/ 58-1-0899	ANU site 44/ IF44 (1986)	247860	6086370	2 silcrete cores	80
	58-1-0900	IF70 (1986)	247880	6087080	grey silcrete fl.	70
	58-1-0901	IF71 (1986)	247800	6087180	grey silcrete fl.	60
	58-1-0902	IF72 (1986)	247820	6087200	red silcrete fl.	50
	58-1-0903	IF73 (1986)	247780	6087220	silcrete fl. piece	70
8	57-6-0429	PH4	759100	6029540	chert fl. 43x32x6	840
	57-6-0430	PBM3	757700	6027210	dk grey chert blade 6mm retouch on margin 20x10x3	790
	57-6-0431	PH5	756700	6027290	chert fl. 32x23x6	670
	57-6-0432	PH6	756360	6028360	chert fl. piece 33x18x7	670
	57-6-0433	PBM1	755000	6026520	white quartz bkn fl. 11x9x2	960
	57-6-0434	AG6	754050	6023440	white quartz manuport (possible core) 82x54x53	870
	57-6-0435	AG5	753690	6023150	dk grey chert fl. piece 33x24x15	840
	57-6-0436	TK6	753550	6021620	grey chert fl. piece 21x16x11	940
	57-6-0437	TK3	753300	6021350	grey chert chip <10mm	970
	57-6-0438	AG4	752320	6020010	dk grey volcanic fl. piece 24x30x11	940
	57-6-0439	TK2	752270	6018670	grey chert fl. piece 9x13x4	930
	57-6-0440	JT3	753140	6016610	lt grey chert chip <10mm	860
	57-6-0441	JT4	753150	6016510	white quartz fl. 4x21x3	740
	57-6-0442	DL4	753300	6016170	lt grey silcrete bkn fl. 22x31x6	750
	57-6-0443	DL6	754420	6015240	lt grey chert fl. piece 18x16x5	780
	62-3-0584	PBM6	759970	6010420	purple rhyolite fl. 34x40x16	760
	62-3-0585	DL10	759420	6009570	purple porphyry fl. 26x25x12	670
	62-3-0586	DL11	756210	6007910	white quartz fl. 17x18x3	770
	62-3-0587	JT12	755240	6007520	grey silcrete fl. piece 29x19x11	730

	62-3-0588	AG8	752410	6006270	dk grey chert fl. piece 16x10x4	720
	62-3-0589	PBM9	749340	6002460	crystal quartz bkn fl. 10x11x3	560
	62-3-0590	PBM11	748010	5998980	lt grey volcanic bkn pebble hammerstone impact pitting on end opposite bkn end 27x32x29	440
	62-3-0591	JT16	747140	5999500	white quartz fl. 22x14x7	280
	62-3-0592	TK22	745340	5997610	white quartz bkn backed blade 22x19x6	440
	62-3-0593	TK21	745540	5997460	white quartz retouched fl. (scraper) 9mm of edge retouched 18x12x5	390
	62-3-0594	TK17	744820	5996340	white quartz fl. 20x17x8	160
	62-3-0595	PH17	744790	5996160	lt grey volcanic fl. 16x40x7	150
	62-3-0596	JT26	745260	5995620	white quartz fl. 18x17x4	250
	62-3-0597	PBM17	745600	5994660	white quartz bipolar core 6 fl. scars 17x11x7	440
	62-3-0598	PH14	746220	5993600	dk grey volcanic bkn pebble hammerstone impact pitting on end opposite bkn end 100x72x52	420
	62-3-0599	PBM13	746220	5993200	dk grey chert fl. piece 21x21x9	370
	62-3-0600	PH13	746170	5993120	white quartz core 2 platforms 8 fl. scars 29x26x28	370
	62-3-0601	DL19	746250	5992820	grey chert fl. piece 21x16x11	410
	62-3-0602	PH9	745740	5991360	white quartz fl. piece 27x16x11	290
	62-3-0603	JT17	745340	5991250	pink quartzite fl. piece 70% pebble cortex 47x21x13	210
9	58-1-0904	PBE1	249870	6111160	lt grey silcrete fl. piece 29x20x10	750
	58-1-0905	TRE1	249900	6111070	white quartz bkn fl. 13x16x4	750
	58-1-0906	PBE2	249820	6110570	lt grey silcrete fl. piece 15x10x7	730
	58-1-0907	BSE1	249990	6109030	brown siltstone fl. piece 34x17x11	720
	58-1-0908	GTE1	248620	6102200	grey quartzite fl. piece 27x30x6	730
	58-1-0909	BSE2	248570	6102150	lt grey quartzite bkn fl. 27x30x6	730
	58-1-0910	GTE4	247750	6100820	grey quartzite bkn retouched fl. 2 margins retouched	690
	58-1-0911	GTE 6	246420	6100590	white quartz fl. piece 25x19x7	690
	58-1-0912	PBE8	245560	6102790	white quartz fl. 8x12x4	620
	58-1-0913	PBE9	245540	6102870	white quartz fl. 12x16x6	620
	58-1-0914	PBE10	245270	6103270	crystal quartz fl. 10x10x2	610
	58-1-0915	PBE11	245190	6103450	dk grey porphyry bkn fl. 16x11x4	610
	58-1-0916	PBE12	245150	6103720	lt grey silcrete fl. 23x21x8	610
	58-1-0917	PBE6	244420	6104000	grey quartzite fl. piece 25% pebble cortex 45x36x15	610
	58-1-0918	PBE7	243910	6104240	lt grey quartzite core 2 platforms 7 fl. scars 20x20x26	610
	58-1-0919	PGE2	243570	6104440	grey silcrete fl. piece 25x20x6	600
	58-1-0920	PGE4	242840	6104390	lt grey quartzite core 1 platform 8 fl. scars 63x35x30	620
	58-1-0921	PGE5	242660	6104530	lt grey quartzite core 2 platforms 7 fl. scars 86x75x49	610
	58-1-0922	PGE11	241010	6106150	lt grey silcrete retouched fl. 22mm of 1 margin retouched 18x27x8	600
	58-1-0923	GTE9	239410	6106000	grey chert core 1 platform 4 fl. scars 24x12x12	560
	58-1-0924	PGE1A	238720	6106300	lt grey silcrete fl. piece 15x14x4	570
	58-1-0925	PGE2A	238520	6106120	lt grey silcrete fl. piece 23x13x7	580
	58-1-0926	PGE8A	236250	6107270	white quartz fl. 29x18x6	620
	58-1-0927	PGE9A	236150	6107440	grey silcrete fl. piece 13x12x8	620
	58-1-0928	PGE10A	235950	6107470	grey silcrete fl. 21x14x5	630

10	62-3-0604	PCT1	750040	5992320	black chert fl. piece 26x19x10	250
	62-3-0605	PCT3	752610	5991740	white quartz fl. 12x13x4	290
	62-3-0606	PBT10	754510	5992940	white quartz core 1 platform 6 fl. scars29x23x11	490
	62-3-0607	PBT11	754960	5991740	white quartz fl. 10x12x4	390
	62-3-0608	PBT12	755940	5989620	lt grey silcrete fl. lt grey silcrete fl.27x37x8	180
	62-3-0609	PCT5	755820	5989490	grey volcanic bkn flaked pebble 90% cortex 175x111x55	150
	62-3-0610	PCT4	755700	5989200	grey chert fl. piece 38x33x12	110
	62-3-0611	PBT22	758100	5990400	lt grey volcanic flaked pebble hatchet preform margin flaked both faces 70% cortex 1 end snapped off 104x68x34	230
	62-3-0612	PBT32	759670	5992600	lt grey chert fl. 26x14x7	250
	62-3-0613	PBT34	750290	5992410	lt grey volcanic fl. piece 21x13x7	200
	62-3-0614	PCT11	761370	5992360	grey volcanic fl. piece 42x27x11	110

Key

survey route number - number of the survey route on which the open scatter or isolated find was recorded.
site number - site identification number assigned in the field by the site recorder - site number initials identify the recorder.
easting - 1:25,000 AGD grid reference easting.
northing - 1:25,000 AGD grid reference northing.
artefact nos - isolated finds are denoted by the number 1.
altitude (m asl) - altitude above mean sea level of the isolated find.

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Site 2 200m

Client Service ID : 799792

Carley Mcgregor

125 ravenswood street
Bega New South Wales 2550

Attention: Carley Mcgregor

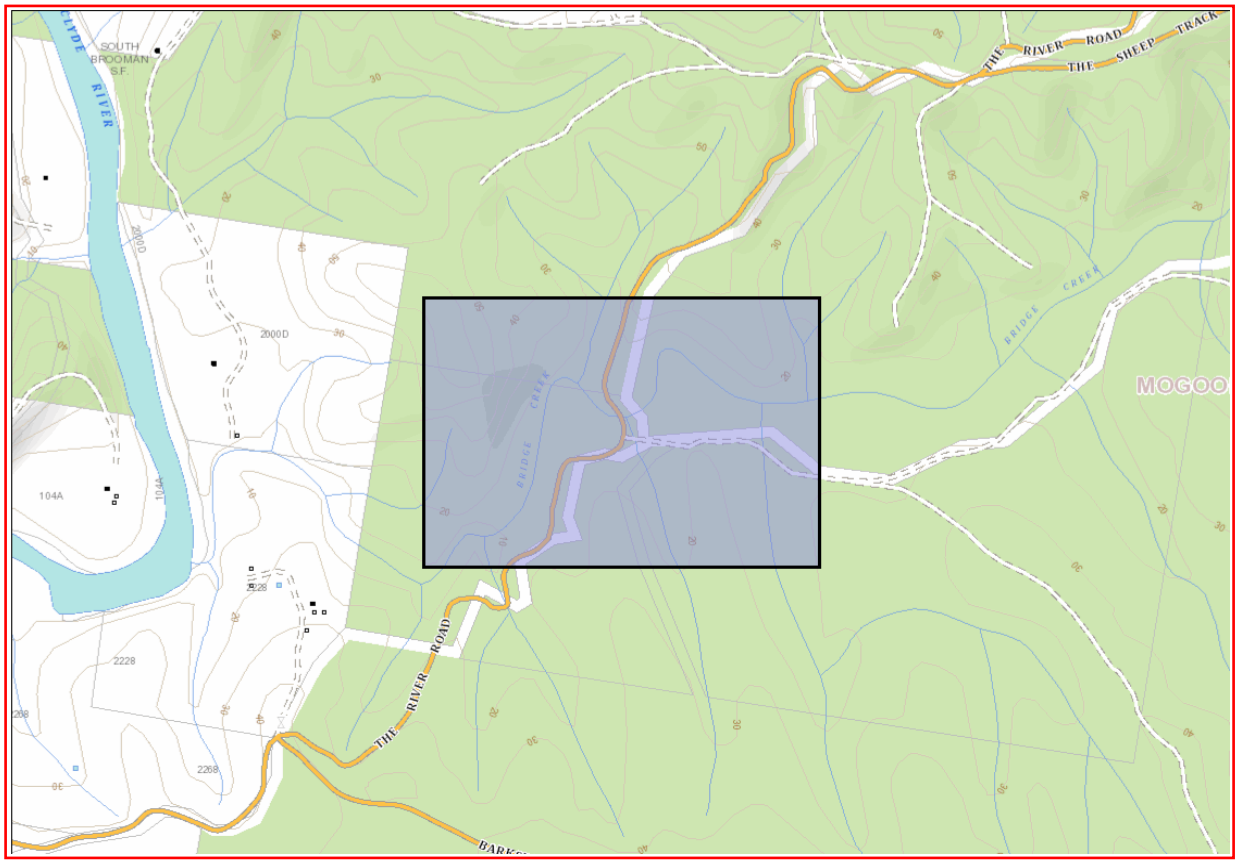
Email: me_carlz@hotmail.com

Date: 12 July 2023

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -35.5201, 150.2105 - Lat, Long To : -35.5157, 150.2183, conducted by Carley Mcgregor on 12 July 2023.

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 Heritage NSW 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 (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW 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 Heritage NSW 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.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

Appendix C

Geotechnical Investigation

TERRA INSIGHT

Geotechnical Investigation for Bridge Sites - Brooman Road & The River Road

Report on Geotechnical Investigation

Prepared for:

Shoalhaven City Council

Our Ref: TERRA23-007.Rep1.Rev0

Prepared for:
Shoalhaven City Council
PO BOX 42
Bridge Rd
NOWRA NSW 2541

10 March 2023

Attention: Mr S Lee

RE: Geotechnical Investigation for Bridge Sites - Brooman Road & The River Road
Report on Geotechnical Investigation

Dear Shin,

Please find enclosed our report for the above site in relation to the geotechnical investigation for the proposed replacement of the bridges on Brooman Road Bridge at Boondobah Creek & The River Road Bridge at Bridge Creek This report should be read in conjunction with the attached document 'About Your Report' in Appendix A. Should you have any questions please contact the undersigned.

For and on behalf of Terra Insight

Karen Gates
Principal Engineer/ Director
CPEng MIEaust BEng MEngSc(Geot) MEnvMgt MBA

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Appendices

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Appendix E: Laboratory Certificates

1. Introduction

At the request of Shoalhaven City Council (SCC), Terra Insight Pty Ltd (Terra) has carried out a geotechnical investigation for the replacement of bridges located on Brooman Road at Boondobah Creek and The River Road at Bridge Creek hereafter referred as the Site 1 and Site 2 respectively. The objective of the geotechnical investigation was to determine the underlying foundation conditions and existing pavement conditions to facilitate the design of new bridges at these locations.

2. Scope of work

The proposed scope of work for this assessment included the following:

- A review of geological maps and aerial photography covering the site;
- A visit to site to observe site surface conditions by a Geotechnical Engineer;
- A subsurface investigation at each site comprising the following:
  - One (1) boreholes using a drill rig to depths of 10m including coring to obtain rock samples;
  - Two (2) boreholes using a 2t excavator with auger drive near the bridge abutments on either side of the proposed bridge location.
  - Dynamic Cone Penetrometer Tests (DCPTs) on the bridge abutments; and
  - Logging and sampling of the materials encountered by a geotechnical engineer;
- Laboratory testing of subgrade material at each site including:
  - One California Bearing Ratio tests (AS 1289.6.1.1) of subgrade materials;
  - One Atterberg Limits test with linear shrinkage (Four Point – AS 1289.3.1.1, 3.2.1, 3.3.1, 3.4.1) where cohesive soils are encountered as subgrade level;
  - One Particle Size Distribution if granular soils are encountered as subgrade material– AS 1141.11.1-2009; and
  - Laboratory testing to assess the potential aggressivity of the underlying soils.
- Provision of report providing the findings of the assessment and recommendations in accordance with the objectives outlined above.

The scope of work undertaken was in general accordance with the above.

3. Investigation Findings

3.1. Site details

The Sites locations are shown in Figure 1A and 1B and are located as follows:

- Site 1 - Brooman Road at Boondobah Creek is located approximately 8.7km west of the Princes Highway near Brooman and can be accessed from Middle Ridge Road from The Old Princes Highway. The bridge is comprised of a short and narrow single span bridge.
- Site 2 – The River Road Bridge at Bridge Creek is located about 9.5km west of the Princes Highway within Mogood and can be accessed by The Sheep Track from The Old Princes Highway. The bridge is comprised of a single span bridge.

3.2. Geology

Online geological mapping accessed using MinView (shown in Figure 1A and 1B) indicates the sites are underlain by Alluvial Valley Deposits comprised of silty, clay, lithic to quartz lithic sand and gravel. These deposits are underlain by the Abercrombie Formation which is expected to underly the sites at depth and is comprised of brown and buff to grey, thin- to thick-bedded, fine- to coarse-grained mica-quartz (±feldspar) sandstone, interbedded with laminated siltstone and mudstone. Sporadic chert-rich units.

3.3. Historical Aerial Photography

Historical aerial photography (shown in Figure 2A and 2B) show minimal changes to the site sand road alignments from 1979 and 1987 to the present day. There is no indication that the creeks have changed alignment in recent history.

3.4. Site Observations

Observations of the site surface conditions were made at the time of the site inspection. .

Observations of Site 1 Brooman Road at Boondobah Creek (shown in Photographs 1 to 6 in Appendix B) include the following:

- The bridge is comprised of a single span timber bridge over Boondobah Creek.
- The creek is incised into an alluvial landform with the base about 3m below the existing bridge level.
- The natural surface is level on the eastern side of the bridge and rises on the western side of the bridge.
- The road is cut into the slope on the western side of the bridge. An exposure (EXP01) in the cutting on the western side of the bridge was logged and is noted to comprise residual soils. Based on these observations, the depth of rock is expected to be shallower on the western side of the bridge and deeper on the eastern side.
- No outcropping rock was observed along the base of the creek. At the time of inspection, the creek was flowing, and the base is mostly comprised of coarse-grained sandy sediment.
- No boulders were observed in the banks or bed of the creek and no excessively large logs were observed over the creek.

Observations of Site 2 – The River Road at Bridge Creek (shown in Photographs 1 to 9 in appendix C) include the following:

- The bridge is comprised of a single span timber bridge over Bridge Creek.
- The creek is incised into an alluvial landform with the base about 3m below the existing bridge level.
- The natural surface is level on the southern side of the bridge and rises on the northern side of the bridge.
- The road is partially cut into the slopes on the northern side of the bridge. An exposure (EXP201) in the cutting on the northern side of the bridge was logged and is noted to comprise soils deposited during a combination of water and gravity (eg colluvial/slope wash soils). Based on these observations, the depth of rock is expected to be shallower towards the naturally rising slopes on the northern side of the bridge and deeper on the eastern side
- No outcropping rock was observed along the base of the creek. At the time of inspection, the creek was flowing, and the base is mostly comprised of coarse-grained sandy sediment.
- No boulders were observed in the banks or bed of the creek and no excessively large logs were observed over the creek.

3.5. Subsurface Observations

On each site, one borehole was drilled using a drill rig named to depths below 8m. These were names BH101 and BH201 for Site 1 and 2 respectively and located on the eastern and southern side of the bridges where rock was expected to be encountered at deeper depths. The drill rig boreholes, BH101 and BH201, were initially augered to tungsten carbide (TC) drilling bit refusal at depths between 7.0m to 6.5m and continued thereafter using core drilling techniques.

The remaining boreholes were undertaken on the western and northern sides of Site 1 and Site 2 respectively with an excavator with auger attachment. Boreholes BH102 and BH202 were undertaken to depths of refusal at 4.1m and 5.3m depth on weathered material.

An additional large diameter borehole was undertaken on the northern side of Site 2, named BH203 to collect bulk samples of the subgrade. Exposures of nearby cuttings were also logged and are named EXP101 and EXP201 for Sites 1 and 2 respectively.

Engineering logs of the materials encountered are provided in Appendix D. The subsurface conditions encountered are summarised in Table 3-1 for Site 1 and Table 3-2 for Site 2 on Pages 4 and 5.

Dynamic Cone Penetrometer (DCP) Testing was undertaken adjacent to boreholes BH101, BH102, BH202 and BH203. This test was conducted to depths of 1.0m in borehole BH101 and BH203 and to depths of 3.2m and 4.3m for boreholes BH102 and BH202. The DCP tests indicate the following:

- Site 1 – The near surface fill soils are medium dense and stiff for the coarse and fined grained soils respectively. The alluvial soils on the northern side of the bridge were initially stiff to about 1.0m depth. On the southern side of the bridge the topsoil/alluvial soil was loose to 1.2m depth, the residual soils were firm to 2.0m depth becoming stiff to 2.7m, transitioning to very stiff and becoming hard below 3.2m depth. These results are generally consistent with penetration rates observed during auger drilling.
- Site 2 – The near surface soils to 1.0m depth comprised of fill and colluvial soils that was stiff. The underlying alluvial soil in BH202 was initially soft to about 1.6m depth, firm to stiff to about 3.3m and very stiff to the termination depth of about 4.3m. These results are generally consistent with penetration rates observed during auger drilling and indicate a potential transition to residual soils below 3.3m depth in BH202.

Standard Penetration Testing (SPT) was undertaken at 1.5m intervals starting from 1.0m depth in boreholes BH101 and BH102. This testing indicates the following:

- The coarse grained alluvial sandy material encountered in BH101 to 4.4m depth are very loose to loose. The residual soils underlying the alluvial material are stiff.
- The fine grained alluvial silty/clayey material encountered in BH201 to 5.2m depth are soft. The extremely weathered material underlying this material is hard with an N value of 35 indicative of low strength weathered material.

The investigation encountered groundwater as follows:

- Groundwater at 2.6m depth in BH101. Groundwater was not encountered in BH102, soil conditions were observed to be dry.
- Groundwater at 2.8m depth in BH201. Seepages were encountered below 1.0m in BH202 where soils were observed to be wet, a standing water level is expected at a similar depth to BH201 in BH202.

3.6. Laboratory Results

A summary of the laboratory test results is provided in Table 3-3 on Page 3 with laboratory certificates provided in Appendix E. These results indicate the following:

- Site 1 – The Sandy CLAY fill along the bridge approaches were dry of the OMC of 12.1% by about 4%, have a Maximum Dry Density of 1.937t/m^3, low swell of 0.0% and CBR of 7.0%. The residual material on the western side of the bridge was wet of the OMC of 18.7% by 13%, have a Maximum Dry Density of 1.609t/m^3, high swells of 4.0% and CBR of 3.0%. Atterberg Limit testing indicates the residual soil is comprised of intermediate (medium) plasticity material with a linear shrinkage of 7.0%.
- Site 2 – The Gravelly Sandy CLAY fill material in BH202 were dry of the OMC of 17.0% by about 1.0%, have a Maximum Dry Density of 1.825t/m^3, low swell of 0.5% and CBR of 4.5%. The Sandy CLAY colluvial material in BH203 were dry of the OMC of 12.5% by about 2.0%, have a Maximum Dry Density of 1.825t/m^3, moderate swell of 1.5% and CBR of 12.0%. Atterberg Limit testing indicates the alluvium is comprised of low plasticity silt/clay material material with a linear shrinkage of 2.0%.

Samples from BH101 and BH201 were also subject to soil aggressivity testing. The sample from BH101 was taken from the sandy alluvial soils, whilst the sample from BH201 was taken from the extremely weathered siltstone which had coloration indicative of a high mineral content. Soil aggressivity results are summarised in Table 3-4 on Page 6.

Samples of the core recovered from BH101 and BH201 were tested for point loads to determine the strength of the rock and are summarised in Table 3-5 on page 7.

Table 3-1: Summary of subsurface investigation Site 1 - Brooman Road at Boondobah Creek

Subsurface conditions *(Soil name, plasticity or particle characteristics, colour, secondary components and minor components)* Approach side to bridge	Structure and other comments	Depth encountered in test pit/exposure (m)		
		BH101 East	BH102 West	EXP101 West
Clayey Gravelly SAND: fine to medium sand, brown/yellow brown, lo plasticity fines, fine to medium angular gravel	Fill	0.0-0.4	NE	NE
Sandy CLAY: low plasticity, brown, fine to medium sand, with fine to medium angular gravels and quartz gravels (appears sandy, workable when moist)		0.4-1.7	0.0-0.4	NE
Silty CLAY: medium plasticity, yellow brown		NE	0.4-0.8	NE
Sandy CLAY, Silty SAND: fine to medium sand, dark brown, low plasticity fines, with fine to medium rounded gravels, trace of organics	Topsoil	NE	0.8-1.2	0.0-0.2
Silty Clayey SAND, Silty SAND, SAND: fine to coarse sand, brown/light brown, low plasticity fines	Alluvium	1.7-4.4	NE	NE
Silty CLAY: medium to high plasticity, white and yellow/orange mottled	Residual	4.4-5.5	1.2-2.7	0.2-0.6
Silty CLAY, Sandy Silty CLAY: low to high plasticity, white and grey banded, yellow brown, trace of fine angular gravels, some bands of white clay recovery	Residual/Extremely Weathered Material	5.5-7.0$^{T/C}$	2.7-4.1^{r}	0.6-1.0*
SILTSTONE: moderately weathered, low strength, light brown, greenish tinge in parts, iron stained, some quartz seams <10mm thick	Weathered Rock	7.0-9.0		
SILTSTONE: slightly weathered, very low to low strength, grey, thinly bedded, 45 to 50 degrees bedding, dark grey seams		9.0-9.8*		

*Notes * - End of hole at target depth; ^{r} - Early refusal on rock, VR- Virtual refusal, NE – not encountered, T/C – Tungsten carbine auger refusal and coring start,*

Table 3-2: Summary of subsurface investigation Site 2 - The River Road at Bridge Creek

Subsurface conditions *(Soil name, plasticity or particle characteristics, colour, secondary components and minor components)* Approach side to bridge	Structure and other comments	Depth encountered in test pit/exposure (m)			
		BH201 South	BH202 North	BH203 North	EXP201 North
Clayey Sandy GRAVEL: fine to coarse angular gravel, light orange brown, fine to coarse sand, with cobbles	Base	0.0-0.4	NE	NE	NE
Gravelly Sandy CLAY: low plasticity, light orange brown, fine to medium sand	Fill	0.4-1.2	0.1-1.0	NE	NE
Sandy CLAY: low plasticity, brown, fine to medium sand, with gravel	Colluvial	NE	NE	0.0-1.0	0.0-0.5
Clayey SILT/Silty CLAY: low plasticity grey brown to dark brown, trace orange mottling, with fine sand	Alluvial	1.2-2.8	1.0-3.3		
Sandy Silty CLAY/Sandy Clayey SILT: low plasticity, brown with grey mottles, fine sand	Alluvial (possibly Residual in BH202)	2.8-5.2	3.3-5.0		
Gravelly CLAY: low plasticity, brown, fine to medium angular gravels	Extremely Weathered Material	NE	5.0-5.3^{r}		
SILTSTONE: very low strength, extremely weathered, blue, friable to Sandy SILT		5.2-6.5$^{T/C}$			
SILTSTONE: grey to light grey, slight blue tinge, thinly bedded, some 70 degree joints, weathered and crushed seams	Weathered Rock	6.5-7.6			
Sandy SILTSTONE: light brown, some near horizontal 60 degree joints and crushed seams		7.6-8.5*			

*Notes * - End of hole at target depth; ^{r} - Early refusal on rock, VR- Virtual refusal, NE – not encountered, T/C – Tungsten carbine auger refusal and coring start, SPTR*

Table 3-3: Summary of subsurface testing results

Sample	Depth (m)	Material	FMC (%)	OMC (%)	MDD (t/m^3)	Swell (%)	CBR	LL (%)	PL (%)	PI	LS (%)
Site 1:											
BH101	2.5	Silty SAND									
BH102	0.0-0.4	Sandy CLAY	8.8	12.1	1.937	0.0	**7.0**				
EXP101	0.2-0.4	Silty CLAY	31.0	18.7	1.609	4.0	**3.0**	40	24	16	7.0
Site 2											
BH201	5.5	SILTSTONE									
BH202	0.1-0.6	Gravelly Sandy CLAY	16.1	17.0	1.825	0.5	**4.5**				
BH202	2.0-3.0	Clayey SILT/Silty CLAY						18	14	4	2.0
BH203	0.1-0.6	Sandy CLAY	10.9	12.5	1.825	1.5	**12**				

Table 3-4: Soil Aggressivity Testing

Sample	Depth (m)	Material	pH	Electrical conductivity (µS/cm)	Resistivity at 25°C (ohm m)	Soluble sulphate (mg/kg)	Chloride (mg/kg)
Site 1 BH101 SPT2	2.5	SAND	7.0	20	490	15	13
Site 2 BH201 SPT4	5.5	Siltstone	5.8	15	680	21	10

Table 3-5: Summary of Rock Core Testing

Sample	Depth (m)	Material	Point Load Index $Is_{(50)}$ (MPa)		Interpreted Rock Strength
			Axial	Diametral	
Site 1 BH101 core	7.07	Siltstone	0.18	0.37	Low – Medium
	7.43	Siltstone	0.24	0.08	Very low – Low
	8.07	Siltstone	0.27	0.87	Low – Medium
	8.57	Siltstone	0.39	0.33	Medium
	8.86	Siltstone	0.05	0.24	Very Low – Low
Site 2 BH201 core	6.54	Siltstone	0.94	0.28	Low – Medium
	7.13	Siltstone	0.49	0.36	Medium
	7.69	Siltstone	0.14	0.06	Very Low – Low
	7.9	Siltstone	1.2	0.47	Medium – High
	8.3	Siltstone	1.5	0.33	Medium - High

4. Engineering Assessment

4.1. Geotechnical Site Model – Brooman Road Over Boondobah Creek

Site 1 comprises a bridge on Brooman Road over Boondobah Creek with a surface level of about RL 23m AHD that crosses an incised creek about 3m deep. The bridge is located in a gently sloping alluvial gully landscape with level terrain on the eastern side and gently sloping terrain on the western side. Subsurface conditions for the Site 1 are summarised in Table 4-1

Table 4-1: Summary of subsurface conditions in Site 1 – Brooman Road

	Description of subsurface conditions	Depth to top of Layer (m)
Fill	Encountered in BH101 and BH102 to depths of 0.8m to 1.7m comprised of surficial clayey gravelly sand to 0.4m depth and Sandy CLAY with gravels and Silty CLAY (similar to residual material) to depths of 0.8m to 1.7m, typically stiff, with CBRs of 7.0% and swells of 0.0%.	0.0
Topsoil	Encountered on the surface and below the fill in BH102. Comprised of sandy CLAY, Silty SAND, fine to medium sand, dark brown, low plasticity fines, with fine to medium rounded gravels, trace of organics.	0.0-1.2
Alluvium	Encountered in BH101 below 1.7m depth, comprised of Silty Clayey SAND, Silty SAND, SAND, fine to coarse sand, brown/light brown, low plasticity fines, typically very loose to loose.	0.0-1.7
Residual	Encountered in BH101 at depths of 4.4m on the eastern side of the bridge, 1.2m depth in BH102 below the fill and old topsoil and 0.2m depth in a cutting to the west of BH102. The residual material comprised of Silty CLAY of medium to high plasticity, white and yellow/orange mottled, initially firm, becoming stiff to very stiff. Testing indicates the material is medium plasticity, with a weak to medium strength CBR of 3.0% and a high swell of 4.0%.	0.2-4.4
Residual/Extremely weathered Material	Encountered below the residual soils at depths of 5.5m, 2.7m and 0.6m in BH101, BH102 and EXP101 respectively. Comprised of Silty CLAY, Sandy Silty CLAY, low to high plasticity, white and grey banded, yellow brown, trace of fine angular gravels, some bands of white clay recovery, typically stiff to very stiff.	0.6-5.5
Weathered Siltstone	Encountered at 7.0m depth in BH101 and expected to be below 4.1m where refusal occurred in BH102. Comprised of low strength, initially moderately weathered SILTSTONE, transitioning to slightly weathered, very low to low strength SILSTONE at 9.0m depth. The material was light brown, to dark grey, with defect spacings of 0mm to 300mm and a total RQD of 10%.	4.1-7.0

The investigation encountered groundwater as follows:

- Groundwater at 2.6m depth in BH101. Groundwater was not encountered in BH102, soil conditions were observed to be dry.

4.2. Geotechnical Site Model – The River Road over Bridge Creek

Site 2 comprises of a bridge on The River Road over Bridge Creek with a surface level of about RL 7m AHD that crosses and incised creek about 3.0m deep. The bridge is located in a gently sloping alluvial gully landscape with level terrain on the southern side and gently sloping terrain on the northern side. Subsurface conditions for the Site 2 are summarised in Table 4-2

Table 4-2: Summary of subsurface conditions in Site 2 – The River Road

	Description of subsurface conditions	Depth to top of Layer (m)
Base	Encountered in BH201, comprised of Clayey Sandy GRAVEL, fine to coarse angular gravel, light orange brown, fine to coarse sand, with cobbles, about 0.4m thick	0.0
Fill	Encountered in BH201 and B202 to depths of 1.0-1.2m, comprised of Gravelly Sandy CLAY, low plasticity, light orange brown, fine to medium sand, stiff, low swell of 0.5% and medium strength CBR of 4.5%	0.1-0.4
Colluvial	Encountered on the northern side of the bridge, to depths of 0.5m to 1.0m, comprised of Sandy CLAY, low plasticity, brown, fine to medium sand, with gravel, on the surface, stiff, maximum dry density of 1.825t/m3, moderate swell of 1.5% and strong strength CBR of 12.0%	0.0
Alluvial	Encountered in BH201 and BH202 below the fill to depths of 5.0m to 5.2m comprised of Sandy - Clayey SILT/Silty CLAY, low plasticity grey brown to dark brown, trace orange mottling, fine sand, soft to depth and stiff to very stiff in BH202, with low linear shrinkages of 2.0%	1.0-1.2
Extremely Weathered Material	Encountered in BH201 and BH202 below the alluvial material, recovered as very low strength/hard SILTSTONE, blue in BH201 and Gravelly CLAY in BH202.	5.0-5.2
Weathered Rock	Encountered in BH201 and expected to be below depths of refusal in BH202, comprised of SILTSTONE, Sandy SILTSTONE, slightly weathered, low to medium strength, some very low to low strength bands, grey, light grey, light brown, some joints, weathered and crushed seams	5.3-6.5

The investigation encountered groundwater as follows:

- Groundwater at 2.8m depth in BH201. Seepages were encountered below 1.0m in BH202 where soils were observed to be wet, a standing water level is expected at a similar depth to BH201 in BH202.

4.3. Proposed Bridge Construction

It is understood that the reconstruction of the bridge will involve the following:

- Removal of the existing bridges,
- Excavation of the sediment from within the bridge footprint, including benching of the abutments.
- Construction of pier footings to support then new bridge
- Construction of the new bridge; and
- Filling around bridge abutments and formation of road pavement.

4.4. Geotechnical Behavioural Parameters for Design

Design Parameters for the soils encountered on both sites are provided in Table 4.3.

Table 4-3: Soil Parameters for design

Material	Bulk Unit Weight (kN/m^3)	Undrained Shear strength (kPa)	At rest earth pressure coefficient K_o	Long Term Elastic Modulus E_u (MPa)	Short Term Elastic Modulus E_u (MPa)	Drained Parameters		
						Cohesion c' (kPa)	Friction Angle Φ' (degrees)	Poisson's Ratio μ'
VL to L Sands	17	NA	0.58	3	5	0	25-30	0.3
Soft Clays/Silts	16	12-25	0.61	2	5	2	15-25	0.4
Stiff or better Clays	16-18	50-150	0.58	7-20	10-25	2	25	0.4
Extremely weathered materials	20-22	150-200	0.50	25-50	50-100	5	25-28	0.35
MW-SW Low to Medium Strength SILTSOTNE	22-25	>200	0.43	100-200	100-200	25	28-35	0.3

4.5. Geotechnical Hazards and Risk Analysis

The creek banks have been subject to local slumping due to erosional processes. Geotechnical hazards observed above, below, or beside the bridge sites include the following:

Table 4-4: Risk Analysis Summary

HAZARDS	Assesement
TYPE	Undercutting of footings adjacent to areas prone to river bank and surface erosion. Risk can be reduced by taking footings below potential zone of soil erosion using piers and or use of scour protection.
LIKELIHOOD	'Likely' (10^{-2}) reducing to unlikely for piers (10^{-4}) and Possible for abutment scour protection (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (35%)
RISK TO PROPERTY	'High' reducing to Low for piers and medium for abutments with scour protection
RISK TO LIFE	<1X10^{-6}/annum
COMMENTS	This level of risk to property is 'ACCEPTABLE' where piers and scour protection are adopted for the footings in accordance with recommendations in this report.

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

It is therefore expected the bridges will be supported on piers taken to below the base of the creek where they will not be susceptible to erosion or alternatively, piers will be taken to extremely weathered material which is less likely to be prone to erosion. Recommended pier depths are discussed in Section 4.6.

4.6. Footing design parameters

The soils at expected level of the eastern bridge abutment of Site 1 was assessed as granular sands and non-plastic but is of limited thickness. It is underlain by a sandy clay. On the western side the soils were medium plasticity clays and reactive with linear shrinkage of 7% and a CBR swell of 4%. Given these reported laboratory results a conservative shrink swell of 4% has been adopted for assessment.

On the abutments of site 2, clayey soils were encountered which when exposed may exhibit shrink swell movements. However, a low linear shrinkage of 2% was reported. A shrink swell index of 2% has been adopted for the assessment.

Movements are expected to be in the range of 35 to 45 mm for site 1 and 20 to 25mm for Site 2. Where footings are founded on granular fills of substantial depth, movements are expected to be <20mm.

It is expected that footings for the bridge could comprise of deep footings (such as piles) within the bridge abutments. Footings should be founded into less weathered rock at depths of 6.0m to 7.0m in Site 1 and into extremely weathered to less weathered rock at depths of greater than 5.5m and 7.0m respectively in Site 2.

Bored piles founded in the low strength rock can be designed on a nominal ultimate end bearing pressure of 3.0MPa and ultimate skin friction of 100kPa. A geotechnical strength reduction factor of 0.45 shall be applied to the ultimate end bearing for the bored pier. Skin friction must not be relied on for piers making less than 400mm penetration into rock, these recommendations are summarised in Table 4-5.

For driven piles, the likely penetration into the rock will be dependent on strength of the rock, the defect spacing (including RQD) and the type of driven pile adopted. It is estimated that pile set up will occur within 2 to 4 effective pile diameters below the interface of the residual soil and rock. The ultimate end bearing is expected to be between 4MPa and 5MPa.

We note that for bored piers, the ultimate end bearing provided is dependent on a clean base of hole. Inspection of high level or pier footings excavations should be undertaken to confirm the founding conditions and the base should be cleared of fall-in prior to the formation of the footing.

Table 4-5 Summarises the bearing capacities that can be adopted for design purposes.

Material	Depth below abutment GSL (m)		Undrained Shear strength (kPa)	Allowable bearing capacity for spread footings (kPa)	Ultimate End bearing capacity (MPa)	Ultimate Shaft adhesion, kPa
	Site 1	Site 2				
Extremely Weathered rock	NA	>5.5	150 -200	300	1.5	80
SW-FR SILSTONE (Low Strength)	>7.0 E >6.0 W	> 7.0	UCS=5-10 MPa	450	3.0	100
	Notes: NA not applicable					

4.7. Durability

Many factors can affect the corrosion potential of soil including soil moisture content, resistivity, permeability and pH, as well as chloride and sulfate concentration. In general, soil resistivity, which is a measure of how easily electrical current flows through soils, is the most influential factor. Based on classification developed by William J. Ellis (1978), the soils would be assessed as very mildly corrosive for both sites.

Chloride and sulfate ion concentrations and pH appear to play secondary roles in affecting corrosion potential. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried metallic improvements or reinforced concrete structures. Sulfate ions in the soil can lower the soil resistivity and can be highly aggressive to Portland Cement Concrete (PCC) by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. Soils containing high sulfate content could also cause corrosion of the

reinforcing steel in concrete. The level of sulfates detected are negligible. The pH of the soils is within the neutral and acidic range for Site 1 and 2 respectively.

Table 6.4.2(C) of the Australian Standard AS2159-2009 Piling – Design and installation defines the exposure conditions for the design of concrete piles based on the level of sulfates and pH of the soil. This indicates based on the laboratory results, the sandy soils for Site 1 and the fine grained soils for Site 2 an exposure classification of mild and non-aggressive for Sites 1 and 2 respectively.

Table 6.5.2(C) of the Australian Standard AS2159-2009 Piling – Design and installation defines the exposure conditions for the design of steel piles based on the level of chlorides, pH, and resistivity. This indicates based on the laboratory results, an exposure classification of mild and non-aggressive for Sites 1 and 2 respectively.

The above recommendations are for piles in soils. The structural engineer shall make a separate assessment for the piles or piers in the water within the creeks.

4.8. Design of Bridges Walls

It is expected that the retaining walls on either side of side of the bridge will support the road fill. Generally, these walls could comprise blockwork or reinforced concrete walls. It is assumed the bridge bridges will be infilled with engineered fill.

Structural design of retaining structures must be sufficient to limit lateral ground movement in the soil at this site. A triangular pressure distribution could be adopted for the design of permanent retaining walls, which cantilever in the lateral direction by a single point restraint. The earth pressures on the active side of the wall may be calculated for a particular depth using the following equation:

$$Pa = K (Ps + \gamma_b.H)$$

where: Pa = Lateral earth pressure on the active side of the wall (kPa)
K = Earth pressure coefficient which depends upon material type; whether movement needs to be limited; whether temporary or permanent.
Ps = Design surcharge pressure (kPa)
H = Height/depth below top of excavation (m)
γb = Bulk unit weight (kN/m3)

The following table provides design values for the following cases:

- Case 1 = permanent retention; no adjacent footings, flat ground behind the wall.
- Case 2 = adjacent footings and hence need to limit movement, sloping ground behind the wall up to 20 degrees.

Table 4-6: Earth Pressure co-efficient

Material	Lateral Earth Pressure Coefficient, Ka		Passive Pressure Coefficient, Kp	At rest Pressure Coefficient, Ko
	Case 1	Case 2	All Cases	All Cases
Fill – gravelly Sand /sandy gravel ø'=30-40 degrees, medium dense	0.30	0.35	3.0	0.45

*Notes to table: * in the less weathered rock, the defects within the rock mass will determine the applied loadings on the retaining wall.*

The assumed lateral pressure distributions may need to be modified to account for material layering, surcharge loads, any concentrated pad or strip footing loadings, or hydrostatic pressure due to build-up of water behind the wall. These parameters are based on the estimated soil parameters for retained materials provided in Table 4.3.

4.9. Earthworks

4.9.1. Site preparation

Ground preparation should allow for the stripping of topsoil and uncontrolled fill (if deemed required) from structural footprints. The stripped material should be suitable for structural fill once processed to exclude cobbles and foreign material (where present). Alternatively, it can be for landscape applications if determined to be suitable for this purpose. Surplus excavated materials may need to be exported or disposed of off the site.

4.9.2. Surface Protection and Stormwater

As both sites are located at creeks and surface soils are expected to be prone to erosion, surface water which flows downhill towards the proposed bridges should be temporarily diverted around the site works to facilitate construction.

Exposed soil should be protected from erosion, by means revegetating the creek banks with small shrubs and grasses and providing rock or similar armouring on both sides of the bridges bridge.

4.9.3. Slope retention

Where possible, unsupported temporary cuts in the topsoil, and fill for excavations up to 4.0m in depth, may be battered at 1.5 horizontal to one vertical (1.5H:1V) for short term works. This assumes:

- The slopes are well drained with surface water runoff diverted around the active working area;
- No surcharge loads are located within a horizontal distance of the cut crest equal to the vertical height of the cut; and
- The slope is inspected on a daily basis as part of the construction (temporary works) management plan.

Where surcharge loads are located within a horizontal distance of the excavation crest equal to the vertical height of the excavation, cut batters would need to be flatter than those recommended above.

4.9.4. Ease of excavation

This ease with which materials can be excavated onsite has been assessed using the Kirsten eight-point classification system provided in Table 4-7 below.

The topsoil, fill and alluvial/residual materials encountered are expected to meet a Kirsten Classification of Class 2 to 3 and should be readily excavated using conventional earthmoving equipment such as hydraulic excavators, backhoes, and dozers.

Table 4-7: Kirsten's eight-point excavation classification system

Class	Material Type	Description of Excavatability
1	Soil / Detritus	Hand spade (Dozer D3)
2		Hand pick and spade
3		Power tools
4	Rock	Easy ripping (Dozer D7)
5		Hard ripping (Dozer D8)
6		Very hard ripping (Dozer D9)
7		Extremely hard ripping / blasting (Dozer D10)
8		Blasting

Weathered rock where encountered at shallow depth should require easy ripping initially with the degree of ripping will increase with depth. Hard to very hard ripping is likely to be required within the less weathered rock. Rock sawing or coring should be considered where the rock is intact at depths below 8 to 10m.

4.9.5. Fill

It is expected that structural fill and pavement materials will need to be placed within the bridge bridges post completion of installation of the bridges retaining walls. These materials should be placed in layers not exceeding 150mm compacted thickness. Fill and pavement materials should be compacted to the density ratio requirements detailed in table 4-8.

General fill placed in areas not subject to structural loadings should be reinstated using lightly compaction in layers not exceeding 200mm compacted thickness to allow for revegetation purposes.

Table 4-8: Fill density requirements

Description	Density Ratio Requirements
Pavement – Base	Minimum 98% Modified
Pavement - Sub-base	Minimum 95% Modified
Subgrade/ structural fill (top 300mm)	Minimum 100% Standard
General fill within residential areas not subject to structural loadings	Maximum 95% standard
General Fill Zone (deeper than 300mm below top of subgrade)	Minimum 98% Standard

Testing of controlled fill should be in accordance with the following:

- Density and compaction testing should be undertaken on all fill placed.
- Density and compaction testing of the fill should be carried out on each 150mm thick layer of compacted fill. Proof rolling of each layer should also be carried out using a smooth drum roller of at least 12 tonne mass, without vibration.

Density testing of fill should be carried out at the rate of three tests per visit or one test every 2000m^2, whichever is the greater. If full time geotechnical supervision of the fill occurs, then a minimum three tests per day should be sufficient.

5. Pavement design

The following has been assumed in the preparation of the proposed pavement design;

1. The proposed alignment of the new bridge follows the proposed bridge alignment which is adjacent to the existing bridge alignment.
2. That boreholes undertaken on the existing bridge abutments are representative of subsurface conditions for the proposed bridge approaches.
3. The proposed bridge elevation is such that it will be higher than the existing surface elevations and that any proposed approaches will be covered in a layer of fill compared with current surface elevations.

5.1.1. Design subgrade

The subgrade material for Site 1 is comprised of Sandy CLAY fill and may intercept Silty CLAY residual material on the western side of the bridge. Site 2 is comprised of gravelly sandy clay fill and sandy clay colluvial soils.

For Site 1 the laboratory CBR testing indicates CBR values of 7% and 3% on the eastern and western side of the bridges respectively and for Site 2 between 4.5% and 12% for the fill and natural colluvial soils respectively.

It is noted that the residual material from Site 1 on the western abutment a reported high swell of 4.0% and would be considered an expansive subgrade. For highly expansive subgrades, a minimum cover is the most common technique to minimise volume change effects on the pavement (Section 5.3.5 - Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology, Department of Transport and Main Roads 2021). The required cover thickness is dependent on the Design Traffic Loading and is inclusive of the pavement material and assumes a minimum of 150mm layer of low permeability material. If fill is imported, it is expected the fill will comprised of a working platform of at least 30mm of CBR 15 or better material.

In addition to laboratory CBR values, dynamic cone penetrometer testing was undertaken. The blow counts recorded during the DCP tests were converted to inferred CBR values by referencing Figure 5.3 in Austroads AGPT02. Correlation of laboratory CBR's with inferred CBR from the DCP testing resulted in CBR values typically 5% or greater, below 0.3m from the existing surface. This DCP derived CBR values (provided in Appendix D) do not consider the potential for the subgrade to become inundated or compacted.

Based on in situ and laboratory testing, the design CBR values recommended for design are provided in Table 4.9.

Table 5-1: Recommended Design Subgrade CBR Value

Zone	Adopted CBR Value
Site 1 west abutment	3 no subgrade replacement 5 after subgrade replacement
Site 1 east abutment and Site 2	5
Both sites filled abutments	5

5.1.2. Design traffic

For all pavements, performance is influenced mainly by the heavy end of the traffic spectrum. In the design of road pavements, little account needs be taken of cars and light commercial vehicles as far as loadings are concerned, though their existence may affect road capacity. The proposed usage suggests most traffic will comprise standard passenger vehicles and trucks.

No guidance on the design traffic has been provided. Given adjacent land uses it is likely that there will be a significant proportion of heavy vehicles. The factors below have been adopted comparing the various Traffic Load Distributions available through Austroads and the State Road Authorities for rural area and similar land uses.

Table 5-2:Design Traffic Adopted Parameters

Parameter	Value for design life of 20 years Council Adopted Values
Design Life	20
AADT	200
DF	0.5
HV	15.0%
LDF	1
Growth Rate	2.0%
CGF	22.2
NHVAG	2.8
ESA/HVAG	1.1
HVAG (NDT)	1.7E+05
DESA	3.4E+05

5.1.3. Pavement design thicknesses

Local council pavement design specifications provide guidance for pavements up to 1 × 10E6 DESA including the derivation of design subgrade CBRs, minimum pavement thicknesses and design life. It is noted that Council requires the following minimum requirements for pavement thickness regardless of design traffic:

- Flexible pavements: Subbase 100mm, Base 100mm
- Rigid pavements Subbase 100mm, Base 150mm

Table 5.3.5 of Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology, Department of Transport and Main Roads 2021 indicates a minimum cover of 600mm over highly expansive material (including pavement material) encountered on the western side of Site 1.

Pavement seals on local streets and access streets can be comprised of a bituminous surface (primer seal plus two coat seal of 21mm minimum thickness, primer seal plus one coat seal and bituminous micro-surfacing, or primer seal with asphalt minimum 25mm thickness).

Following procedures outlined in Austroads, (Austroads, 2012), the design parameters shown in Table 4.11 have been adopted to determine the required pavement thickness.

Table 5-3: Summary of Adopted Design Parameters

Parameter	Value
Reliability	80
Subgrade Modulus (MPa)	10 × CBR Value
Design granular base modulus (MPa)	DGB 500 MPa DGS 350 MPa
Cement stabilised heavily bound base modulus (MPa)	5000 MPa
In Situ Lime Stabilised base	500MPa
Design Asphalt Modulus AC14 C320 binder	2200 MPa
Design Asphalt Modulus AC20 C320 Binder	2500 MPa

Based on the above, pavement thickness designs which are deemed most practical for the roads have been presented in Table 4.12. The roadway pavement thickness design has been undertaken using the industry standard mechanistic design software Circly. Analysis shows that the minimum layer thicknesses specified by Council govern. The pavement designs are summarised in Table 4.4.

Table 5-4: Pavement Thickness Designs - Unbound Granular Material

Layer Material	Layer Thickness	
	CBR 3	CBR 5
Asphalt seal or two coat seal	30 (AC14)*	30 (AC14)*
DGB20 (possible could adopt a wearing course for unsealed road)	150	150
DGS20	200	200
Minimum Cover Select Fill CBR 15%	300	NA
Total Pavement Thickness	680	380

Note to table * this thickness has not been considered in the structural design thickness of the pavement.

5.1.4. Environmental Conditions

Environmental factors that impact the performance of pavements include;

– Ingress of moisture from the surface
– Ingress of moisture from surrounding soils

– Oxidation of bitumen in either spray seal or asphalt layers
– Deformation of seal or asphalt layers due to high lateral forces from vehicle turning.

Consideration should be given to the likely movement of moisture from the surrounding soils into the pavement layers. This can be controlled by elevating the pavement layers above the surrounding soils or including subsoil drainage or a combination of both. Edge drains and intra-pavement drains at existing/new pavement interfaces as detailed in RMS Standards should be included as appropriate. The edge of the pavement area should be either bound by kerb and gutter running the full depth of the pavement, or the pavement should extend a minimum of 0.5m and preferably 1.0m past the edge of the designated trafficable areas.

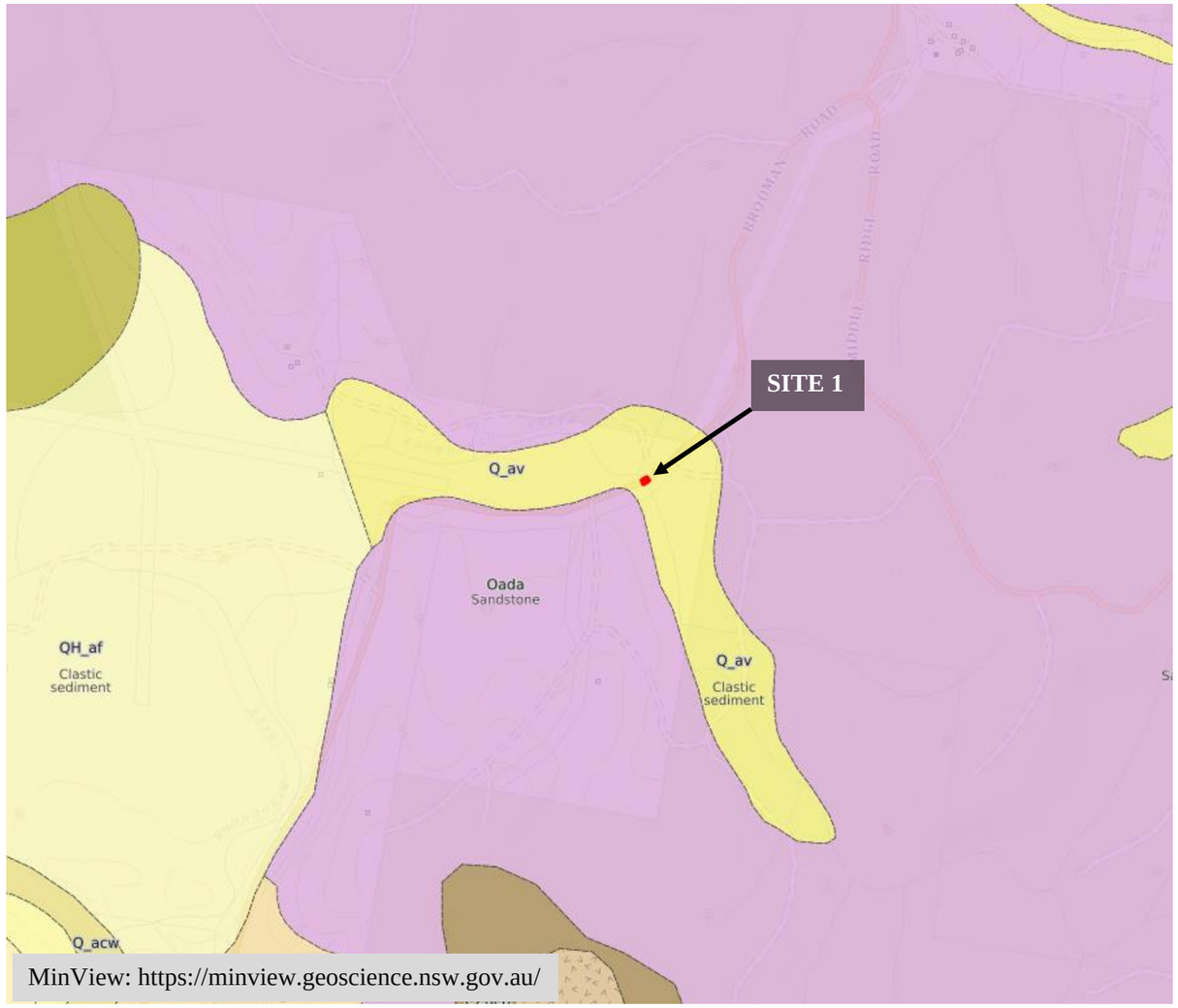
5.1.5. Construction practices

Generally, it has been assumed that roadway construction practices will be in accordance with either RMS construction specifications or AUS-SPEC Construction Specifications. It is assumed that Taxiway construction practices will be in accordance with White 2017. These specifications detail the assessment of the *in situ* subgrade condition and the requirements for removal and replacement of unsuitable subgrade material as well as the requirements of the base and subbase materials, their placement and compaction, and testing.

It is recommended that all pavement construction works are undertaken in the presence of a suitably qualified geotechnical engineer to observe actual site conditions and advise actions where site conditions vary from those assumed for the designs presented in this report. It may also be appropriate to refer to the designer for advice where site conditions vary significantly.

The DGB20 and DGS20 materials are Densely Graded Base and Densely Graded Subbase in accordance with RMS Construction Specifications. Materials performing to these standards should be used. Where materials do not perform to these standards then reassessment of the design thicknesses might be required...

Figures



MinView: https://minview.geoscience.nsw.gov.au/

Site Geology – Site 1

Symbol	Group	Unit	Lithology
Q_av	-	Alluvial valley deposits	Silt, clay, (fluvially deposited) lithic to quartz-lithic sand, gravel.
Oada	Abercrombie Formation	-	Brown and buff to grey, thin- to thick-bedded, fine- to coarse-grained mica-quartz (±feldspar) sandstone, interbedded with laminated siltstone and mudstone. Sporadic chert-rich units.

Site Location – Site 1

revision	description	drawn	approved	date
	Site location	XJ	KEG	9/03/2023

N

TERRA INSIGHT

client:	**Shoalhaven City Council**
project:	**Geotechnical Investigation Brooman Road Bridge at Boondobah Creek & The River Road Bridge at Bridge Creek**
scale	NTS
title:	**Site 1 Location**
original size	**A3**
project no:	**TERRA23-007**
figure no:	**FIGURE 1A**

Site Geology – Site 2

Symbol	Group	Unit	Lithology
Q_av	-	Alluvial valley deposits	Silt, clay, (fluvially deposited) lithic to quartz-lithic sand, gravel.
Oada	Abercrombie Formation	-	Brown and buff to grey, thin- to thick-bedded, fine- to coarse-grained mica-quartz (±feldspar) sandstone, interbedded with laminated siltstone and mudstone. Sporadic chert-rich units.

Site Location – Site 2

revision	description	drawn	approved	date
	Site location	XJ	KEG	9/03/2023

N

TERRA INSIGHT

client:	**Shoalhaven City Council**
project:	**Geotechnical Investigation** **Brooman Road Bridge at Boondobah Creek &** **The River Road Bridge at Bridge Creek**
scale	NTS
title:	**Site 2 Location**
original size	**A3**
project no:	**TERRA23-007**
figure no:	**FIGURE 1B**

1987	2020
	

Historical Imagery – Site 1

revision	description	drawn	approved	date
	Historical Aerial Imagery	XJ	KEG	9/03/2023

N

TERRA INSIGHT

scale	NTS
original size	**A3**

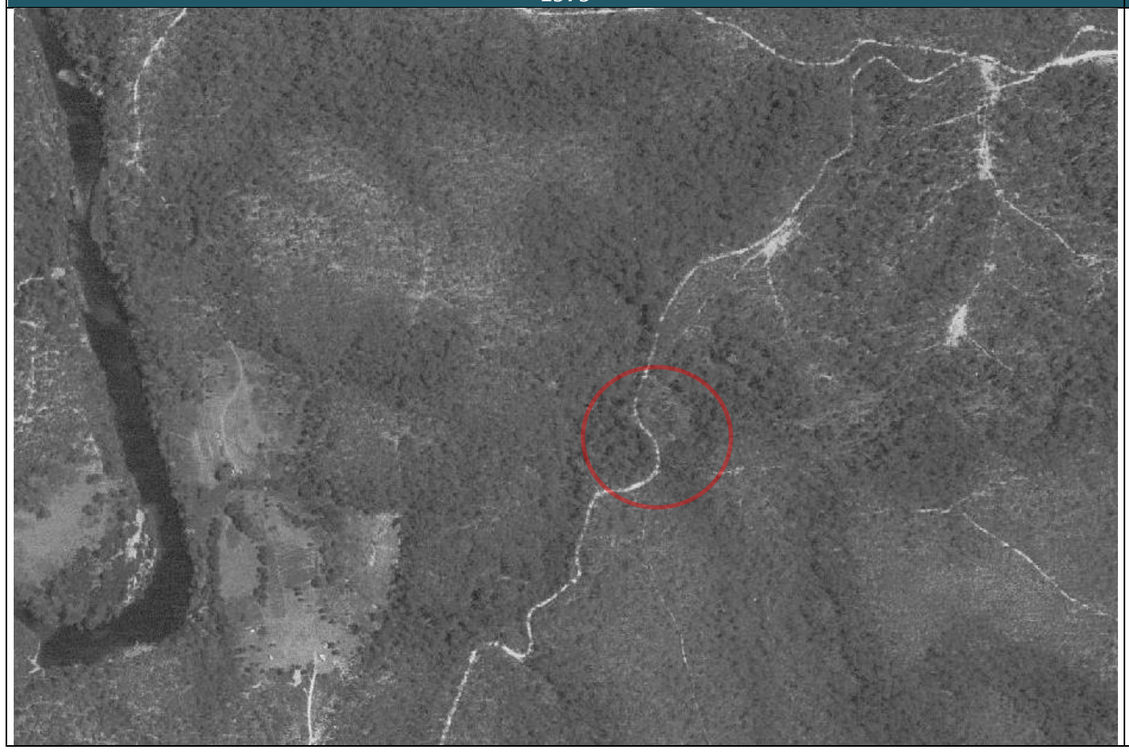
client: **Shoalhaven City Council**

project: **Geotechnical Investigation**
Brooman Road Bridge at Boondobah Creek &
The River Road Bridge at Bridge Creek

title: **Historical Imagery – Site 1**

project no: **TERRA23-007**

figure no: **FIGURE 2A**

1979	2018
	

Historical Imagery – Site 2

revision	description	drawn	approved	date
	Historical Aerial Imagery	XJ	KEG	9/03/2023

N

TERRA INSIGHT

scale	NTS
original size	**A3**

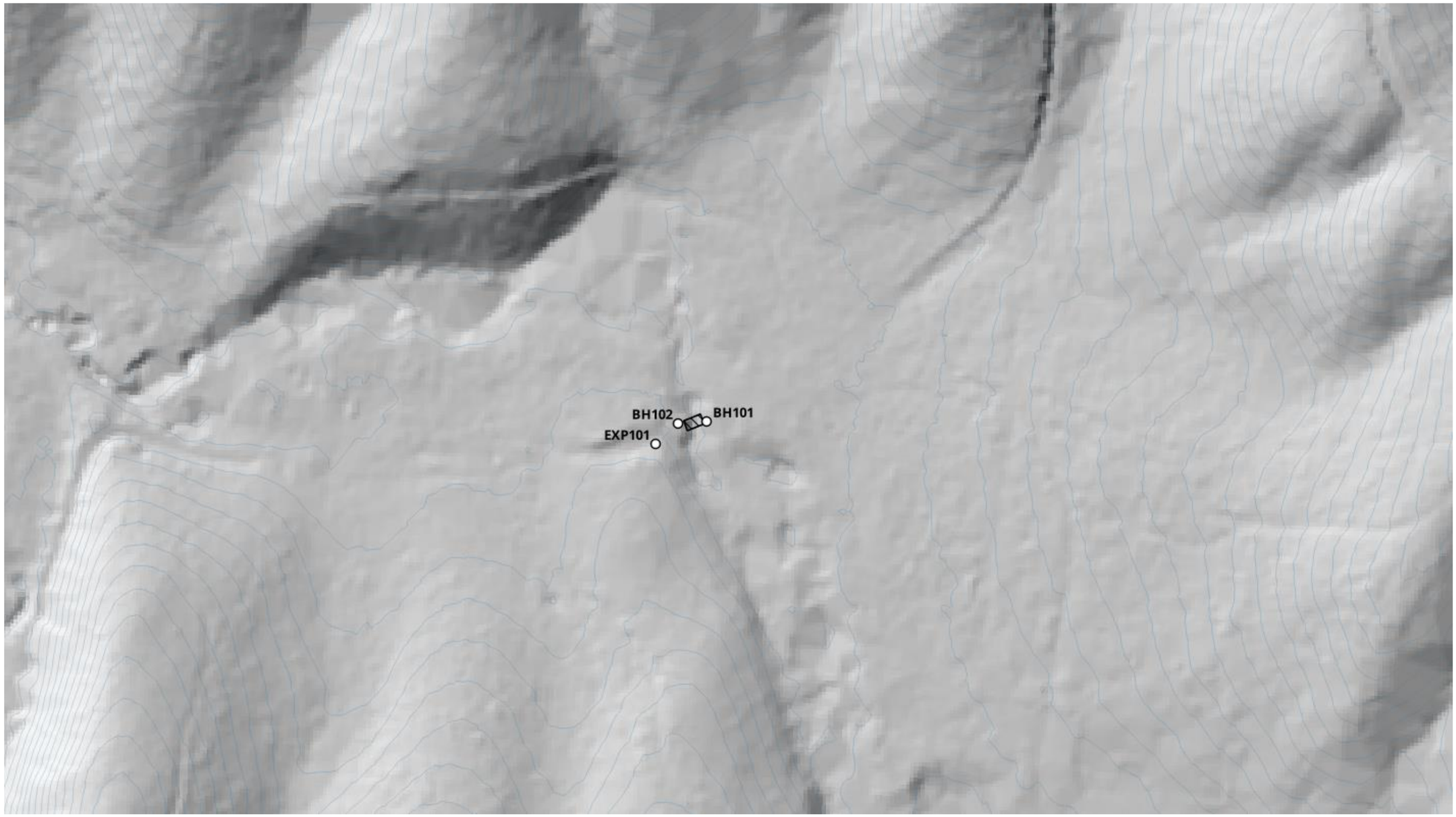
client: **Shoalhaven City Council**

project: **Geotechnical Investigation**
Brooman Road Bridge at Boondobah Creek &
The River Road Bridge at Bridge Creek

title: **Historical Imagery – Site 2**

project no: **TERRA23-007**

figure no: **FIGURE 2B**



Legend

◯ Terra Test site

▨ Approximate Bridge Location

Brooman Road Bridge at Boongobah Creek, Site Plan

revision	description	drawn	approved	date
	Test Site Location	XJ	KEG	25/01/2023

N

TERRA INSIGHT

scale	NTS
original size	**A3**

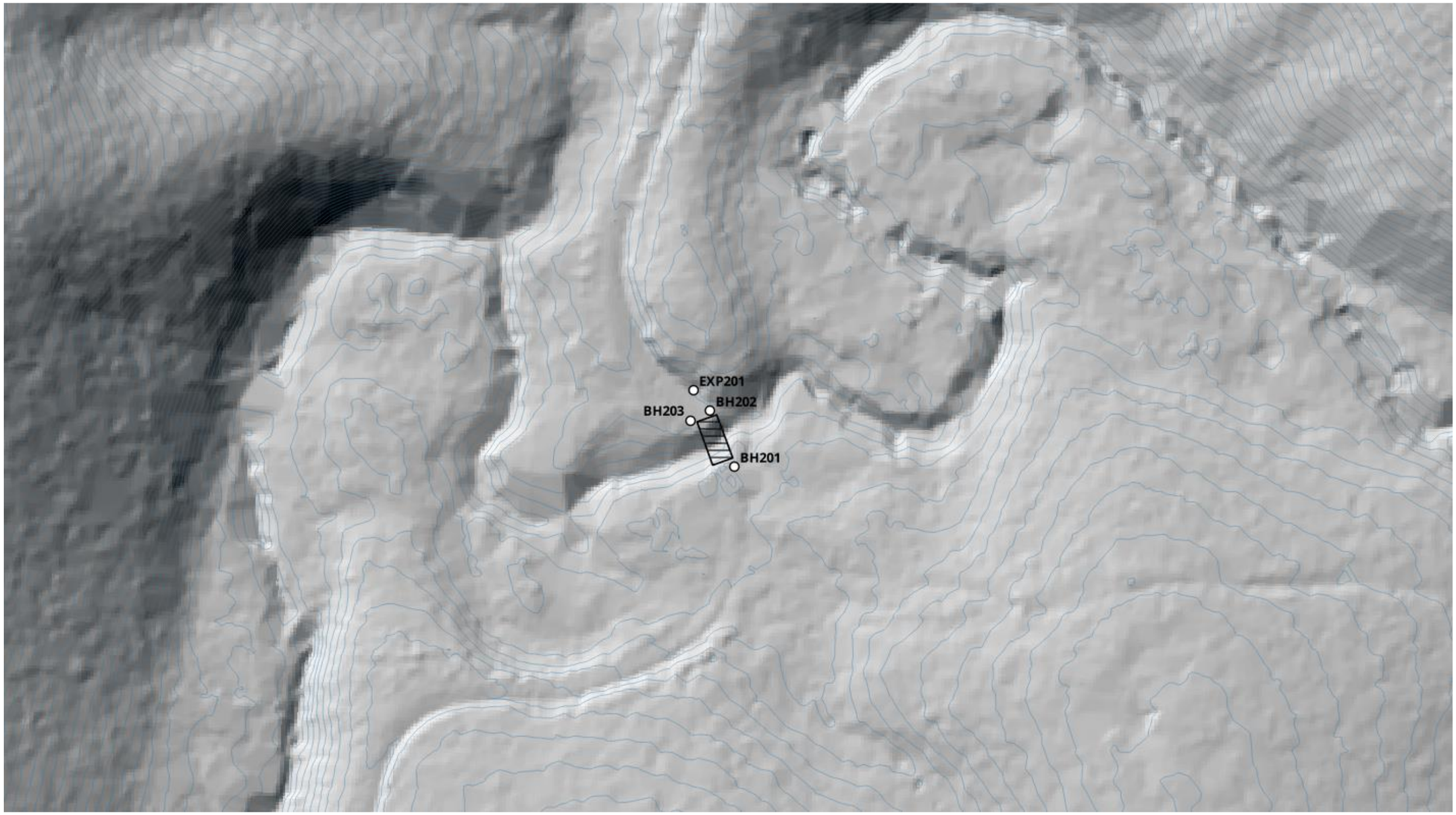
client: **Shoalhaven City Council**

project: **Geotechnical Investigation Brooman Road Bridge at Boondobah Creek & The River Road Bridge at Bridge Creek**

title: **Site Plan and Test Location**

project no: **TERRA23-007**

figure no: **FIGURE 3A**



Legend

◯ Terra Test site

▨ Approximate Bridge Location

The River Road Bridge at Bridge Creek, Site Plan

revision	description	drawn	approved	date
	Test Site Location	XJ	KEG	25/01/2023

N

TERRA INSIGHT

client:	**Shoalhaven City Council**		
project:	**Geotechnical Investigation Brooman Road Bridge at Boondobah Creek & The River Road Bridge at Bridge Creek**		
scale	NTS	title:	**Site Plan and Test Location**
original size	**A3**	project no: **TERRA23-007**	figure no: **FIGURE 3B**

Appendix A: Your Report

TERRA INSIGHT

Your Report

These notes have been prepared to help you understand the advice provided in Your Report and its limitations.

Your Report is based on what you tell us

Your Report has been developed based on the information you have provided such as the scope and size of your project. It applies only to the site investigated. If there are changes to the proposed works, then the advice provided within Your Report may need to be reviewed

Your Report is written with your needs in mind

The advice provided within Your Report is also not relevant to another purpose other than that originally specified at the time the report was issued. Please seek advice from Terra Insight before you share Your Report with another third party – except for the purpose for which the report was written.

Terra Insight assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in Your Report.

Your Report is based on what we observed

The advice provided within Your Report assumes that the site conditions, revealed through selective point sampling (undertaken in accordance with normal practices and standards) at a particular point in time, are indicative of the actual conditions on your site. However, the nature of the materials underlying your site is affected by natural processes and the activity of man. Under no circumstances can it be considered that these findings represent the actual state at all points. The subsurface conditions may vary significantly on the other parts of the site, particularly where no nearby sampling and testing work has been carried out.

As a result conditions on your site can change with time; they can also vary spatially. As a result, the actual conditions encountered may differ from those detailed within Your Report. Although nothing can be done to change the actual site conditions which exist, steps can be taken to gain a better understanding of the subsurface conditions underlying your site and reduce the potential for unexpected conditions to be encountered

The advice within Your Report also relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it. Only Terra Insight is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If the details of your project have changed, the site conditions have changed or a significant amount of time as elapsed since our report was written, the advice provided within Your Report may need to be reviewed.

Your Report has been written by a Professional

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

Your Report is better when it is kept together

Your Report presents all the findings of the site assessment and should not be copied in part or altered in any way. Keeping Your Report intact reduces the potential for yourself or other design professionals to misinterpret the report.

Your Geo-Environmental Report

If Your Report is for geotechnical purposes only, it will not relate any findings, conclusions, or recommendations about the potential for hazardous materials to exist at the site unless you have specifically asked us to do so. If your report is written for Geo-Environmental purposes the following should be noted in addition to the above:

- Advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in Your Report should be verified if you propose to use this report more than 6 months after its date of issue;
- Your Report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. The assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, which includes budget and timing;
- The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice. Any interpretation in Your Report is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment.
- We may have relied on data and other information provided by you and other qualified individuals in preparing Your Report. We have not verified the accuracy or completeness of such data or information except as otherwise stated in Your Report. For these reasons Your Report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.
- For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination posed in the context of the agreed purpose. If the proposed use of the site changes, the assessment may no longer be valid and will need to be reviewed.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Appendix B: Site Images – Brooman Road

Photograph 1: Site 1 – view looking west towards bridge from the eastern approach.

Photograph 2: Site 1 – view of bridge looking southwest.

Photograph 3: Site 1 – view of bridge looking east.

Photograph 4: Site 1 – view of Boondobah Creek looking north.

revision	description	drawn	approved	date
	Plate1	XJ	KEG	9/03/2023

TERRA INSIGHT

client:	**Shoalhaven City Council**		
project:	**Geotechnical Investigation** **Brooman Road Bridge at Boondobah Creek**		
scale	NTS	Title	**Images of the site – Site 1**
original size	**A3**	project no: **TERRA23-007**	Plate no:**1**

Photograph 5: Site 1 – View looking west of bridge showing rise in natural surface level.

Photograph 6: Site 1 – View of EXP101 on the western side of the bridge.

revision	description	drawn	approved	date
	Plate2	XJ	KEG	9/03/2023

TERRA INSIGHT

client:	**Shoalhaven City Council**
project:	**Geotechnical Investigation** **Brooman Road Bridge at Boondobah Creek**
scale	NTS
Title	**Images of the site – Site 1**
original size	**A3**
project no: **TERRA23-007**	Plate no:**2**

Appendix C: Site Images – River Road

Photograph 1: Site 2 – View of Bridge creek looking east.

Photograph 2: Site 2 – View of bridge creek looking west.

Photograph 3: Site 2 – View of northern abutment.

Photograph 4: Site 2 – View of northern abutment.

revision	description	drawn	approved	date
	Plate3	XJ	KEG	9/03/2023

TERRA INSIGHT

client:	**Shoalhaven City Council**
project:	**Geotechnical Investigation** **The River Road Bridge at Bridge Creek**
scale	NTS
Title	**Images of the site – Site 2**
original size	**A3**
project no: **TERRA23-007**	Plate no:**1**

Photograph 5: Site 2 – View of northern approach looking north and rise in natural surface.

Photograph 6: Site 2 – View of bridge looking south.

Photograph 7: Site 2 – View of southern abutment.

Photograph 8: Site 2 – View of southern abutment.

revision	description	drawn	approved	date
	Plate2	XJ	KEG	9/03/2023

TERRA INSIGHT

client:	**Shoalhaven City Council**
project:	**Geotechnical Investigation** **The River Road Bridge at Bridge Creek**
Title	**Images of the site – Site 2**
scale	NTS
original size	**A3**
project no:	**TERRA23-007**
Plate no:	2

Photograph 9: Site 2 – View of EXP201 on the northern side of the bridge.

revision	description	drawn	approved	date
	Plate4	XJ	KEG	9/03/2023

TERRA INSIGHT

client:	**Shoalhaven City Council**		
project:	**Geotechnical Investigation** **The River Road Bridge at Bridge Creek**		
scale	NTS	Title	**Images of the site – Site 2**
original size	**A3**	project no: **TERRA23-007**	Plate no:**3**

Appendix D: Engineering logs

TERRA INSIGHT

How to interpret the engineering logs in Your Report

FIELD DECRIPTIONS OF SOILS

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)				USC	PRIMARY NAME
COARSE GRAINED SOILS More than 65% of materials less than 63 mm is larger than 0.075 mm	GRAVELS More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	GRAVEL
			Predominantly one size or a range of sizes with more intermediate sizes missing.	GP	GRAVEL
		GRAVELS WITH FINES Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	GM	SILTY GRAVEL
			Plastic fines (for identification procedures see CL below)	GC	CLAYEY GRAVEL
	SANDS More than half of coarse fraction is smaller than 2.36 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes	SW	SAND
			Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	SAND
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	SM	SILTY SAND
			Plastic fines (for identification procedures see CL below).	SC	CLAYEY SAND

FINE GRAINED SOILS More than 35% of material less than 63 mm is smaller than 0.075 mm	IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm (Note a 75Um particle is about the smallest particle that is visible to the naked eye.)				
		DRY STRENGTH	DILATANCY	TOUGHNESS	USC	PRIMARY NAME
	SILTS & CLAYS Liquid limit less than 50	None to Low	Quick to slow	None	ML	SILT
		Medium to High	None	Medium	CL	CLAY
		Low to medium	Slow to very slow	Low	CL	ORGANIC SILT
	SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium	MH	SILT
		High	None	High	CH	CLAY
		Medium to High	None	Low to medium	OH	ORGANIC CLAY
HIGHLY ORGANIC	Readily identified by colour, odour, spongy feel and frequently by fibrous texture by fibrous texture.				PT	PEAT

● Low plasticity – Liquid Limit w_L less than 35%. ● Medium plasticity – w_L between 35% and 50%. ● High plasticity – w_L greater than 50%.

Particle size descriptive terms

NAME	SUBDIVISION	SIZE
Boulders Cobbles		>200 mm 63 mm to 200 mm
Gravel	coarse medium fine	20 mm to 63 mm 6 mm to 20 mm 2.36 mm to 6 mm
Sand	coarse medium fine	600 µm to 2.36 mm 200 µm to 600 µm 75 µm to 200 µm

Minor components

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

TERRA INSIGHT

How to interpret the engineering logs in Your Report

Moisture condition

TERM	DEFINITION
Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

Soil structure

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

Consistency of cohesive soils

TERM	UNDRAINED STRENGTH s_u (kPa)	VISUAL OBSERVATION IN FIELD
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 – 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 – 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 – 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 – 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

Density of granular soils

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 – 35
Medium Dense	35 – 65
Dense	65 – 85
Very Dense	Greater than 85

Geological origin

TRANSPORTED SOILS

Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TERRA INSIGHT

How to interpret the engineering logs in Your Report

FIELD DESCRIPTIONS OF ROCK

The descriptive terms used by Terra Insight are given below. They are broadly consistent with Australian Standard AS1726-1993.

Rock Substance — **In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.**

Defect — **Discontinuity or break in the continuity of a substance or substances.**

Mass — **Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.**

Classification of weathering products

Term	Abbreviation	Definition
Residual Soil	RS	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	XW	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	HW	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	MW	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	SW	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	FR	Rock substance unaffected by weathering.

Notes on Weathering:

AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.

Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

Rock substance strength terms

Term	Abbreviation	UCS (MPa)	Point Load Index, $I_{s(50)}$ (MPa)	Field Guide
Very Low	**VL**	<2	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	6 to 20	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	20 to 60	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	60 to 200	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	>200	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:

In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index Is(50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

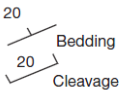
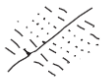
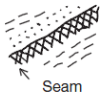
SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

TERRA INSIGHT

How to interpret the engineering logs in Your Report

Common defects observed in rock

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.

Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Veneer	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

TERRA INSIGHT

Borehole No.
BH101
Page 1 of 5

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	250261.4 m E 6072400.2 m N MGA94 Zone 56	Checked By:	XJ

Drill Model and Mounting:	Drill Rig	Inclination:	-90°	RL Surface:	23.00 m		
Hole Diameter:		Bearing:		Datum:	AHD	Operator:	

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm (Target)	Structure and Additional Observations
AD/T			2.6 mbgl , 03/02/23	SPT 1.00 m 4, 5, 5 N=10		22.0	1		SC	Clayey Gravelly SAND: fine to medium sand, brown/yellow brown, lo plasticity fines, fine to medium angular gravel	D	MD - D	9 10 10	FILL
									CL	Sandy CLAY: low plasticity, brown, fine to medium sand, with fine to medium angular gravels and quartz gravels (appears sandy, workable when moist) organics recovered (timber or crushed roots)	D	St	13 5 6 11 5 6	ALLUVIAL SOIL
						21.0	2		SC	Silty Clayey SAND: fine to medium sand, brown/light brown, low plasticity fines slightly clayey	D	VL		
				SPT 2.50 m 1,0,1 N=1		20.0	3		SM	Silty SAND: fine sand, brown/light brown, trace of orange mottles, low plasticity, with clay	W	VL - L		
				SPT 4.00 m 1,2,2 N=4		19.0	4		SP	SAND: coarse quartz sand, white, with fine angular gravels	W	L		
						18.0	5		CI-CH	Silty CLAY: medium to high plasticity, white and yellow/orange mottled	W	St		RESIDUAL SOIL

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	250261.4 m E 6072400.2 m N MGA94 Zone 56	Checked By:	XJ
Drill Model and Mounting:	Drill Rig	Inclination: -90°	RL Surface: 23.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator:

Drilling Information									Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm Target	Structure and Additional Observations
AD/T WB				SPT 5.50 m 2,3,7 N=10		17.0	6		CI-CH	Silty CLAY: medium to high plasticity, white and grey banded	M - W	St - VSt		RESIDUAL SOIL / EXTREMELY WEATHERED MATERIAL
						16.0	7			Continued on cored borehole sheet				
						15.0	8							
						14.0	9							
						13.0	10							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Cored Borehole No.
BH101 (cored)

Engineering Log - Cored Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	250261.4 m E 6072400.2 m N MGA94 Zone 56	Checked By:	XJ
Drill Model and Mounting:	Drill Rig	Inclination: -90°	RL Surface: 23.00 m
Barrel Type and Length:		Bearing:	Datum: AHD Operator:

Drilling Information								Rock Substance				Rock Mass Defects	
Method	Support	Water	TCR (%)	SCR (%)	RQD (%)	RL (m)	Depth (m)	Graphic Log	Material Description rock type: grain characteristics, colour, structure, minor components	Weathering	Strength Is(50) ● - Axial ○ - Diametral VL L M H VH EH	Average Defect Spacing (mm) 30 100 300 1000 3000	Defect Description thickness, type, inclination, planarity, roughness, coating/infilling Particular / General
						16.5	6.5		Continued from non-cored borehole sheet				
NQ3					10	16.0	7.0		SILTSTONE: light brown, greenish tinge in parts, iron stained, some quartz seams <10mm thick				JT, Fe SN, PR, RF, NH
													CS, NH and 45 degrees breaks
						15.5	7.5						JT, 45°, Fe SN, PR, S
													JT, 80°, Fe SN, PR, S
													SM, 60°, quartz seam
													BP, 30°, Fe SN, PR, S, 10-60mm spacing
									CORE LOSS				
						15.0	8.0		SILTSTONE: light brown, greenish tinge in parts, iron stained, some quartz seams <10mm thick	MW			BP, 45°, CN, PR, S
													CS, BP
									CORE LOSS				
						14.5	8.5		SILTSTONE: light brown, greenish tinge in parts, iron stained, some quartz seams <10mm thick				BP, Fe CN, CU, RF, NH
													SM, 45°, quartz seam
													BP, 45°, Fe SN, PR, RF, 20-40mm spacing

Method
AS - Auger Screwing
WB - Washbore
HQ3 - HQ3 Core Barrel
NQ3 - NQ3 Core Barrel

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Support
T - Timbering

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Weathering
FR - Fresh
SW - Slightly Weathered
DW - Distinctly Weathered
XW - Extremely Weathered
RS - Residual Soil

Strength
(indirect tensile strength)
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

TERRA INSIGHT

Cored Borehole No.
BH101 (cored)
Page 5 of 5

Engineering Log - Cored Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	250261.4 m E 6072400.2 m N MGA94 Zone 56	Checked By:	XJ
Drill Model and Mounting:	Drill Rig	Inclination: -90°	RL Surface: 23.00 m
Barrel Type and Length:		Bearing:	Datum: AHD Operator:

Drilling Information								Rock Substance				Rock Mass Defects		
Method	Support	Water	TCR (%)	SCR (%)	RQD (%)	RL (m)	Depth (m)	Graphic Log	Material Description rock type: grain characteristics, colour, structure, minor components	Weathering	Strength Is(50) ● - Axial ○ - Diametral VL L M H VH EH	Average Defect Spacing (mm) 30 100 300 1000 3000	Defect Description thickness, type, inclination, planarity, roughness, coating/infilling Particular	General
NQ3					10	13.5	9.5		CORE LOSS - recovery as quartz and siltstone gravels	SW			core loss recovered as gravels	
									SILTSTONE: grey, thinly bedded, 45 to 50 degrees bedding, dark grey seams				JT, 45°, CN, PR, RF CS, 20 degree breaks CSBP, PR, S, NH CSBP, PR, S, 5mm spacing	
						13.0	10.0		Hole Terminated at 9.80 m Target					
						12.5	10.5							
						12.0	11.0							
						11.5	11.5							

Method
AS - Auger Screwing
WB - Washbore
HQ3 - HQ3 Core Barrel
NQ3 - NQ3 Core Barrel

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Support
T - Timbering

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Weathering
FR - Fresh
SW - Slightly Weathered
DW - Distinctly Weathered
XW - Extremely Weathered
RS - Residual Soil

Strength
(indirect tensile strength)
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Core Recovery BH101

Start Core at 7.0m depth
EOH at 9.8m Depth

revision	description	drawn	approved	date
	Core recovery	XJ	KEG	3/03/2023

N

TERRA INSIGHT

scale	NTS
original size	**A3**

client: **Shoalhaven City Council**

project: **Geotechnical Investigation Brooman Road Bridge at Boondobah Creek & The River Road Bridge at Bridge Creek**

title: **Recovered Core**

project no: **TERRA23-007**

figure no: **FIGURE C1**

TERRA INSIGHT

Borehole No.
BH102
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	250246.3 m E 6072398.8 m N MGA94 Zone 56	Checked By:	XJ

Drill Model and Mounting: 1.8t excavator | Inclination: -90° | RL Surface: 23.00 m
Hole Diameter: | Bearing: | Datum: AHD | Operator:

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description: Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm (Virtual Refusal)	Structure and Additional Observations
AD/T			Not Encountered	B1 0.00-0.40 m					CL-CI	Sandy CLAY: low to medium plasticity, brown, fine to medium sand, with gravel Encountered to 1.0m adjacent to borehole	M	St	5 7 6	FILL
									CI	Silty CLAY: medium plasticity, yellow brown	D	St	3 3 5 5	
						22.0	1		SM	Silty SAND: fine to medium sand, dark brown, low plasticity fines, trace of organics	D	L	5 3 5 3 2	TOPSOIL ALLUVIAL SOIL
				S1 1.20-1.50 m					CI	Silty CLAY: medium plasticity, yellow brown, white mottled, trace of fine angular gravels	D	F	2 2 3 2 5 3 3	RESIDUAL SOIL
						21.0	2					St	4 6 11 12 7 6 9	
						20.0	3		CL	Sandy Silty CLAY: low plasticity, yellow brown, trace of white mottling, low plasticity, trace of fine angular gravels, some bands of white clay recovery	D - M	VSt - H	15 13 16 12 22 30	RESIDUAL SOIL EXTREMELY WEATHERED MATERIAL
						19.0	4							
						18.0	5			Hole Terminated at 4.10 m Refusal (XWM)				

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Borehole No.
EXP101
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	250234.8 m E 6072387.6 m N MGA94 Zone 56	Checked By:	XJ
Drill Model and Mounting:		Inclination: -90°	RL Surface: 24.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator:

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description: Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
X			Not Encountered	B1 0.20-0.40 m		23.0	0		CL	Sandy CLAY: low plasticity, brown, fine to coarse sand, with quartz fine to medium rounded gravels	M	S - F		TOPSOIL
									CI	Silty CLAY: medium plasticity, yellow and white mottled	M	F		RESIDUAL SOIL
AD/T									CL	Sandy Silty CLAY: low plasticity yellow brown/orange brown, fine to medium sand	D - M	F - St VSt - H		EXTREMELY WEATHERED MATERIAL
						22.0	1			Hole Terminated at 1.00 m End of Exposure				
						21.0	2							
						20.0	3							
						19.0	4							
							5							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
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M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

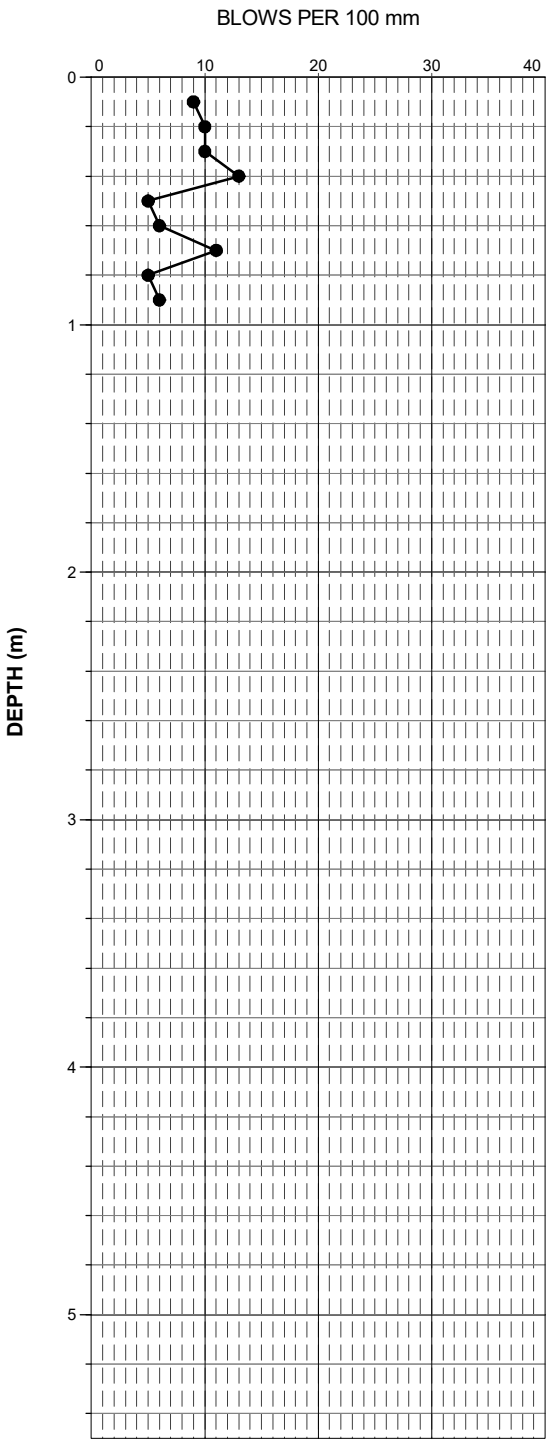
TERRA INSIGHT

9 KG DYNAMIC CONE PENETROMETER

Hole ID **BH101**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 1
CONTRACTOR	:	EASTING	: 250261.4 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6072400.2 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 23.00 m AHD		

DEPTH (m)	NO OF BLOWS PER 100 mm
0.10	9
0.20	10
0.30	10
0.40	13
0.50	5
0.60	6
0.70	11
0.80	5
0.90	6



Final Depth (m)	0.80

RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	Target
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

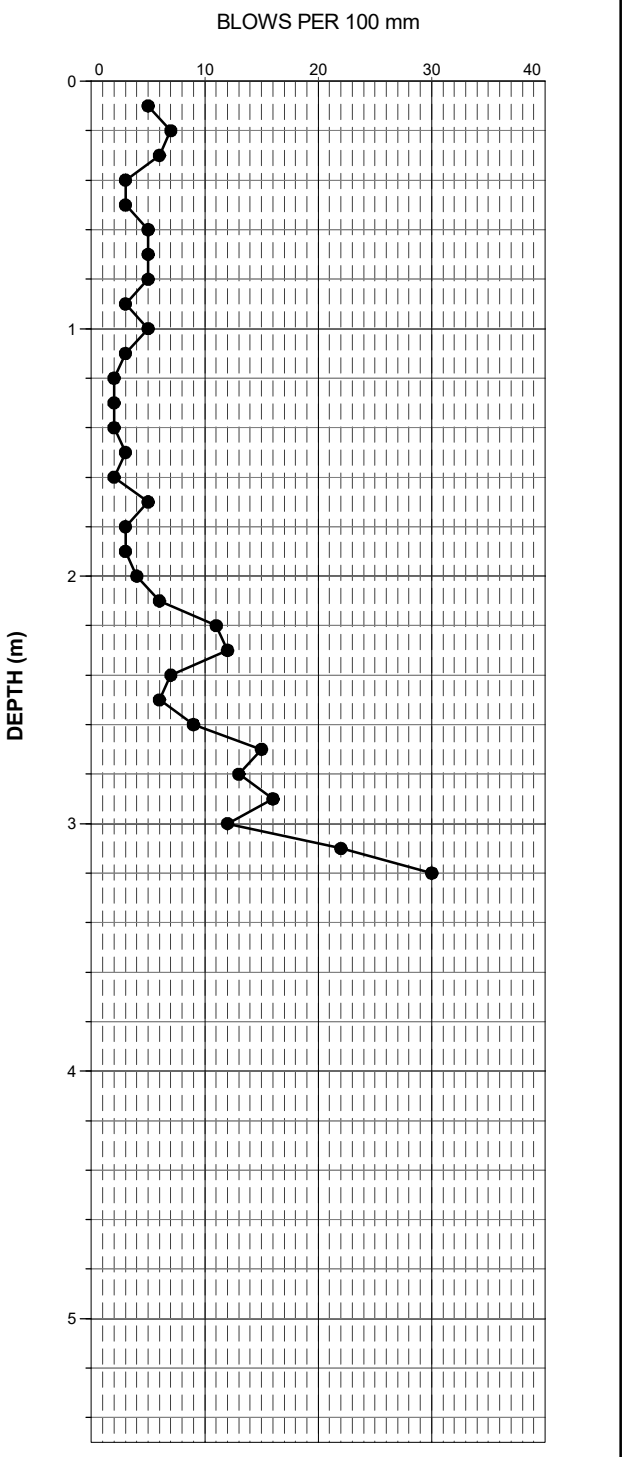
TERRA INSIGHT

9 KG DYNAMIC CONE PENETROMETER

Hole ID **BH102**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 1
CONTRACTOR	:	EASTING	: 250246.3 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6072398.8 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 23.00 m AHD		

DEPTH (m)	NO OF BLOWS PER 100 mm
0.10	5
0.20	7
0.30	6
0.40	3
0.50	3
0.60	5
0.70	5
0.80	5
0.90	3
1.00	5
1.10	3
1.20	2
1.30	2
1.40	2
1.50	3
1.60	2
1.70	5
1.80	3
1.90	3
2.00	4
2.10	6
2.20	11
2.30	12
2.40	7
2.50	6
2.60	9
2.70	15
2.80	13
2.90	16
3.00	12
3.10	22
3.20	30



Final Depth (m)	3.10

RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	Virtual Refusal
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

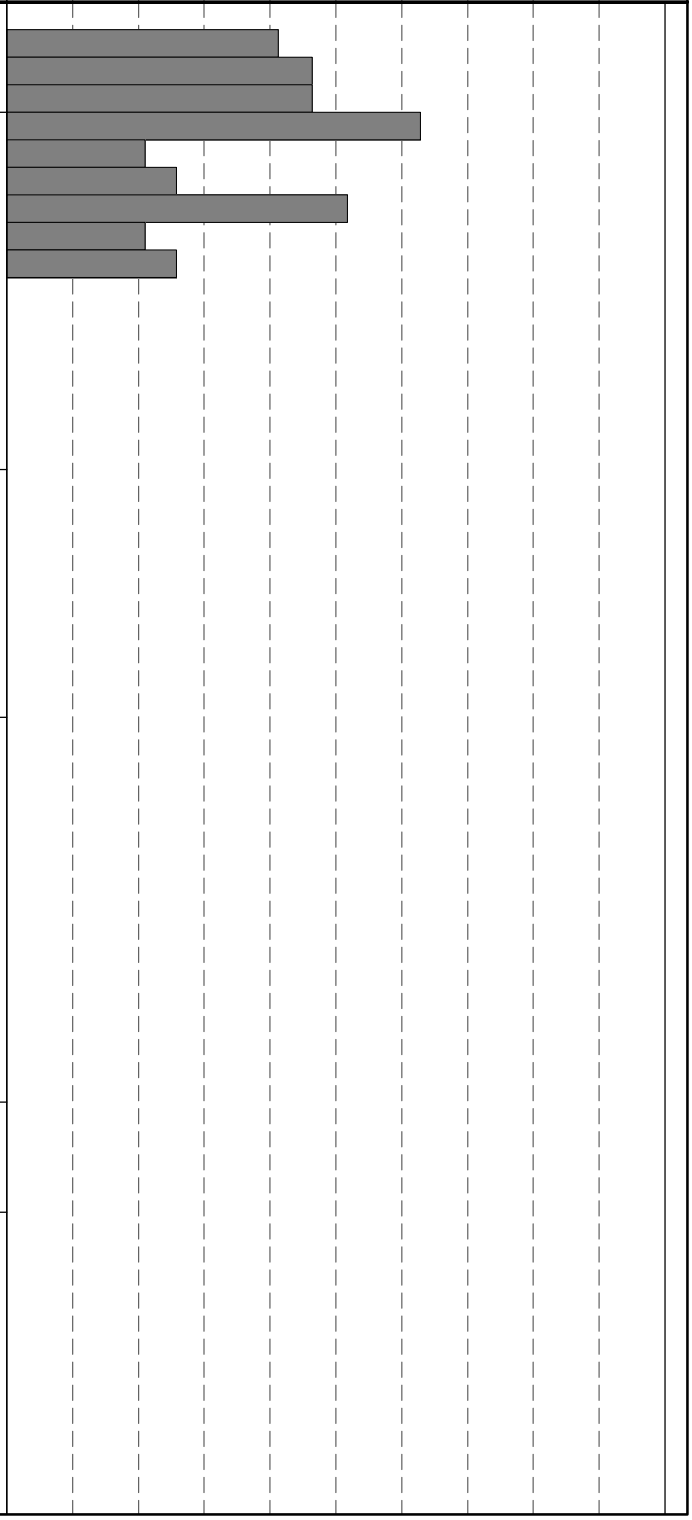
TERRA INSIGHT

Hole ID **BH101**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 2
CONTRACTOR	:	EASTING	: 250261.4 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6072400.2 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 23.00 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T	2.6 mbgl , 03/02/23	0.0	23.0		Clayey Gravelly SAND: fine to medium sand, brown/yellow brown, lo plasticity fines, fine to medium angular gravel
		0.5	22.5		Sandy CLAY: low plasticity, brown, fine to medium sand, with fine to medium angular gravels and quartz gravels (appears sandy, workable when moist)
		1.0	22.0		
		1.5	21.5		
		2.0	21.0		Silty Clayey SAND: fine to medium sand, brown/light brown, low plasticity fines
		2.5	20.5		Silty SAND: fine sand, brown/light brown, trace of orange mottles, low plasticity, with clay
		3.0	20.0		
		3.5	19.5		
		4.0	19.0		SAND: coarse quartz sand, white, with fine angular gravels
		4.5	18.5		Silty CLAY: medium to high plasticity, white and yellow/orange mottled
		5.0	18.0		

Interpreted CBR Results from Austroads



RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

TERRA INSIGHT

Hole ID **BH101**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 2 OF 2
CONTRACTOR	:	EASTING	: 250261.4 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6072400.2 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 23.00 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T		0	23.0		Silty CLAY: medium to high plasticity, white and grey banded
WB		6.0	17.0		
		6.5	16.5		
		7.0	16.0		Hole Terminated at 7.00 m Core commenced
		7.5	15.5		
		8.0	15.0		
		8.5	14.5		
		9.0	14.0		
		9.5	13.5		
		10.0	13.0		
		10.5	12.5		

Interpreted CBR Results from Austroads

0 5 10 15 20 25 30 35 40 45 50

RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

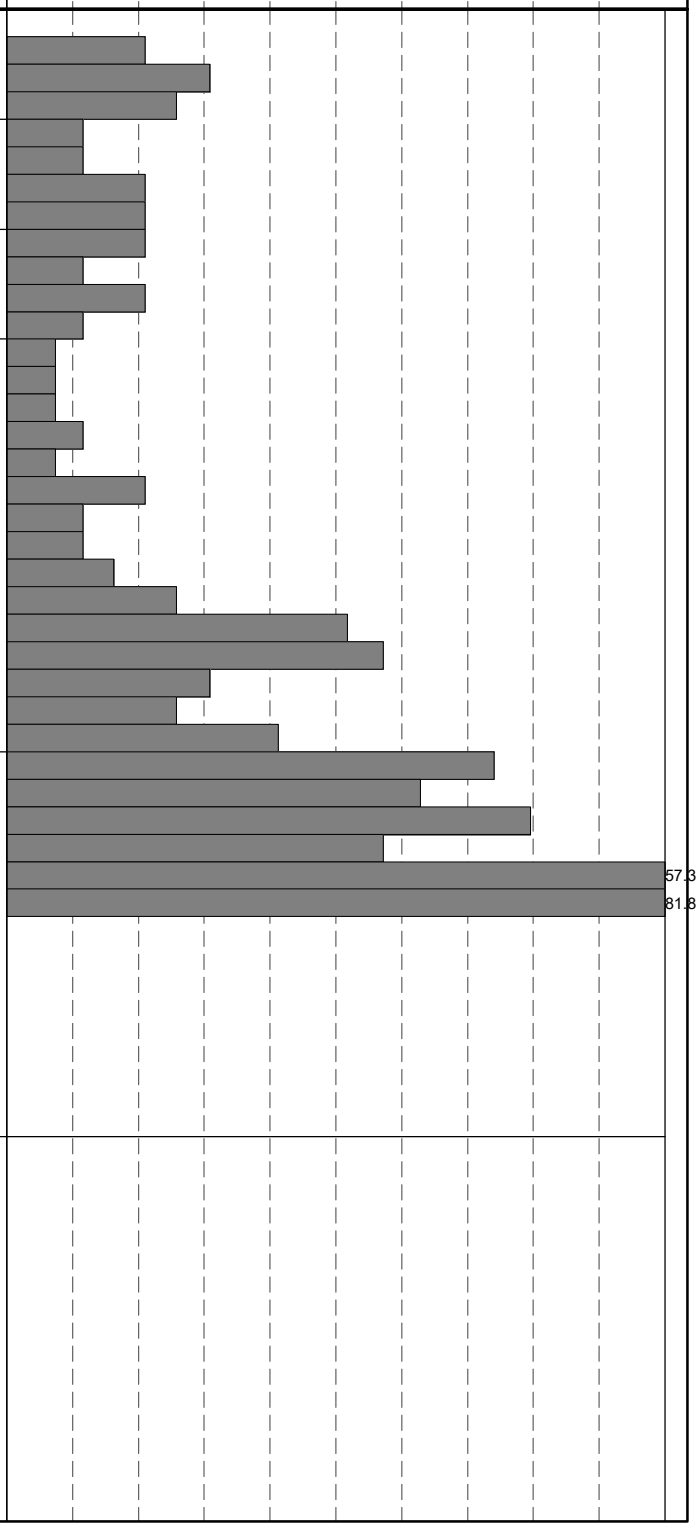
TERRA INSIGHT

Hole ID **BH102**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 1
CONTRACTOR	:	EASTING	: 250246.3 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6072398.8 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 23.00 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T	Not Encountered	0.0	23.0		Sandy CLAY: low to medium plasticity, brown, fine to medium sand, with gravel
		0.5	22.5		Silty CLAY: medium plasticity, yellow brown
		1.0	22.0		Silty SAND: fine to medium sand, dark brown, low plasticity fines, trace of organics
		1.5	21.5		Silty CLAY: medium plasticity, yellow brown, white mottled, trace of fine angular gravels
		2.0	21.0		
		2.5	20.5		
		3.0	20.0		Sandy Silty CLAY: low plasticity, yellow brown, trace of white mottling, low plasticity, trace of fine angular gravels, some bands of white clay recovery
		3.5	19.5		
		4.0	19.0		Hole Terminated at 4.10 m Refusal (XWM)
		4.5	18.5		
		5.0	18.0		

Interpreted CBR Results from Austroads



RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

TERRA INSIGHT

Borehole No.
BH201
Page 1 of 3

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	247393.4 m E 6065972.9 m N MGA94 Zone 56	Checked By:	XJ

Drill Model and Mounting:	Drill Rig	Inclination:	-90°	RL Surface:	7.00 m		
Hole Diameter:		Bearing:		Datum:	AHD	Operator:	

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
AD/T			2.8 mbgl , 03/02/23	SPT 1.00 m 4, 4, 4 N=8		6.0	1		GC	Clayey Sandy GRAVEL: fine to coarse angular gravel, light orange brown, fine to coarse sand, with cobbles	D - M	MD - D		BASECOURSE
									CL	Gravelly Sandy CLAY: low plasticity, light orange brown, fine to medium sand	D - M	F		FILL
				SPT 2.50 m 1, 2, 2 N=4		5.0	2		CL-ML	Clayey SILT/Silty CLAY: low plasticity grey brown to dark brown, trace orange mottling, with fine sand	M	S		ALLUVIAL SOIL
									ML	Clayey SILT: low plasticity, brown, orange mottled, with sand, trace of carbonaceous material	M - W	S		
						4.0	3		CL-ML	Sandy Silty CLAY/Sandy Clayey SILT: low plasticity, brown with grey mottles, fine sand				
				SPT 4.00 m 2, 2, 1 N=3		3.0	4				W	S		
						2.0	5							
										SILTSTONE: very low strength, extremely weathered, blue, friable to Sandy SILT	D - M	H		EXTREMELY WEATHERED MATERIAL

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	247393.4 m E 6065972.9 m N MGA94 Zone 56	Checked By:	XJ
Drill Model and Mounting:	Drill Rig	Inclination: -90°	RL Surface: 7.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator:

Drilling Information									Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
AD/T				SPT 5.50 m 14, 15, 20 N=35		1.0	6			SILTSTONE: very low strength, extremely weathered, blue, friable to Sandy SILT *(continued)*	D - M	H		EXTREMELY WEATHERED MATERIAL
						0.0	7			Continued on cored borehole sheet				
						-1.0	8							
						-2.0	9							
						-3.0	10							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Cored Borehole No.

BH201 (cored)

Engineering Log - Cored Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	247393.4 m E 6065972.9 m N MGA94 Zone 56	Checked By:	XJ

Drill Model and Mounting:	Drill Rig	Inclination:	-90°	RL Surface:	7.00 m
Barrel Type and Length:		Bearing:		Datum: AHD	Operator:

Drilling Information								Rock Substance				Rock Mass Defects	
Method	Support	Water	TCR (%)	SCR (%)	RQD (%)	RL (m)	Depth (m)	Graphic Log	Material Description rock type: grain characteristics, colour, structure, minor components	Weathering	Strength Is(50) ● - Axial ○ - Diametral VL L M H VH EH	Average Defect Spacing (mm) 30 100 300 1000 3000	Defect Description thickness, type, inclination, planarity, roughness, coating/infilling Particular / General
									Continued from non-cored borehole sheet				
NQ3					50	0.5	6.5		SILTSTONE: grey to light grey, slight blue tinge, thinly bedded, some 70 degree joints, weathered and crushed seams	SW			XS JT, 60°, CN, PR, RF
						0.0	7.0			XW			CS JT, 70°, CN, PR, RF
						-0.5	7.5		CORE LOSS	SW			JTDB, CN, IR, RF
						-1.0	8.0		Sandy SILTSTONE: light brown, some near horizontal 60 degree joints and crushed seams	XW - HW SW			JT, 30°, CN, PR, RF JT, Fe SN, PR, RF, NH CS CS
						-1.5	8.5		Hole Terminated at 8.50 m Target				

Method
AS - Auger Screwing
WB - Washbore
HQ3 - HQ3 Core Barrel
NQ3 - NQ3 Core Barrel

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Support
T - Timbering

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Weathering
FR - Fresh
SW - Slightly Weathered
DW - Distinctly Weathered
XW - Extremely Weathered
RS - Residual Soil

Strength (indirect tensile strength)
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Core Recovery BH201

Start Core at 6.5m depth
EOH at 8.5m Depth

revision	description	drawn	approved	date
	Core recovery	XJ	KEG	3/03/2023

N

TERRA INSIGHT

scale	NTS
original size	**A3**

client: **Shoalhaven City Council**

project: **Geotechnical Investigation Brooman Road Bridge at Boondobah Creek & The River Road Bridge at Bridge Creek**

title: **Recovered Core**

project no: **TERRA23-007**

figure no: **FIGURE: C2**

TERRA INSIGHT

Borehole No.
BH202
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	247385.2 m E 6065990.3 m N MGA94 Zone 56	Checked By:	XJ
Drill Model and Mounting:	1.8t excavator	Inclination: -90°	RL Surface: 7.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator:

Drilling Information									Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm (Target)	Structure and Additional Observations
AD/T			2.8 mbgl , 03/02/23	S1 2.00-3.00 m S2 3.30-4.00 m		6.0 5.0 4.0 3.0 2.0	1 2 3 4 5		GW	GRAVEL: fine to medium angular gravel, grey	D	VL	1	BASECOURSE
									CL-Cl	Gravelly Sandy CLAY: low to medium plasticity, yellow/orange brown, fine to coarse gravel	M	St	4 3 6 7 6 3 3 3	FILL
									CL-ML	Clayey SILT/Silty CLAY: low plasticity, brown, with fine sand	W	S F	0 0 0 3 3 3 3 5 5 5 4 4 4 5 5 3 5 5 5 5 5 6 9	ALLUVIAL SOIL
									CI	Silty CLAY: medium to high plasticity, brown	M - W	VSt	10 9 8 10 14 13 16 15 15 10 11	RESIDUAL SOIL
									CL	Gravelly CLAY: low plasticity, brown, fine to medium angular gravels	M	H		EXTREMELY WEATHERED MATERIAL
										Hole Terminated at 5.30 m Refusal (XWM)				

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Plastic Limit
< PL
= PL
< PL

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

TERRA INSIGHT

Borehole No.
BH203
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	247378.9 m E 6065987.1 m N MGA94 Zone 56	Checked By:	XJ
Drill Model and Mounting:	1.8t excavator	Inclination: -90°	RL Surface: 7.00 m
Hole Diameter:		Bearing:	Datum: AHD Operator:

Drilling Information									Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm (Target)	Structure and Additional Observations
AD/T			Not Encountered	B1 0.10-1.00 m		6.0	1		CL	Sandy CLAY: low plasticity, dark brown, fine to medium sand, with gravel	M	S	1	TOPSOIL
									CL	Sandy CLAY: low plasticity, brown, fine to medium sand, with gravel	M	St	1 4 6 7 6 7 7 7	COLLUVIAL SOIL
						5.0	2							
						4.0	3							
						3.0	4							
						2.0	5			Hole Terminated at 1.00 m Target				

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

TERRA INSIGHT

Borehole No.
EXP201
Page 1 of 1

Engineering Log - Borehole

Project No.: TERRA23-007

Client:	Shoalhaven City Council	Commenced:	03/02/2023
Project Name:	Geotechnical Investigation	Completed:	03/02/2023
Hole Location:	Brooman Road & The River Road Bridge	Logged By:	XJ
Hole Position:	247379.8 m E 6065996.5 m N MGA94 Zone 56	Checked By:	XJ

Drill Model and Mounting: | Inclination: -90° | RL Surface: 7.00 m
Hole Diameter: | Bearing: | Datum: AHD | Operator:

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Group Symbol	Material Description Soil name, plasticity/grainsize characteristics, colour, description of secondary component. Minor components, i.e., some/trace . . . other soil substance observations	Moisture Condition	Consistency Relative Density	DCP NO OF BLOWS PER 100 mm	Structure and Additional Observations
X			Not Encountered						CL	Sandy CLAY: low plasticity, brown, fine to medium sand, with gravel	D - M	S - F		COLLUVIAL SOIL
						6.0	1			Hole Terminated at 0.50 m End of Exposure				
						5.0	2							
						4.0	3							
						3.0	4							
						2.0	5							

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
Fr - Friable
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

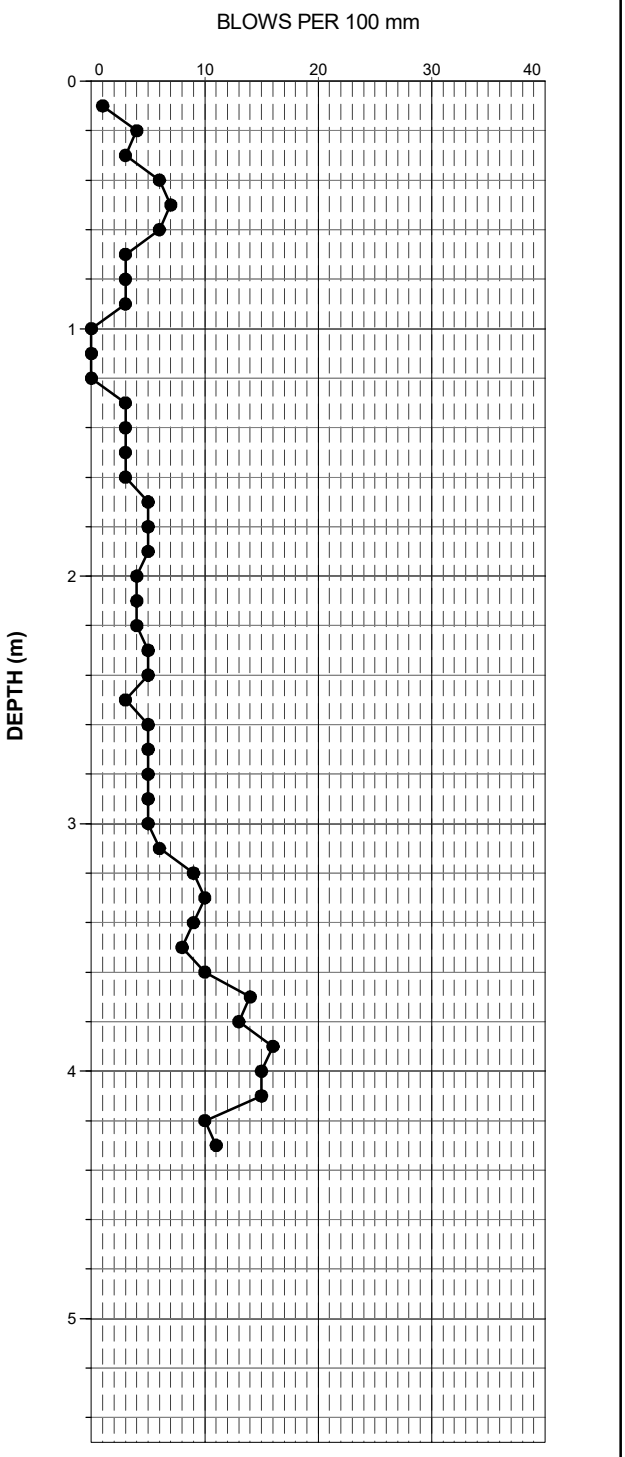
9 KG DYNAMIC CONE PENETROMETER

TERRA INSIGHT

Hole ID **BH202**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 1
CONTRACTOR	:	EASTING	: 247385.2 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6065990.3 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 7.00 m AHD		

DEPTH (m)	NO OF BLOWS PER 100 mm
0.10	1
0.20	4
0.30	3
0.40	6
0.50	7
0.60	6
0.70	3
0.80	3
0.90	3
1.00	0
1.10	0
1.20	0
1.30	3
1.40	3
1.50	3
1.60	3
1.70	5
1.80	5
1.90	5
2.00	4
2.10	4
2.20	4
2.30	5
2.40	5
2.50	3
2.60	5
2.70	5
2.80	5
2.90	5
3.00	5
3.10	6
3.20	9
3.30	10
3.40	9
3.50	8
3.60	10
3.70	14
3.80	13
3.90	16
4.00	15
4.10	15
4.20	10
4.30	11



Final Depth (m)	4.20

RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	Target
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

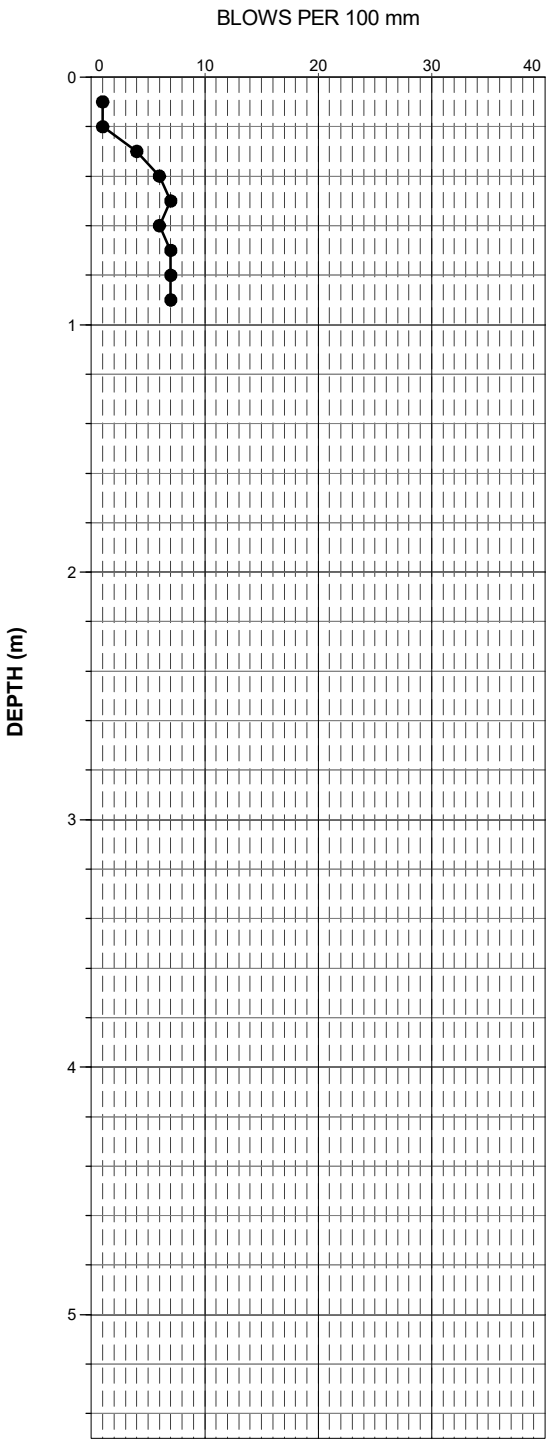
TERRA INSIGHT

9 KG DYNAMIC CONE PENETROMETER

Hole ID **BH203**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 1
CONTRACTOR	:	EASTING	: 247378.9 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6065987.1 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 7.00 m AHD		

DEPTH (m)	NO OF BLOWS PER 100 mm
0.10	1
0.20	1
0.30	4
0.40	6
0.50	7
0.60	6
0.70	7
0.80	7
0.90	7



Final Depth (m)	0.80

RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	Target
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

TERRA INSIGHT

Hole ID **BH202**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 1
CONTRACTOR	:	EASTING	: 247385.2 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6065990.3 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 7.00 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T	2.8 mbgl , 03/02/23	0.0	7.0		GRAVEL: fine to medium angular gravel, grey
		0.5	6.5		Gravelly Sandy CLAY: low to medium plasticity, yellow/orange brown, fine to coarse gravel
		1.0	6.0		Clayey SILT/Silty CLAY: low plasticity, brown, with fine sand
		1.5	5.5		
		2.0	5.0		
		2.5	4.5		
		3.0	4.0		
		3.5	3.5		Silty CLAY: medium to high plasticity, brown
		4.0	3.0		
		4.5	2.5		
		5.0	2.0		Gravelly CLAY: low plasticity, brown, fine to medium angular gravels
		5.3	1.7		Hole Terminated at 5.30 m Refusal (XWM)

Interpreted CBR Results from Austroads

0 5 10 15 20 25 30 35 40 45 50

RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

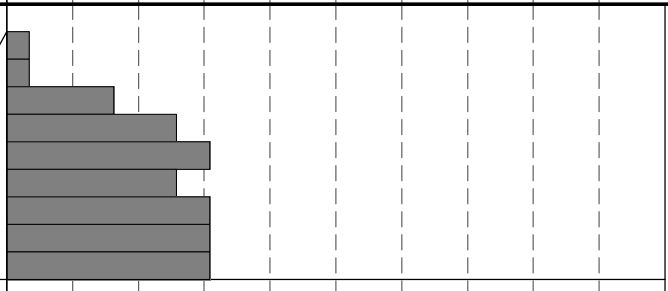
TERRA INSIGHT

Hole ID **BH203**

CLIENT	: Shoalhaven City Council	POSITION	:	SHEET	: 1 OF 1
CONTRACTOR	:	EASTING	: 247378.9 m	STATUS	:
PROJECT	: Geotechnical Investigation	NORTHING	: 6065987.1 m	LOGGED BY	: XJ
LOCATION	: Brooman Road & The River Road Bridge	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 03/02/2023
PROJECT No.	: TERRA23-007	GROUND RL	: 7.00 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T	Not Encountered	0.0	7.0		Sandy CLAY: low plasticity, dark brown, fine to medium sand, with gravel
		0.5	6.5		Sandy CLAY: low plasticity, brown, fine to medium sand, with gravel
		1.0	6.0		Hole Terminated at 1.00 m Target
		1.5	5.5		
		2.0	5.0		
		2.5	4.5		
		3.0	4.0		
		3.5	3.5		
		4.0	3.0		
		4.5	2.5		
		5.0	2.0		

Interpreted CBR Results from Austroads



RIG	:	CHECKED BY	: XJ	REMARK
INCLINATION	:	CHECKED DATE	: 06/03/2023	
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

Appendix E: Laboratory Certificates

ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

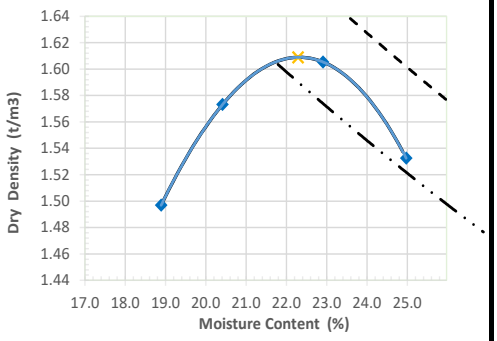
Report on AS CBR and MDD

Client:	Terra Insight (NSW)	Report No:	**78-422-CBR**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	16/02/2023
Project:	Geotechnical Testing	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used(Source):	-	Test Request/Order:	**TERRA23-007**
Material Description:	-	Lot Number:	-
Lot Boundaries:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 07/02/2023 to 16/02/2023	Control Line:	EXP101

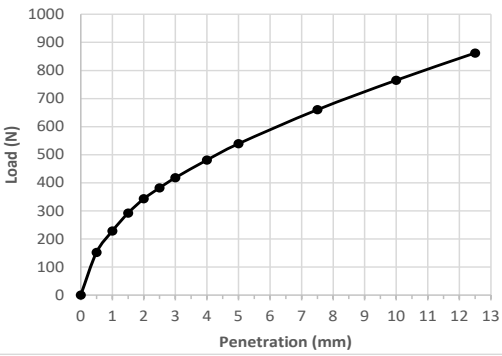
Sample Number	Sample Date	Chainage/Location	Offset	Level of Test	Test Depth
6038	-	-	-	**EXP101**	**0.2-0.4**

Parameters	Units	Test Results		Information
Pretreatment Regime	--	No Pretreatment		
Portion Retained on AS Sieve	%	1% on 19mm		Retained material excluded from CBR
Material Plasticity (Liquid Limit)	--	Sand / Granular		By Technician's Assessment
Sample Curing Time	hrs	MDD = 2 hrs	CBR = 71 hrs	
Soil Particle Density	t/m3	2.67		Estimated value only**
Maximum Dry Density (MDD)	t/m3	1.609		Standard compactive effort
Optimum Moisture Content (OMC)	%	22.3		
Field/Prep Moisture Content	%	Field 31.0 %	Prep 18.7 %	Passing 19.0mm portion
Compaction Moisture Content	%	Achieved 22.2 %	LMR = 99.5%	Specified LMR = 100%
Compaction Dry Density	t/m3	Achieved 1.59 t/m3	LDR = 98.5%	Specified LDR = 98%
Surcharge Load	kg	4.5		
Period of Soaking	Days	Soaked - 4 Days		Dry Density (after soaking) = 1.53 t/m3.
Specimen Swell	%	4.0		
Moisture Content - Top 30mm	%	27.8		After Penetration
Moisture Content - Remaining	%	23.6		After Penetration

Dry Density Vs Moisture Content



Load-Penetration Curve



Material CBR Value (%)

3.0

California Bearing Ratios

CBR $_{2.5}$ = 3.0

CBR $_{5.0}$ = 2.5

Including an Applied Correction of 0.0 mm

Sampling & Test Methods (Results relate only to the items sampled/tested)

Sampled by Customer: Results apply to the sample/s as received. **
AS 1289.1.1: (2001)Preparation of disturbed soil samples
AS1289.2.1.1: (2005) Moisture Content of a Soil (Oven Drying)
AS1289.5.1.1: (2017)Dry Density/Moisture content relation of a soil (Standard)
AS1289.6.1.1: (2014)California Bearing Ratio of a soil (remoulded specimen)

Report Remarks & Endorsement

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA Accreditation number: 20656

Issued By: L.Romano
L.Romano
Approved Signatory

**** NATA accreditation does not cover the performance of this service**

ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

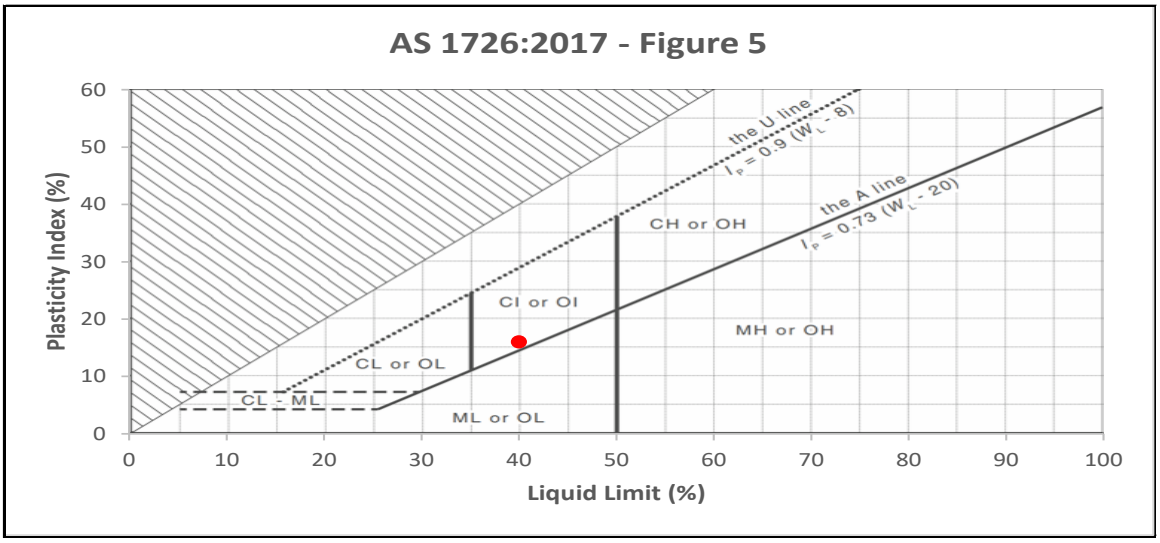
Report on Plastic Properties

Client:	Terra Insight (NSW)	Report No:	**422**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	13/02/2023
Project:	Geotechnical Testing	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used:	-	Test Request:	TERRA23-007
Material Description:	-	Lot Number:	-
Lot Comments:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 09/02/2023	Control Line:	EXP101

Sample Number	Sample Date	Chainage/Location	Offset	Level of Test	Test Depth
6038	**-**	**-**	**-**	**EXP101**	**0.2-0.4**

Specification Name	

Pretreatment	**Units**	**Result**	**Specification Limits**	**Remarks**
Retained 53.0mm Sieve	%			
Pretreatment by Weathering	--			
Pretreatment by Compaction	--			
Plasticity	**Units**	**Result**	**Specification Limits**	**Remarks**
Liquid Limit	%	**40**		Oven Dried & Dry Sieved
Plastic Limit	%	**24**		Oven Dried & Dry Sieved
Plastic Index	%	**16**		Oven Dried & Dry Sieved
Linear Shrinkage	%	**7.0**		Single/Straight Bar - Oven Dried & Dry Sieved



Sampling & Test Methods (Results relate only to the items sampled/tested)	**Report Remarks & Endorsement**
Sampled by Customer: Results apply to the sample/s as received. ** AS 1289.1.1: (2001)Preparation of disturbed soil samples for testing AS 1289.3.1.2: (2009)Liquid Limit, One point Casagrande AS 1289.3.2.1: (2009)Plastic Limit of a soil AS 1289.3.3.1: (2009)Plasticity Index of a soil AS 1289.3.4.1: (2008)Linear Shrinkage of a soil	

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA Accreditation number: 20656

Issued By: P.Baltoski
P.Baltoski
Approved Signatory

(NATA accreditation does not cover the performance of this service)**

ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

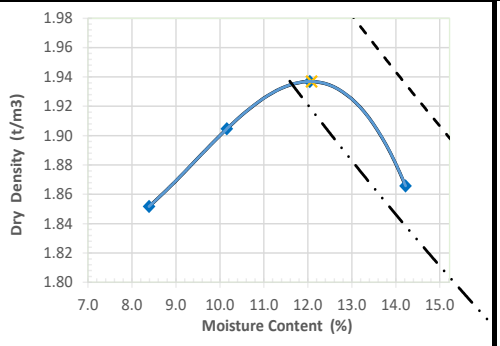
Report on AS CBR and MDD

Client:	Terra Insight (NSW)	Report No:	**78-423-CBR**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	16/02/2023
Project:	Geotechnical Testing	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used(Source):	-	Test Request/Order:	**TERRA23-007**
Material Description:	-	Lot Number:	-
Lot Boundaries:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 07/02/2023 to 16/02/2023	Control Line:	BH102

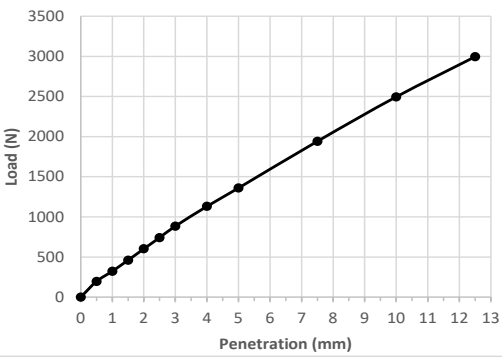
Sample Number	Sample Date	Chainage/Location	Offset	Level of Test	Test Depth
6039	-	-	-	**BH102**	**0.0-0.4**

Parameters	Units	Test Results		Information
Pretreatment Regime	--	No Pretreatment		
Portion Retained on AS Sieve	%	11% on 19mm		Retained material excluded from CBR
Material Plasticity (Liquid Limit)	--	Sand / Granular		By Technician's Assessment
Sample Curing Time	hrs	MDD = 2 hrs	CBR = 51 hrs	
Soil Particle Density	t/m3	2.67		Estimated value only**
Maximum Dry Density (MDD)	t/m3	1.937		Standard compactive effort
Optimum Moisture Content (OMC)	%	12.1		
Field/Prep Moisture Content	%	Field 8.8 %	Prep 10.4 %	Passing 19.0mm portion
Compaction Moisture Content	%	Achieved 12.5 %	LMR = 103.0%	Specified LMR = 100%
Compaction Dry Density	t/m3	Achieved 1.91 t/m3	LDR = 98.5%	Specified LDR = 98%
Surcharge Load	kg	4.5		
Period of Soaking	Days	Soaked - 4 Days		Dry Density (after soaking) = 1.91 t/m3.
Specimen Swell	%	0.0		
Moisture Content - Top 30mm	%	13.8		After Penetration
Moisture Content - Remaining	%	13.0		After Penetration

Dry Density Vs Moisture Content



Load-Penetration Curve



Material CBR Value (%)

7

California Bearing Ratios

CBR $_{2.5}$ = 6

CBR $_{5.0}$ = 7

Including an Applied Correction of 0.0 mm

Sampling & Test Methods (Results relate only to the items sampled/tested)

Sampled by Customer: Results apply to the sample/s as received. **
AS 1289.1.1: (2001)Preparation of disturbed soil samples
AS1289.2.1.1: (2005) Moisture Content of a Soil (Oven Drying)
AS1289.5.1.1: (2017)Dry Density/Moisture content relation of a soil (Standard)
AS1289.6.1.1: (2014)California Bearing Ratio of a soil (remoulded specimen)

Report Remarks & Endorsement

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA Accreditation number: 20656

Issued By: L.Romano
L.Romano
Approved Signatory

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ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

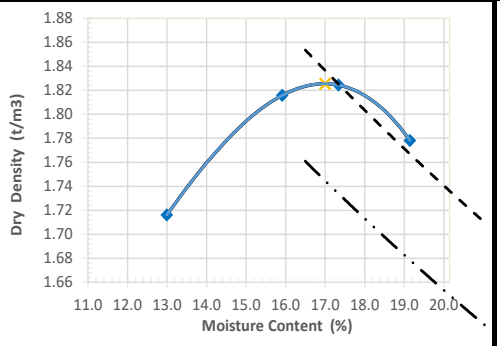
Report on AS CBR and MDD

Client:	Terra Insight (NSW)	Report No:	**78-424-CBR**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	17/02/2023
Project:	Geotechnical Testing	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used(Source):	-	Test Request/Order:	**TERRA23-007**
Material Description:	-	Lot Number:	-
Lot Boundaries:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 07/02/2023 to 17/02/2023	Control Line:	BH202

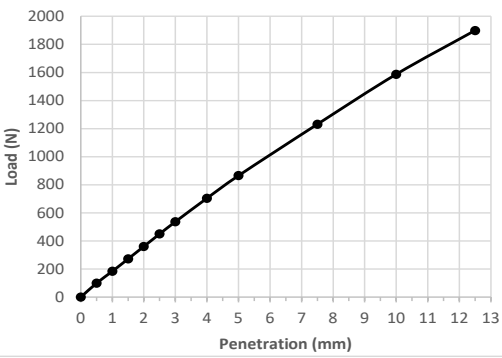
Sample Number	Sample Date	Chainage/Location	Offset	Level of Test	Test Depth
6040	-	-	-	**BH202**	**0.1-0.6**

Parameters	Units	Test Results		Information
Pretreatment Regime	--	No Pretreatment		
Portion Retained on AS Sieve	%	10% on 19mm		Retained material excluded from CBR
Material Plasticity (Liquid Limit)	--	Low (Less than 35%)		By Technician's Assessment
Sample Curing Time	hrs	MDD = 24 hrs	CBR = 71 hrs	
Soil Particle Density	t/m3	2.67		Estimated value only**
Maximum Dry Density (MDD)	t/m3	1.825		Standard compactive effort
Optimum Moisture Content (OMC)	%	17.0		
Field/Prep Moisture Content	%	Field 16.1 %	Prep 16.1 %	Passing 19.0mm portion
Compaction Moisture Content	%	Achieved 16.8 %	LMR = 99.0%	Specified LMR = 100%
Compaction Dry Density	t/m3	Achieved 1.81 t/m3	LDR = 99.0%	Specified LDR = 98%
Surcharge Load	kg	4.5		
Period of Soaking	Days	Soaked - 4 Days		Dry Density (after soaking) = 1.80 t/m3.
Specimen Swell	%	0.5		
Moisture Content - Top 30mm	%	17.8		After Penetration
Moisture Content - Remaining	%	17.2		After Penetration

Dry Density Vs Moisture Content



Load-Penetration Curve



Material CBR Value (%)

4.5

California Bearing Ratios

CBR $_{2.5}$ = 3.5

CBR $_{5.0}$ = 4.5

Including an Applied Correction of 0.0 mm

Sampling & Test Methods (Results relate only to the items sampled/tested)

Sampled by Customer: Results apply to the sample/s as received. **
AS 1289.1.1: (2001)Preparation of disturbed soil samples
AS1289.2.1.1: (2005) Moisture Content of a Soil (Oven Drying)
AS1289.5.1.1: (2017)Dry Density/Moisture content relation of a soil (Standard)
AS1289.6.1.1: (2014)California Bearing Ratio of a soil (remoulded specimen)

Report Remarks & Endorsement

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA Accreditation number: 20656

Issued By: P.Baltoski
P.Baltoski
Approved Signatory

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ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

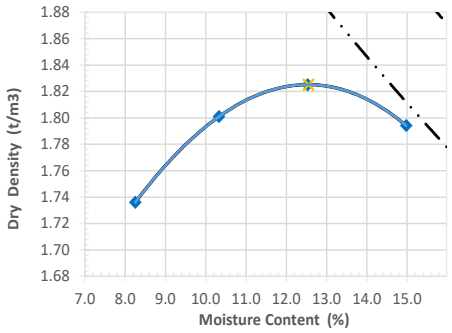
Report on AS CBR and MDD

Client:	Terra Insight (NSW)	Report No:	**78-425-CBR**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	17/02/2023
Project:	Geotechnical Testing	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used(Source):	-	Test Request/Order:	**TERRA23-007**
Material Description:	-	Lot Number:	-
Lot Boundaries:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 07/02/2023 to 17/02/2023	Control Line:	BH203

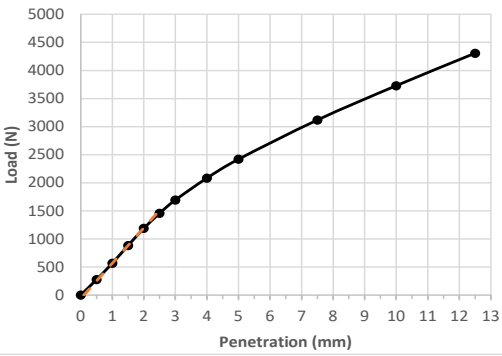
Sample Number	Sample Date	Chainage/Location	Offset	Level of Test	Test Depth
6041	**-**	**-**	**-**	**BH203**	**0.1-0.6**

Parameters	Units	Test Results		Information
Pretreatment Regime	--	No Pretreatment		
Portion Retained on AS Sieve	%	1% on 19mm		Retained material excluded from CBR
Material Plasticity (Liquid Limit)	--	Sand / Granular		By Technician's Assessment
Sample Curing Time	hrs	MDD = 2 hrs	CBR = 71 hrs	
Soil Particle Density	t/m3	2.67		Estimated value only**
Maximum Dry Density (MDD)	t/m3	1.825		Standard compactive effort
Optimum Moisture Content (OMC)	%	12.5		
Field/Prep Moisture Content	%	Field 10.9 %	Prep 10.9 %	Passing 19.0mm portion
Compaction Moisture Content	%	Achieved 13 %	LMR = 104.0%	Specified LMR = 100%
Compaction Dry Density	t/m3	Achieved 1.8 t/m3	LDR = 98.5%	Specified LDR = 98%
Surcharge Load	kg	4.5		
Period of Soaking	Days	Soaked - 4 Days		Dry Density (after soaking) = 1.77 t/m3.
Specimen Swell	%	1.5		
Moisture Content - Top 30mm	%	16.4		After Penetration
Moisture Content - Remaining	%	15.2		After Penetration

Dry Density Vs Moisture Content



Load-Penetration Curve



Material CBR Value (%)

12

California Bearing Ratios

CBR $_{2.5}$ = 11

CBR $_{5.0}$ = 12

Including an Applied Correction of 0.1 mm

Sampling & Test Methods (Results relate only to the items sampled/tested)

Sampled by Customer: Results apply to the sample/s as received. **
AS 1289.1.1: (2001)Preparation of disturbed soil samples
AS1289.2.1.1: (2005) Moisture Content of a Soil (Oven Drying)
AS1289.5.1.1: (2017)Dry Density/Moisture content relation of a soil (Standard)
AS1289.6.1.1: (2014)California Bearing Ratio of a soil (remoulded specimen)

**** NATA accreditation does not cover the performance of this service**

Report Remarks & Endorsement

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA Accreditation number: 20656

Issued By: P.Baltoski
P.Baltoski
Approved Signatory

ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

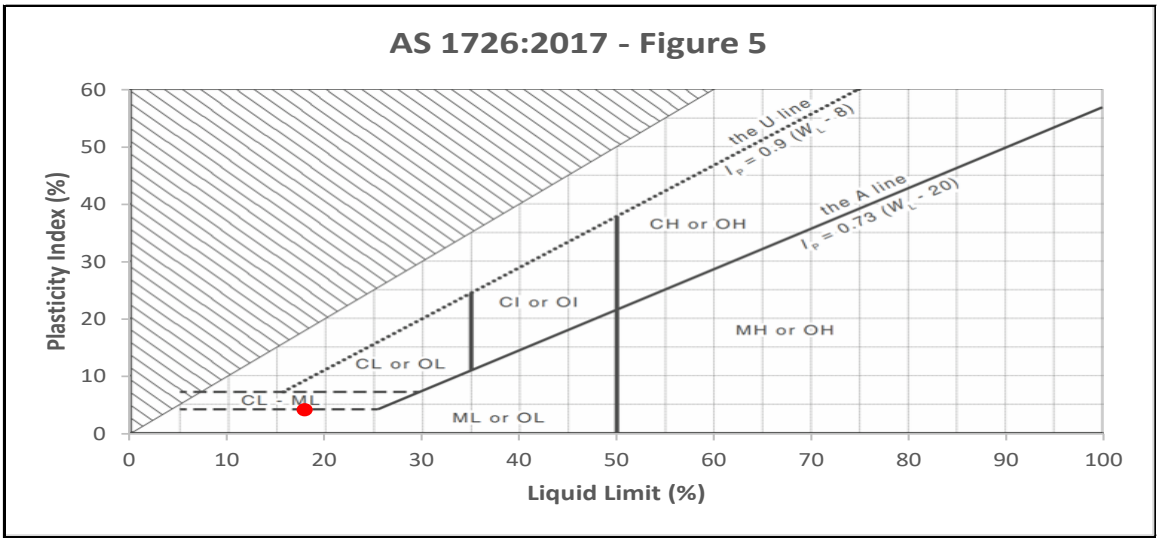
Report on Plastic Properties

Client:	Terra Insight (NSW)	Report No:	**426**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	13/02/2023
Project:	Geotechnical Testing	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used:	-	Test Request:	TERRA23-007
Material Description:	-	Lot Number:	-
Lot Comments:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 09/02/2023	Control Line:	BH202

Sample Number	Sample Date	Chainage/Location	Offset	Level of Test	Test Depth
6042	**-**	**-**	**-**	**BH202**	**2.0-3.0**

Specification Name	

Pretreatment	**Units**	**Result**	**Specification Limits**	**Remarks**
Retained 53.0mm Sieve	%			
Pretreatment by Weathering	--			
Pretreatment by Compaction	--			
Plasticity	**Units**	**Result**	**Specification Limits**	**Remarks**
Liquid Limit	%	**18**		Oven Dried & Dry Sieved
Plastic Limit	%	**14**		Oven Dried & Dry Sieved
Plastic Index	%	**4**		Oven Dried & Dry Sieved
Linear Shrinkage	%	**2.0**		Cracked/Broken Bar - Oven Dried & Dry Sieved



Sampling & Test Methods (Results relate only to the items sampled/tested)	Report Remarks & Endorsement
Sampled by Customer: Results apply to the sample/s as received. ** AS 1289.1.1: (2001)Preparation of disturbed soil samples for testing AS 1289.3.1.2: (2009)Liquid Limit, One point Casagrande AS 1289.3.2.1: (2009)Plastic Limit of a soil AS 1289.3.3.1: (2009)Plasticity Index of a soil AS 1289.3.4.1: (2008)Linear Shrinkage of a soil	

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA Accreditation number: 20656

Issued By: P.Baltoski
P.Baltoski
Approved Signatory

(NATA accreditation does not cover the performance of this service)**

ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

Report on Rock Core Testing

Client:	**Terra Insight (NSW)**	Report No:	**427**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	6/02/2023
Project:	**Geotechnical Testing**	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used:	-	Test Request:	TERRA23-007
Material Description:	-	Lot Number:	-
Lot Comments:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 03/02/2023	Control Line:	BH201
Sample Date:		**Sample Number:**	**6043**

Point Load Strength Index	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Specimen 6	Specimen 7	Specimen 8	Specimen 9	Specimen 10
Client ID Number										
Borehole	**BH201**	**BH201**	**BH201**	**BH201**	**BH201**	**BH201**	**BH201**	**BH201**	**BH201**	**BH201**
Depth	**6.54m**	**6.54m**	**7.13m**	**7.13m**	**7.69m**	**7.69m**	**7.9m**	**7.9m**	**8.30m**	**8.30m**
Lithological Description	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary
Moisture Condition	Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Test Type	Diametral	Axial	Diametral	Axial	Diametral	Axial	Diametral	Axial	Diametral	Axial
Anisotropic Direction										
Failure Mode	1	2	1	2	1	2	1	2	1	2
Failure Sketch										
Uncorrected Strength (Mpa)	0.98	0.26	0.50	0.36	0.14	0.06	1.4	0.46	1.5	0.31
Point Load Strength Index (Mpa)	**0.94**	**0.28**	**0.49**	**0.36**	**0.14**	**0.06**	**1.2**	**0.47**	**1.5**	**0.33**
Descriptive Strength (AS1726, Table 19)	Medium	Low	Medium	Medium	Low	Very Low	High	Medium	High	Medium
UCS [AS1726, Table 19] (MPa)	6 to 20	2 to 6	6 to 20	6 to 20	2 to 6	0.6 to 2	20 to 60	6 to 20	20 to 60	6 to 20
Comments										

MEAN VALUE - Point Load Strength Index (Mpa)	**Normal Direction**	-	**Parallel Direction**	-	**Strength Anisotropy Index [Ia(50)] (Mpa)**	-

Sampling & Test Methods (Results relate only to the items sampled/tested)

Sampled by Client: Results apply to the sample/s as received. **
Client: Test specimens selected by the client.
As Received: Samples stored & Tested in as received condition.
AS4133.4.1: (2007) Determination of Point Load Index

(NATA accreditation does not cover the performance of this service)**

Point Load - Failure Mode Descriptions

1	Fracture through fabric, oblique to banding.
2	Fracture along banding.
3	Fracture through rock mass.
4J	Fracture influenced by Joint Plane.
4M	Fracture influenced by Micro-fracture.
4F	Fracture influenced by Foliation.
4V	Fracture influenced by Vein.
5	Invalid Result (Partial fracture, or chip).

Report Endorsement

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NATA Accreditation number: 20656

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Approved Signatory

WB62 - Rev 8, 09/09/2022

ASCT Illawarra
Postal: 2/15 Miall Way, Albion Park Rail NSW 2527
Lab: 2/15 Miall Way, Albion Park Rail NSW 2527
Telephone: +61 (02) 4256 1684
E-Mail: illawarra@asct.com.au
Mobile: 0497 979 929
A.B.N. 34 635 062 609

Report on Rock Core Testing

Client:	**Terra Insight (NSW)**	Report No:	**428**
Client Address:	Unit 34 / 10-12 Sylvester Avenue Unanderra NSW 2526	Report Date:	6/02/2023
Project:	**Geotechnical Testing**	Report Page:	Page 1 of 1
Works Component:	Bridge Sites, Brooman, NSW	Project No:	78
Material Used:	-	Test Request:	TERRA23-007
Material Description:	-	Lot Number:	-
Lot Comments:	-	ITP/PCP Number:	-
Lab Test Date/s:	Laboratory testing 03/02/2023	Control Line:	BH101
Sample Date:		**Sample Number:**	**6044**

Point Load Strength Index	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Specimen 6	Specimen 7	Specimen 8	Specimen 9	Specimen 10
Client ID Number										
Borehole	**BH101**	**BH101**	**BH101**	**BH101**	**BH101**	**BH101**	**BH101**	**BH101**	**BH101**	**BH101**
Depth	**7.07m**	**7.07m**	**7.43m**	**7.43m**	**8.07m**	**8.07m**	**8.57m**	**8.57m**	**8.86m**	**8.86m**
Lithological Description	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary
Moisture Condition	Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Test Type	Diametral	Axial	Diametral	Axial	Diametral	Axial	Diametral	Axial	Diametral	Axial
Anisotropic Direction										
Failure Mode	2	1	2	1	2	1	2	1	2	1
Failure Sketch										
Uncorrected Strength (Mpa)	0.18	0.39	0.26	0.07	0.28	0.88	0.40	0.32	0.05	0.25
Point Load Strength Index (Mpa)	**0.18**	**0.37**	**0.24**	**0.08**	**0.27**	**0.87**	**0.39**	**0.33**	**0.05**	**0.24**
Descriptive Strength (AS1726, Table 19)	Low	Medium	Low	Very Low	Low	Medium	Medium	Medium	Very Low	Low
UCS [AS1726, Table 19] (MPa)	2 to 6	6 to 20	2 to 6	0.6 to 2	2 to 6	6 to 20	6 to 20	6 to 20	0.6 to 2	2 to 6
Comments										

MEAN VALUE - Point Load Strength Index (Mpa)	**Normal Direction**	-	**Parallel Direction**	-	**Strength Anisotropy Index [Ia(50)] (Mpa)**	-

Sampling & Test Methods (Results relate only to the items sampled/tested)

Sampled by Client: Results apply to the sample/s as received. **
Client: Test specimens selected by the client.
As Received: Samples stored & Tested in as received condition.
AS4133.4.1: (2007) Determination of Point Load Index

(NATA accreditation does not cover the performance of this service)**

Point Load - Failure Mode Descriptions

1	Fracture through fabric, oblique to banding.
2	Fracture along banding.
3	Fracture through rock mass.
4J	Fracture influenced by Joint Plane.
4M	Fracture influenced by Micro-fracture.
4F	Fracture influenced by Foliation.
4V	Fracture influenced by Vein.
5	Invalid Result (Partial fracture, or chip).

Report Endorsement

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WB62 - Rev 8, 09/09/2022

Appendix D

Concept Bridge Design Plans

PO Box 9140,
Wyoming, NSW 2250
ph (02) 4322 0011
ABN 63 145 429 063

Attention: Trevor Delaney

Document Register/Issue: B2343-1-DI-04

Date: 14 December 2023

Bridge Over Boondabah Creek on Brooman Road

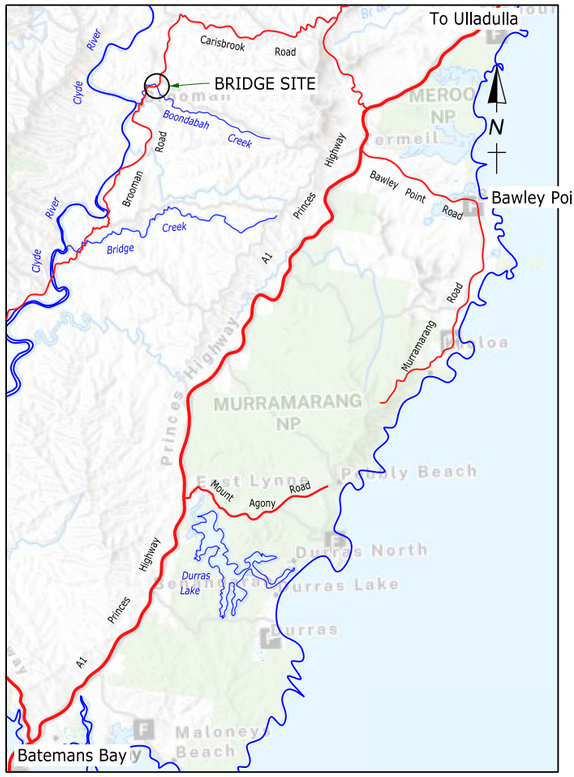
		Issued to HD Civil		
Document number	Title	Rev	Format	No
B2343-1-D01	Cover Sheet	A1	A3	pdf
B2343-1-D02	General Arrangement	A1	A3	pdf
B2343-1-D03	Substructure - Setout And Piling Details	A1	A3	pdf
B2343-1-D04	Abutment Headstocks - Concrete Details	A2	A3	pdf
B2343-1-D05	Abutment Headstocks - Reinforcement Details	A1	A3	pdf
B2343-1-D06	Prestressed Beams - Details	A1	A3	pdf
B2343-1-D07	Deck - Concrete Details	A2	A3	pdf
B2343-1-D08	Deck - Reinforcement Details	A1	A3	pdf
B2343-1-D09	Barriers, Bearings And Miscellaneous Steelwork Details	A2	A3	pdf
B2343-1-D10	Reinforcement - Bar Shapes	A1	A3	pdf

Notes

- Highlighted drawings are included in this issue
- Darker Highlight drawings are new in this issue

BRIDGE OVER BOONDABAH CREEK ON BROOMAN ROAD AT 18 KM WEST OF BAWLEY POINT

AUTHORITY - Shoalhaven City Council



LOCATION

1:250 000

Latitude:35.4604º S
Longitude:150.2484º E

DRAWING LIST

D01 COVER SHEET
D02 GENERAL ARRANGEMENT
D03 SUBSTRUCTURE - SETOUT AND PILING DETAILS
D04 ABUTMENTS - CONCRETE DETAILS
D05 ABUTMENTS - REINFORCEMENT DETAILS
D06 PRESTRESSED BEAMS - DETAILS
D07 DECK - CONCRETE DETAILS
D08 DECK - REINFORCEMENT DETAILS
D09 BARRIERS, BEARINGS AND MISCELLANEOUS STEELWORK DETAILS
D10 REINFORCEMENT - BAR SHAPES

Replacement bridge - 2023.
Bridge design to AS 5100.
Traffic loadings SM1600. Design speed 60kph.
Design heavy vehicle count 5 vpd. Route factor 0.5.
Allowance for superimposed dead loads 1.7 kPa (serviceability).
Earthquake hazard factor 0.08. Earthquake design classification BEDC-1.
Minimum design lateral loading 500kN.
Traffic barriers low performance level.
Wind Loading 40m/s.
Waterway data:

Average recurrence interval	Flow m^3/s	Velocity m/s	Water level RL (incl. afflux) m
10	16	1.0	98.9
100	43	1.4	99.7

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DRAWING SCALES TRUE AT A3

HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN: AJF
VERIFIED:
DRAWING: BNC
CHECKED: AJF

DIRECTOR, BRIDGE DESIGN PTY LTD

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Brooman Road Shoalhaven City
BOONDABAH CREEK BRIDGE
COVER SHEET

JOB NUMBER B2343-1
DOCUMENT NUMBER D01
SHEET 1 OF 10
REVISION A1

14/12/2023 12:43:16 PM Ashley
...\B2343-1 D01 cover sheet.dgn

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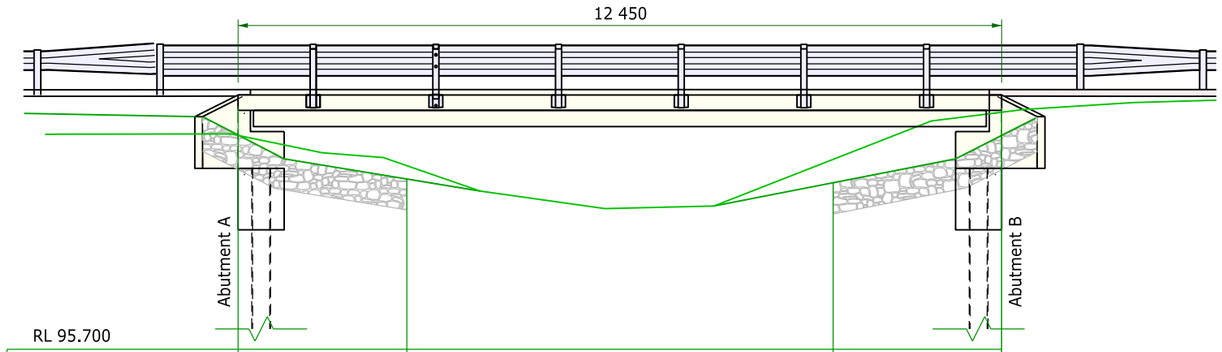
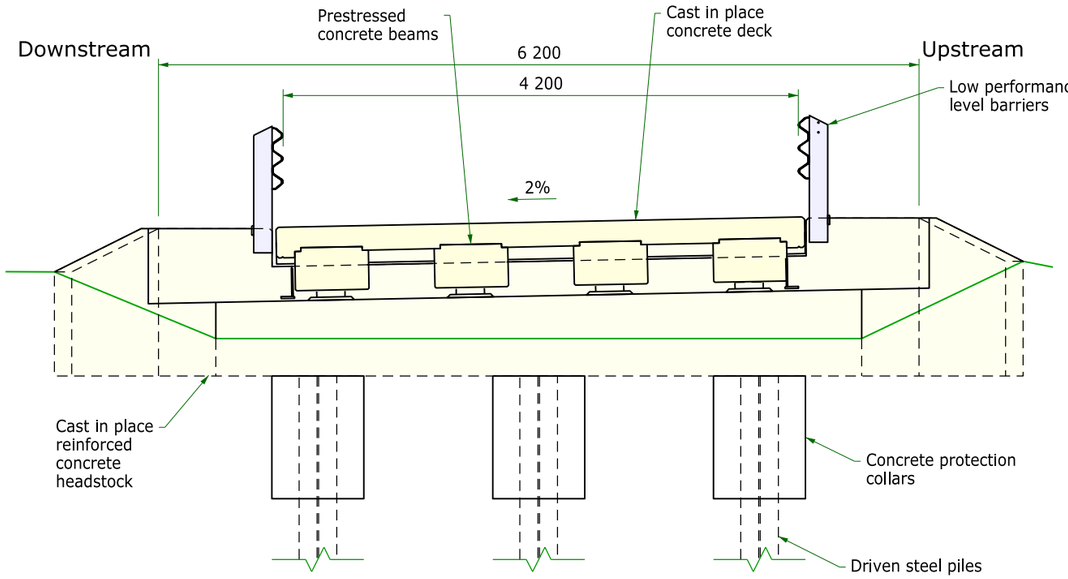
200mm on original



Design Level on Control Line	99.890	99.890	99.890	99.890
Existing Surface Level on Control Line	99.82	99.82	99.88	99.92
Chainage on Control Line	100.000	102.750	109.700	112.450

ELEVATION
1:100



SECTION 1/-
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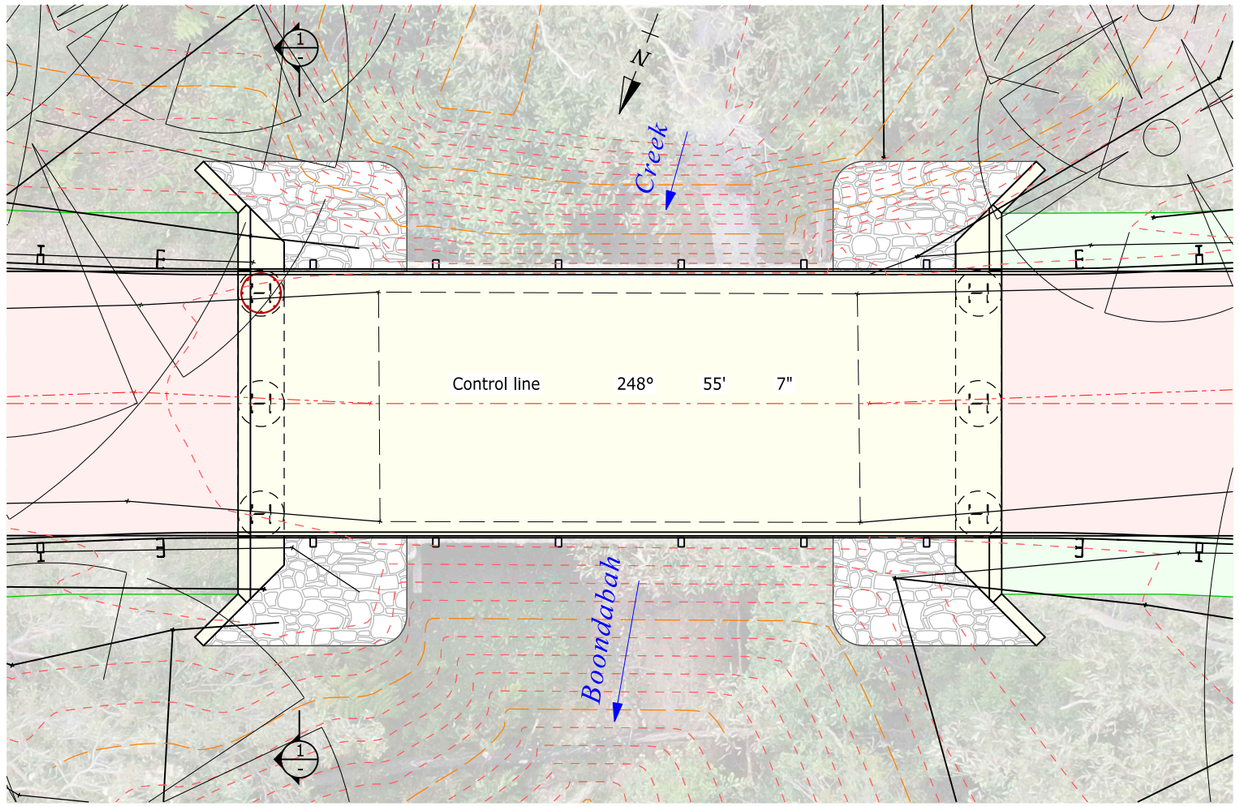

PLAN
1:100

General Notes

Dimensions in millimetres.
Chainages and reduced levels in metres.
Reduced levels are to local datum.
SOL denotes set out line.

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1:50 0 250 500 750 1000 1250 (200 100)
1:100 0 500 1000 1500 2000 2500 (500 250)

DRAWING SCALES TRUE AT A3

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ABN 63 145 429 063

DESIGN: AJF
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DRAWING: BNC
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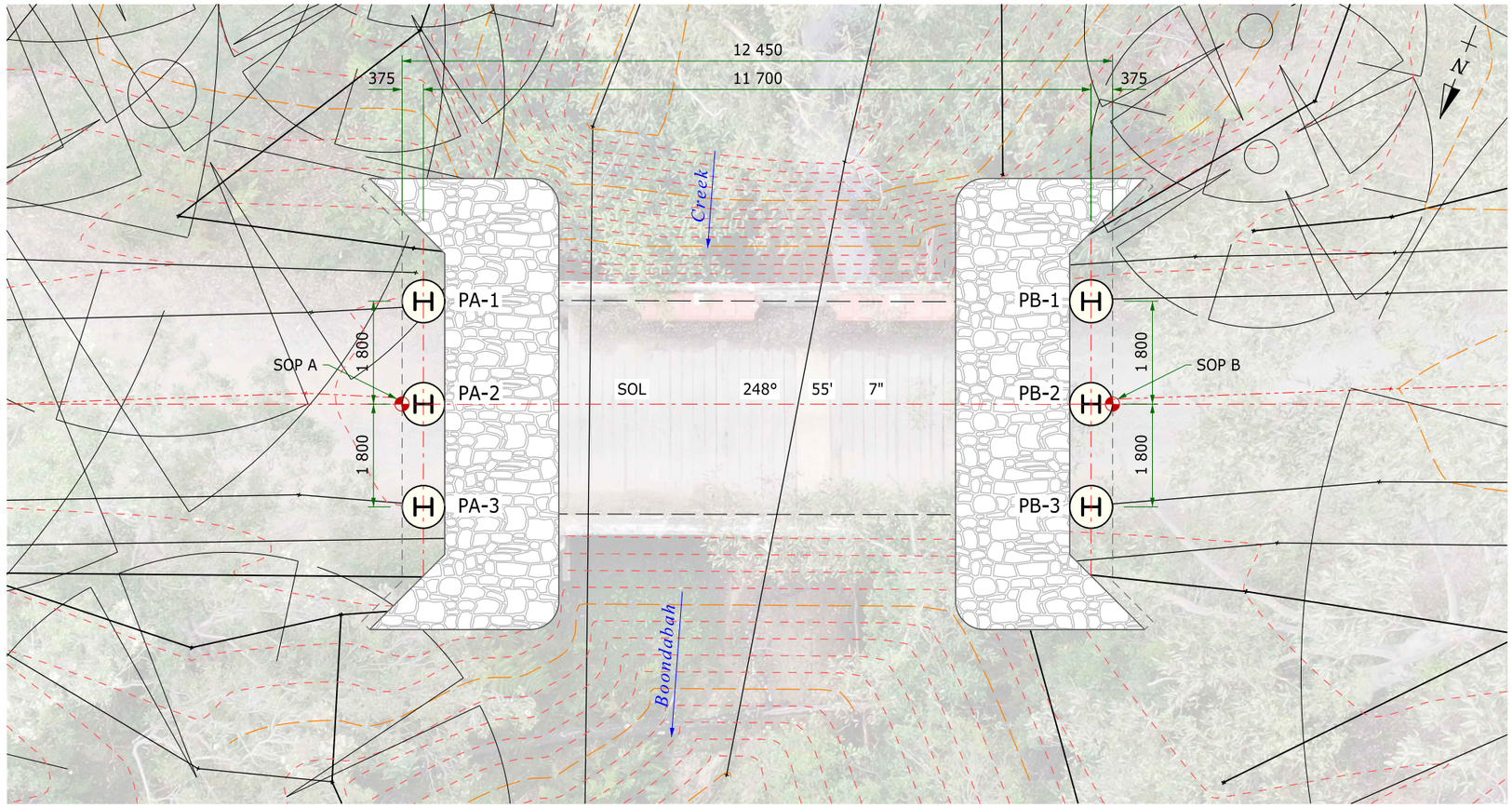
Brooman Road — Shoalhaven City

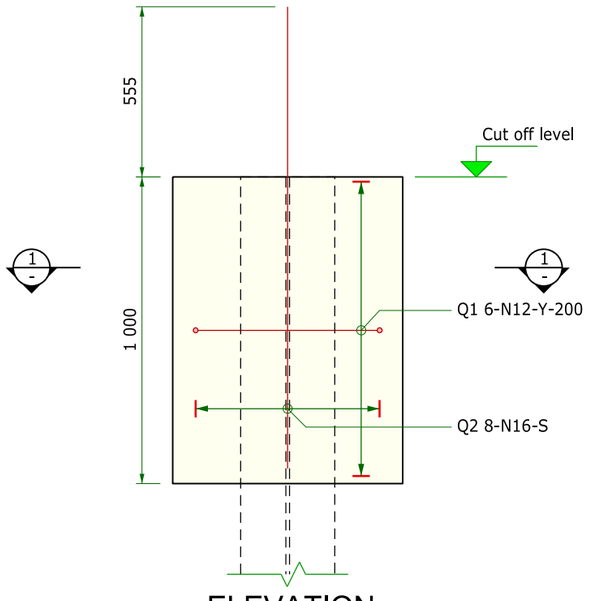
BOONDABAH CREEK BRIDGE

GENERAL ARRANGEMENT

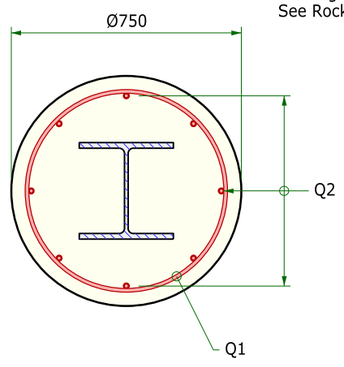
JOB NUMBER B2343-1
DOCUMENT NUMBER D02
SHEET 2 OF 10
REVISION A1



PLAN
1:100



ELEVATION
PILE
1:20



SECTION 1/-
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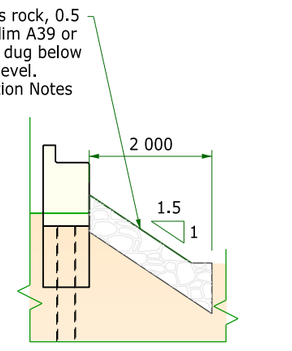

SCOUR PROTECTION
Not to scale

	Easting	Northing	RL	Notes
SOP A	250 237.776	6 072 374.439		
SOP B	250 226.159	6 072 369.961		

TABLE 1 - SETOUT

	Easting	Northing	RL	Notes
PA-1	250 238.074	6 072 372.624		
PA-2	250 237.426	6 072 374.304		
PA-3	250 236.779	6 072 375.983		
PB-1	250 227.157	6 072 368.416		
PB-2	250 226.509	6 072 370.095		
PB-3	250 225.862	6 072 371.775		

TABLE 2 - PILE COORDINATES

Pile No.	Ultimate Design Loads			Contract Toe Level	Cut off Level
	Vertical (kN)	Lateral min (kN)	Bending (kNm)		
PA-1	530	170	260	92.0	98.640
PA-2	530	170	260	92.0	98.640
PA-3	530	170	260	92.0	98.640
PB-1	530	170	260	95.0	98.640
PB-2	530	170	260	95.0	98.640
PB-3	530	170	260	95.0	98.640

TABLE 3 - PILE DETAILS

General Notes

Dimensions in millimetres.
Reduced levels in metres to assumed datum.

Rock Protection Notes

Rock protection to consist of igneous or durable approved rock of minimum specific gravity 2.5 meeting the following requirements:
Not more than 5% over 90kg
Not less than 50% over 35kg
Not less than 95% over 10kg
Maximum average size 0.3m.

Piling Notes

For geotechnical information see TERRA23-007.Rep1.Rev0
All piles 310UC118 Grade 300 to AS3679.1.
Drive piles to sets calculated to produce a capacity ØgRu at least equal to the ultimate axial load given in table 3. Where no dynamic testing is performed use a Øg of 0.6. Where at least one dynamic test is carried out on a pile of a nominated capacity used a Øg of 0.78.
Minimum driving energy 5kJ.
Maximum driving energy 30kJ.

Concrete Notes

Concrete exposure classification A.
Minimum 28 day compressive strength of concrete (f'c) 40MPa.
Nominal cover to reinforcement nearest to the concrete surface:
Cast against the ground 75mm
Formed or in casing 50mm
Lap lengths to be:
N16 620
N12 460
"SP" bar shapes may be used in lieu of "Y" shapes.

1:20 0 100 200 300 400 500 / 100 50
1:100 0 500 1000 1500 2000 2500 / 500 250

DRAWING SCALES TRUE AT A3

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...\B2343-1 D03 Substructure setout and Piles.dgn 14/12/2023 10:58:16 AM Ashley

HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN: AJF
VERIFIED: -
DRAWING: BNC
CHECKED: AJF

DIRECTOR, BRIDGE DESIGN PTY LTD
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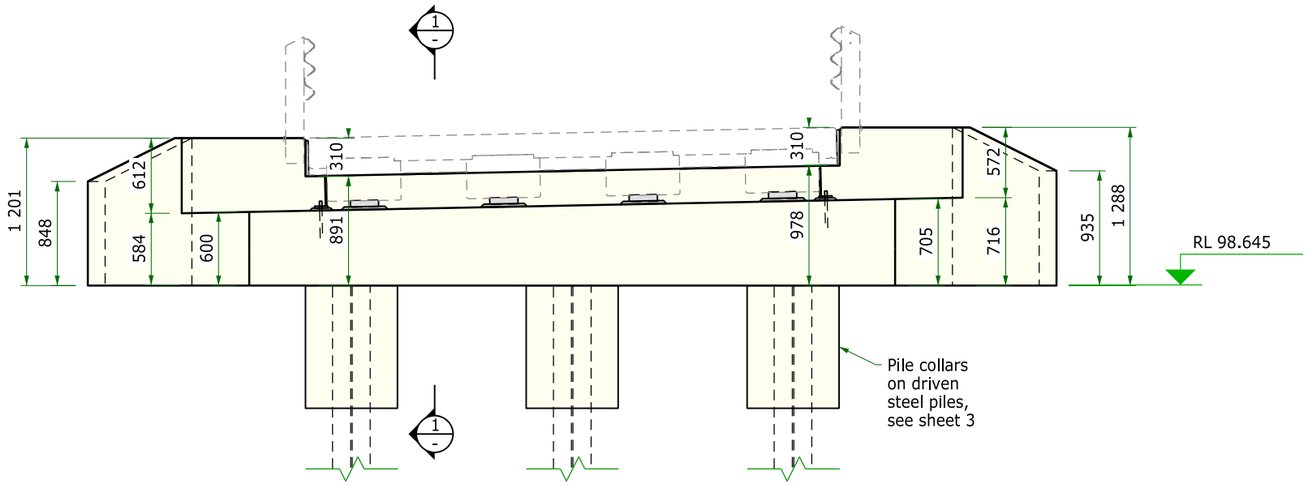
Brooman Road Shoalhaven City
BOONDABAH CREEK BRIDGE
SUBSTRUCTURE SETOUT AND PILING DETAILS

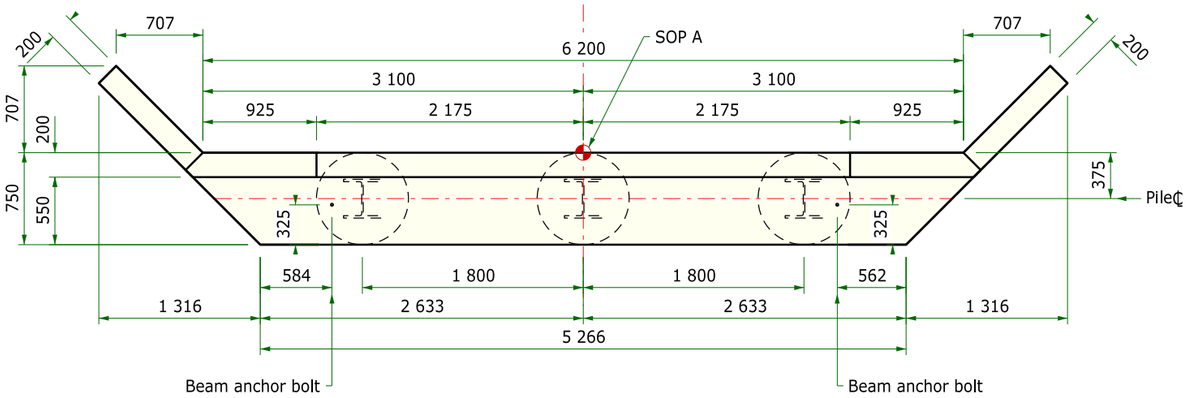
JOB NUMBER B2343-1
DOCUMENT NUMBER D03
SHEET 3 OF 10
REVISION A1

100mm on original
200mm on original



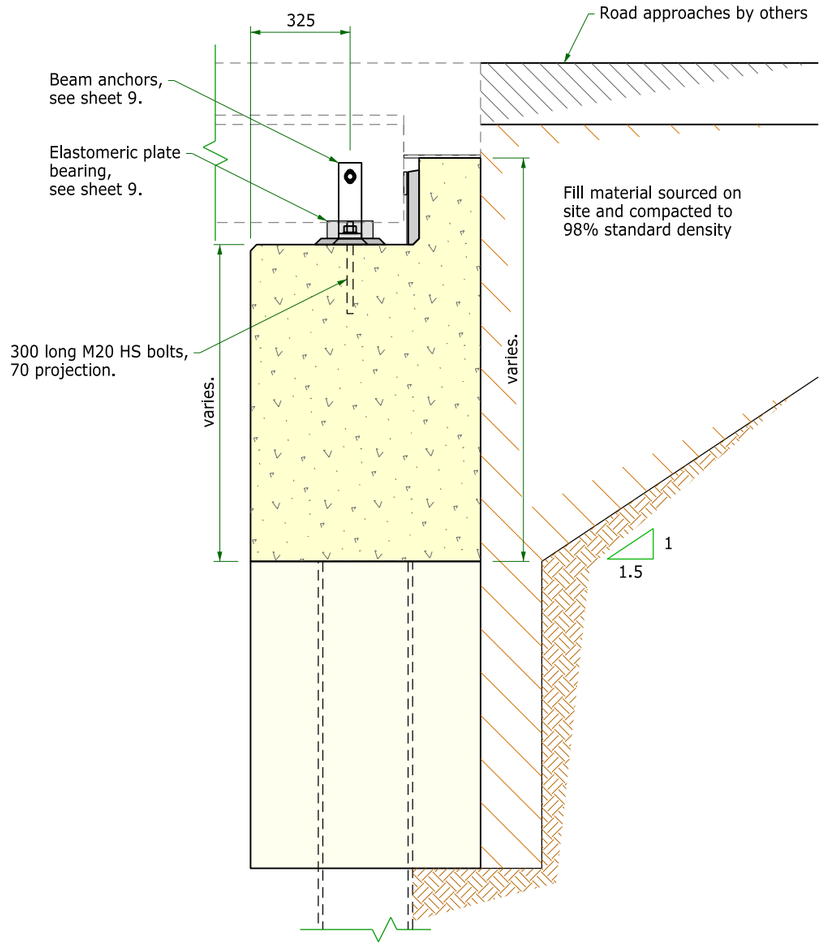
ELEVATION

1:50 Abutment A shown
Abutment B opposite hand



PLAN

1:50



SECTION 1/-

1:20

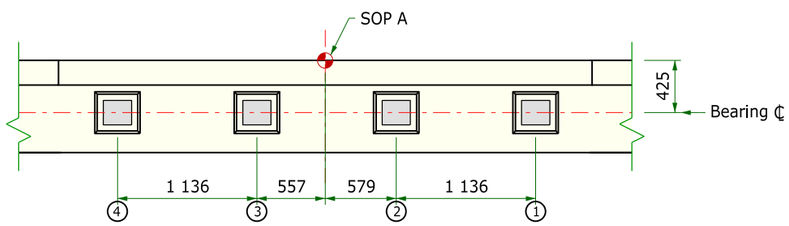
General Notes

Dimensions in millimetres.
Concrete exposure classification B1.
Minimum 28 day compressive strength of concrete 40 MPa.
Chamfer edges 20 x 20 and fillet re-entrant angles 20x20 USO.
NCF denotes no chamfer or fillet.
USO unless specified otherwise.

Bearing no.	RL (m)	Fall (mm)
1	99.409	4.6
2	99.386	4.6
3	99.364	4.6
4	99.341	4.6

TABLE 1 - BEARING LEVELS

Levels at top centre of bearing.



BEARING LAYOUT

1:50

1:20 0 100 200 300 400 500 (100 50)
1:50 0 250 500 750 1000 1250 (200 100)

DRAWING SCALES TRUE AT A3

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HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN: AJF
VERIFIED: -
DRAWING: BNC
CHECKED: AJF

DIRECTOR, BRIDGE DESIGN PTY LTD

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Brooman Road Shoalhaven City
BOONDABAH CREEK BRIDGE
ABUTMENTS
CONCRETE DETAILS

JOB NUMBER B2343-1
DOCUMENT NUMBER D04
SHEET 4 OF 10
REVISION A2

100mm on original
200mm on original

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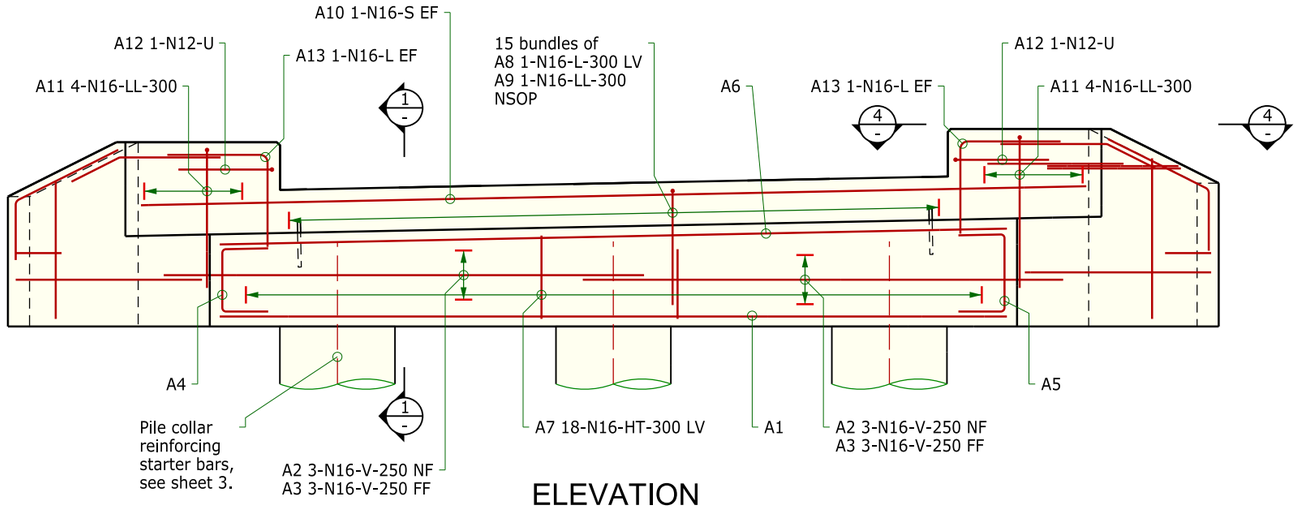

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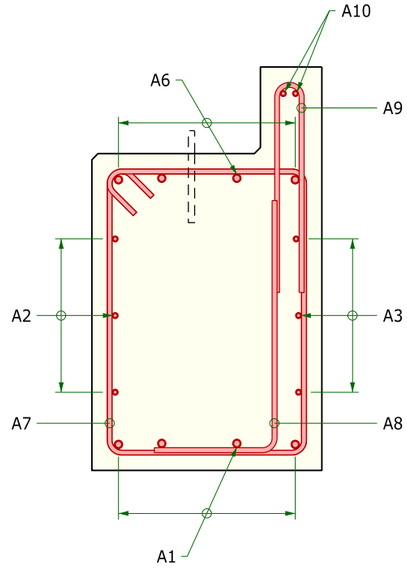
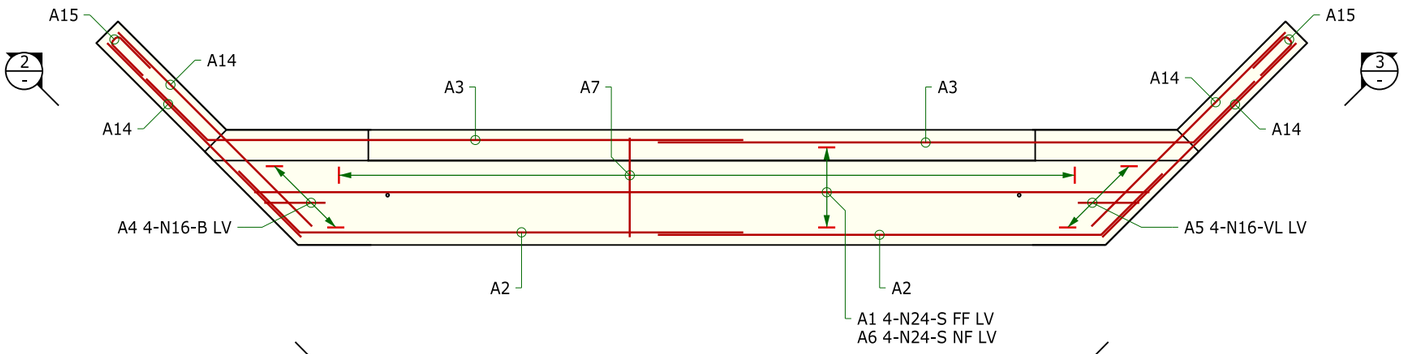
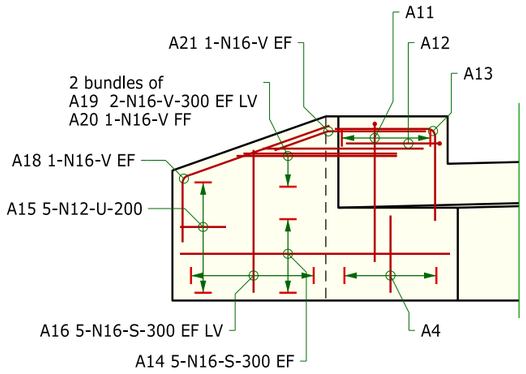
1:50



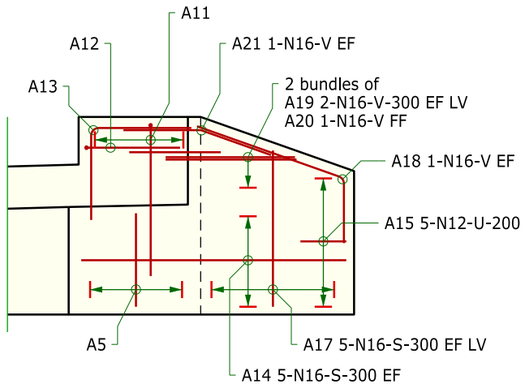
SECTION 1
1:20



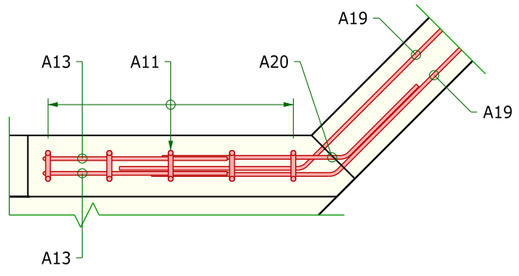
PLAN
1:50



VIEW 2
1:40



VIEW 3
1:40



SECTION 4
1:20

General Notes

Dimensions in millimetres.
Nominal cover to reinforcement nearest to the concrete surface 45mm USO.

FF	far face	NF	near face
EF	each face	LV	length varies.
USO	unless specified otherwise.		
NSOP	not shown on plan.		

Lap lengths to be as follows USO:

Bar size	N12	N16	N20	N24	N28	N32
Horizontal bars with >300mm of concrete cast below the bar	460	650	...	1250	...	...
Other bars	350	500	...	960	...	...

Development length to be 100% of the lap length above USO.
Reinforcement may be displaced slightly to clear embedded objects, holes and recesses.

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

1:20 0 100 200 300 400 500 (100 50)
1:40 0 200 400 600 800 1000 (200 100)
DRAWING SCALES TRUE AT A3

...\B2343-1 D05 Abutment Reinforcement.dgn 5/12/2023 8:02:48 AM Ashley

HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN: AJF
VERIFIED: -
DRAWING: BNC
CHECKED: AJF

DIRECTOR, BRIDGE DESIGN PTY LTD
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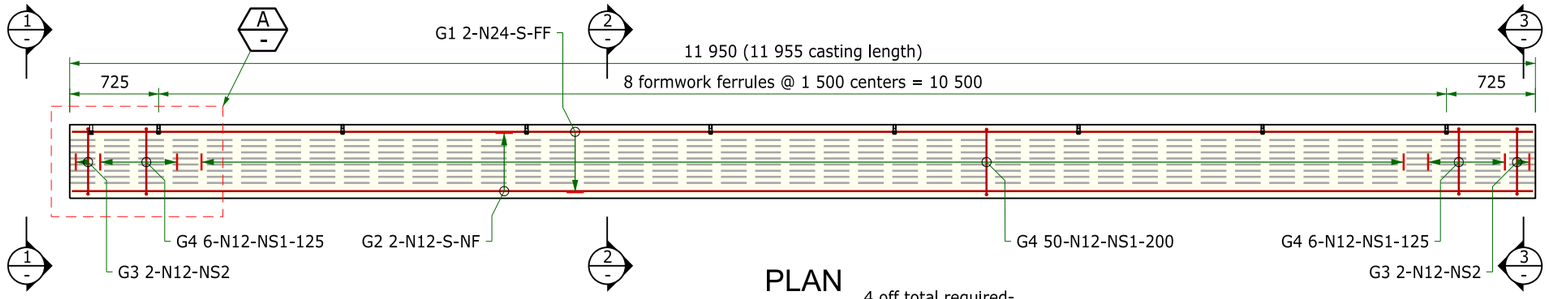
Brooman Road Shoalhaven City
BOONDABAH CREEK BRIDGE
ABUTMENTS
REINFORCEMENT DETAILS

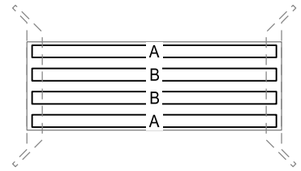
JOB NUMBER B2343-1
DOCUMENT NUMBER D05
SHEET 5 OF 10
REVISION A1

100mm on original
200mm on original

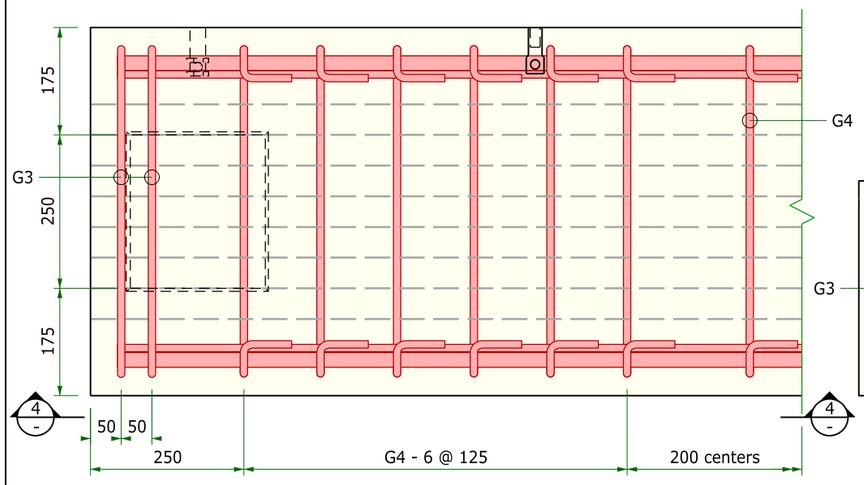


PLAN
1:50

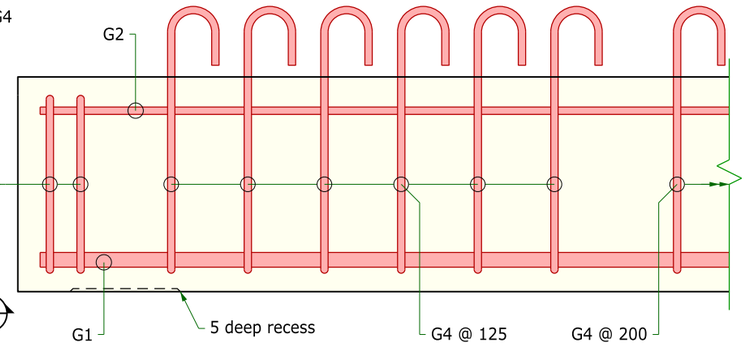
4 off total required-
2 Beams Mark A
2 Beam Mark B



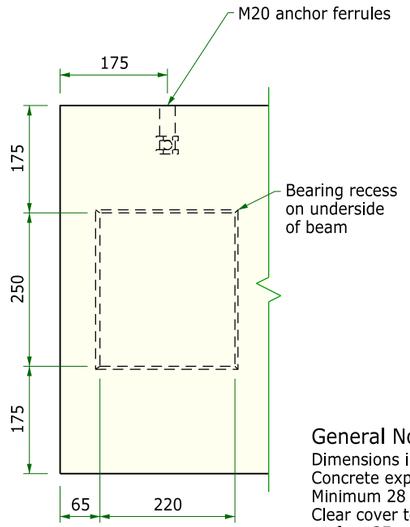
BEAM LAYOUT
NOT TO SCALE



DETAIL A
1:10



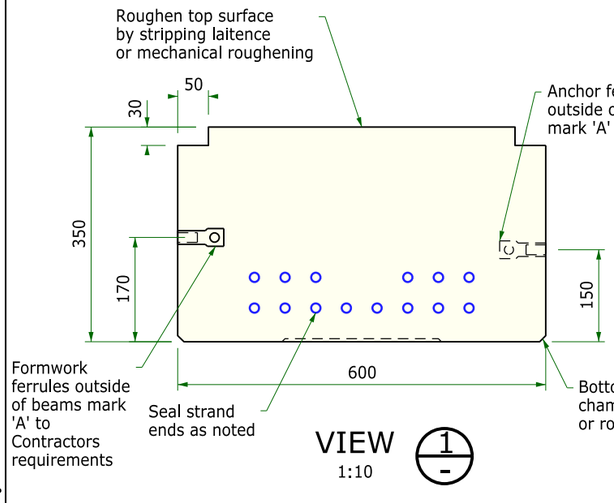
VIEW 4
1:10



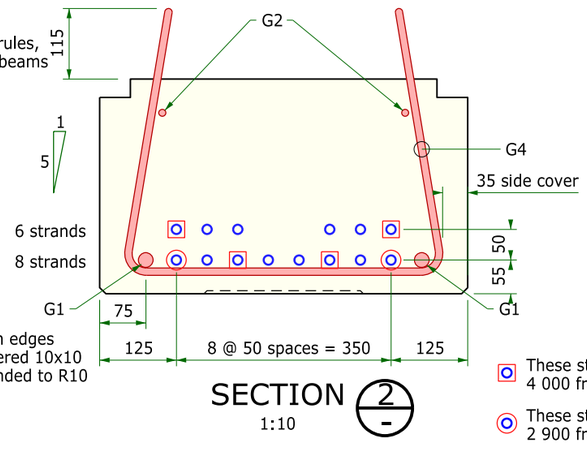
BEARING RECESS DETAIL
1:10

General Notes
Dimensions in millimetres.
Concrete exposure classification: A.
Minimum 28 day compressive strength of concrete 50MPa.
Clear cover to reinforcement nearest to the concrete surface 35mm USO.
Mass of beams is 6.3 tonnes.
During storage, transport and handling, keep beam upright and supported at not more than 1 800mm from each end.
Provide suitable lifting devices not further than 600mm from beam ends.

Concrete Notes
Minimum compressive strength of concrete at transfer 35MPa.
Strands shall be AS/NZS 4672.1- 7 wire ordinary - 15.2 - 1850 - relax 2.
The force remaining in each strand at midspan of the beam immediately after tensioning shall be 165kN.
Cut strands flush with the end of the beam and seal exposed strands against corrosion with 3 thick epoxy resin - MEGAPOXY H THIXOTROPIC or equivalent.
The calculated hog of the beams at release is 17mm, increasing to 20mm at 28 days, assuming:
- Density = 2550kg/m³
- Elastic modulus at transfer = 25,000MPa
- Steam curing in accordance with RMS B80.
- Storage in open air, after steam curing, at 20°C
- Average temperature and relative humidity in range of 50%-75%
- No loads except beam self weight.



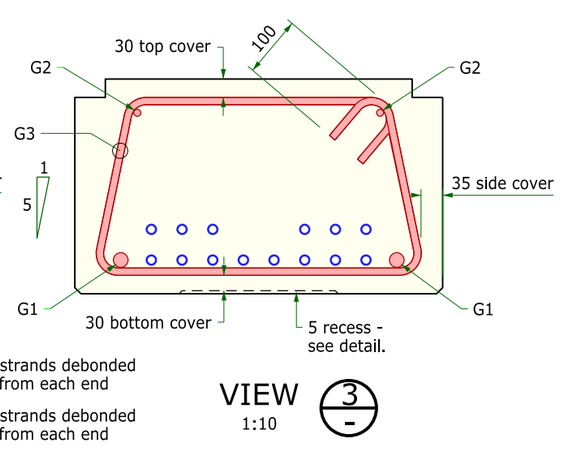
VIEW 1
1:10



SECTION 2
1:10

These strands debonded 4 000 from each end

These strands debonded 2 900 from each end



VIEW 3
1:10

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

1:10 0 50 100 150 200 250 (50 25)
1:50 0 250 500 750 1000 1250 (200 100)
DRAWING SCALES TRUE AT A3

HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN: AJF
VERIFIED: -
DRAWING: BNC
CHECKED: AJF

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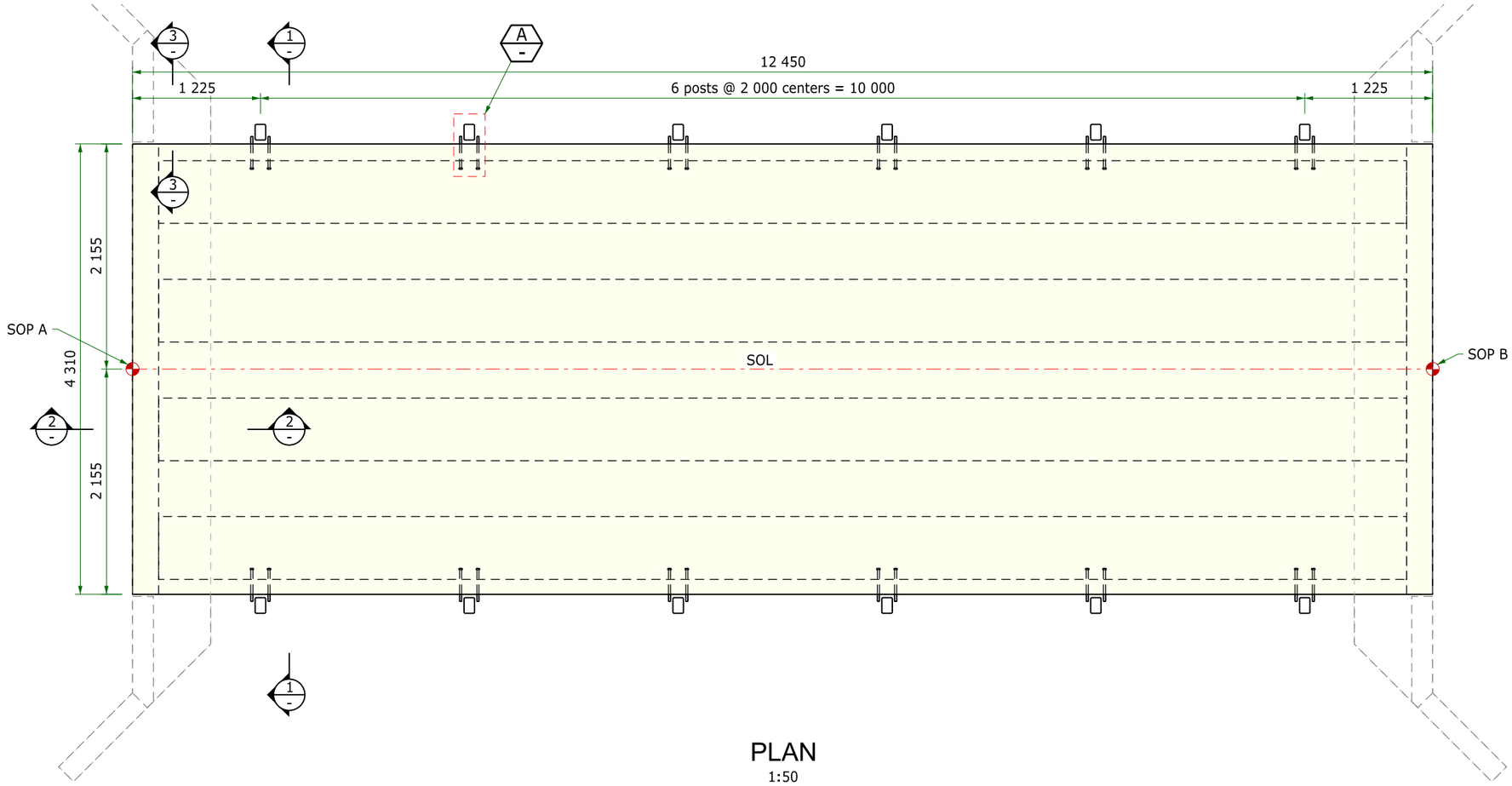
Brooman Road — Shoalhaven City
BOONDABAH CREEK BRIDGE
PRESTRESSED BEAMS DETAILS

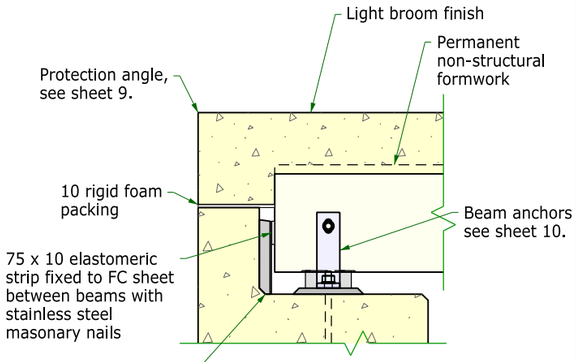
JOB NUMBER B2343-1
DOCUMENT NUMBER D08
SHEET 8 OF 1
REVISION A1

100mm on original
200mm on original

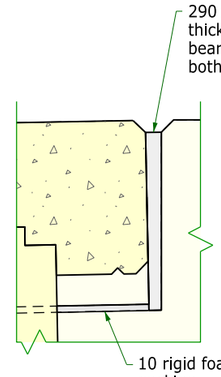
...\B2343-1 D08 PS Beams.dgn 28/11/2023 10:05:10 AM Ashley



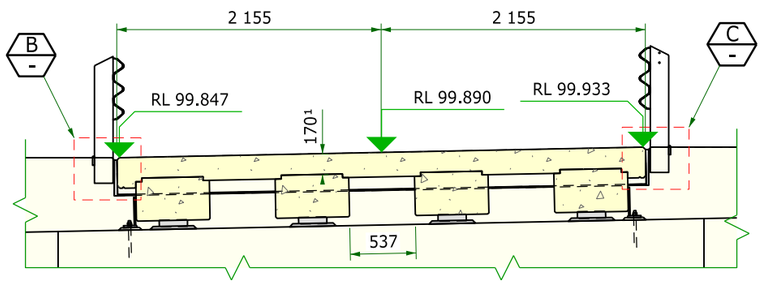
PLAN
1:50



SECTION 2
1:20

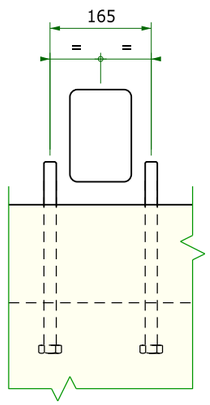


SECTION 3
1:10

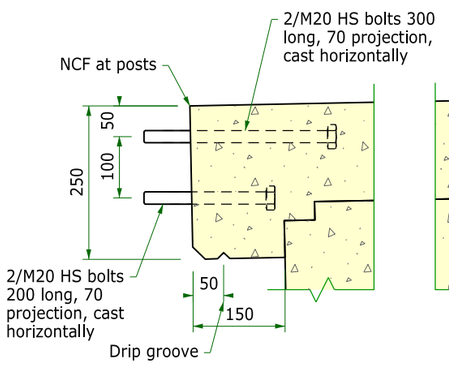


SECTION 1
1:50

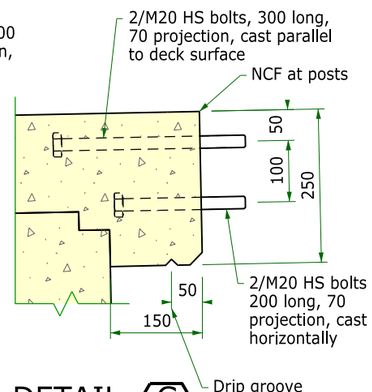
¹ Dimension at abutments.
Deck thickness to vary to suit beam hogs.
Minimum midspan dimension 160mm.



DETAIL A
1:10



DETAIL B
1:10



DETAIL C
1:10

General Notes

Dimensions in millimetres.
Concrete exposure classification B1 USO.
Minimum compressive strength of concrete (f'c) 32 MPa.
Chamfer edges 20 x 20 and fillet re-entrant angles 20x20 USO.
NCF denotes no chamfer or fillet.
Bolting category 4.6/S to AS 5100.6 USO.
HS denotes bolting category 8.8/S to AS5100.6.
USO denotes unless specified otherwise.
Anticipated deflection under weight of wet concrete: 15mm

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

1:10 0 50 100 150 200 250 (50 25)
1:20 0 100 200 300 400 500 (100 50)
1:50 0 250 500 750 1000 1250 (200 100)

DRAWING SCALES TRUE AT A3

HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN: AJF
VERIFIED: -
DRAWING: BNC
CHECKED: AJF

DIRECTOR, BRIDGE DESIGN PTY LTD

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Brooman Road — Shoalhaven City

BOONDABAH CREEK BRIDGE

DECK
CONCRETE DETAILS

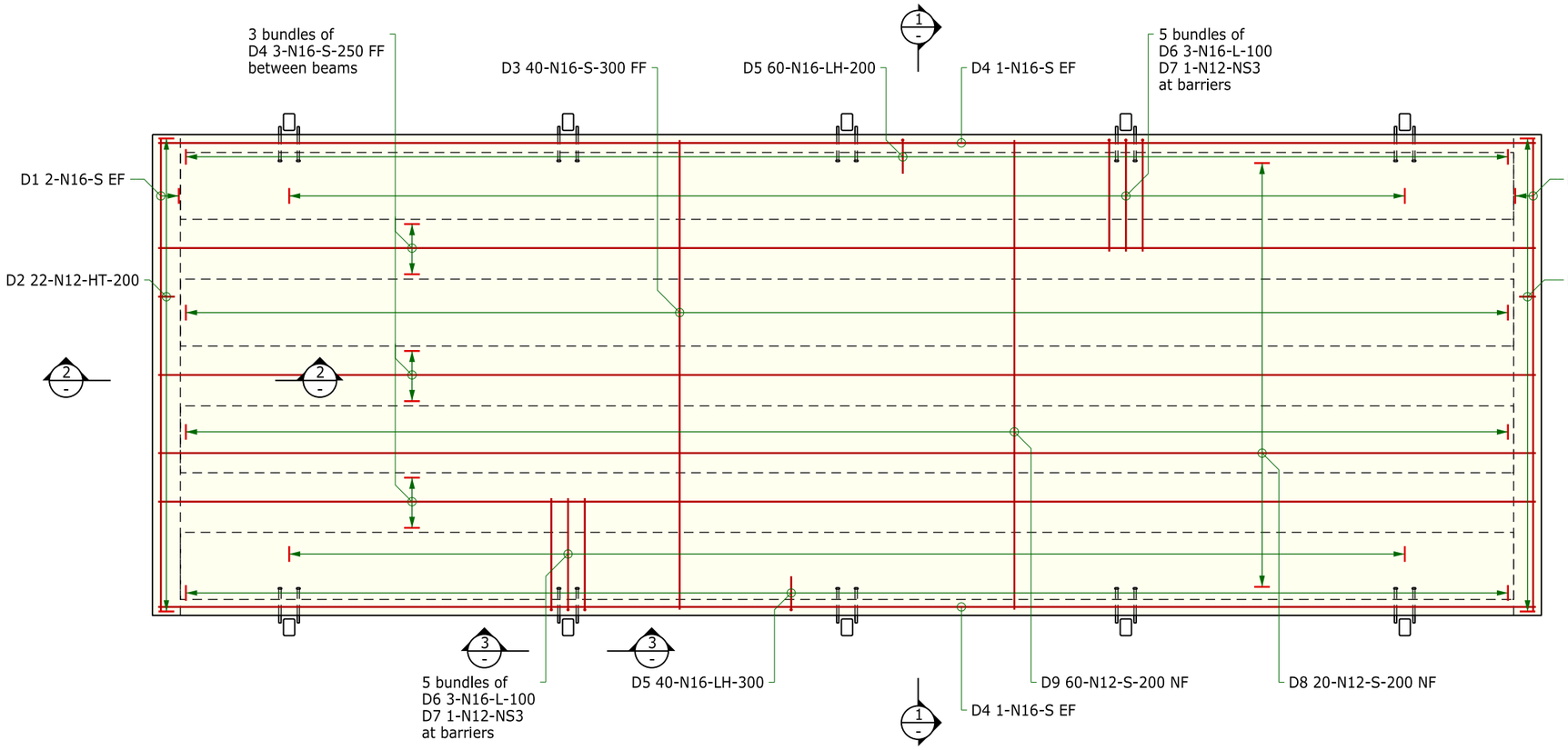
JOB NUMBER B2343-1
DOCUMENT NUMBER D08
SHEET 8 OF 10
REVISION A2

100mm on original
200mm on original

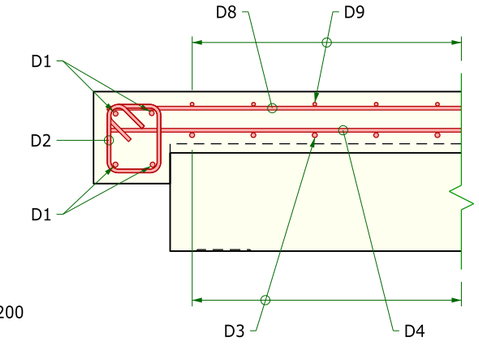
Ashley

5/12/2023 8:03:15 AM

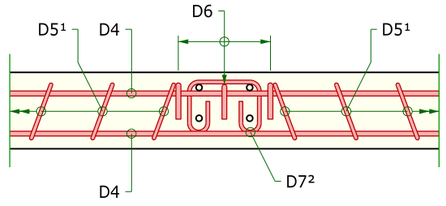
...\B2343-1 D09 Deck Rev.dgn



PLAN
1:50

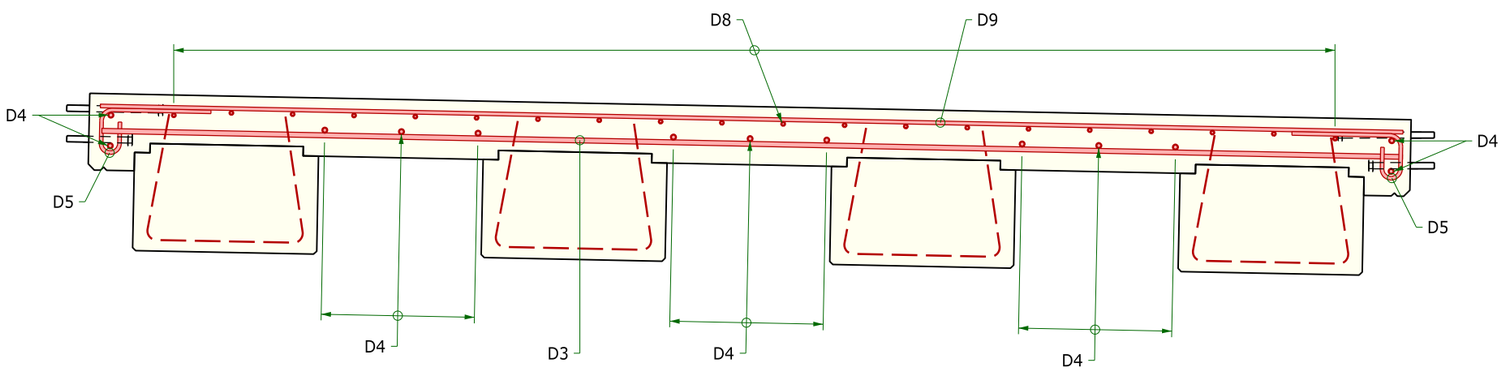


SECTION 2-
1:20



VIEW 3-
1:20

¹ Bend D5 to suit edge height of 250mm.
Rotate elsewhere to suit lesser edge heights.
² D7 galvanised and placed with 20 top cover.



SECTION 1-
1:50

General Notes

Dimensions in millimetres.
Nominal cover to reinforcement nearest to the concrete surface 50mm USO.

FF	far face	NF	near face
EF	each face	LV	length varies.
USO	unless specified otherwise.		
NSOP	not shown on plan.		

Lap lengths to be as follows USO:

Bar size	N12	N16	N20	N24	N28	N32
Horizontal bars with >300mm of concrete cast below the bar	570	760	...	...	...	...
Other bars	440	580	...	...	...	...

Development length to be 80% of the lap lengths above USO.
Reinforcement may be displaced slightly to clear embedded objects, holes and recesses.
Laps not shown on the drawings are to be staggered so that not more than 50% of the laps are in one line.

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

1:20 0 100 200 300 400 500 / 100 50
1:50 0 250 500 750 1000 1250 / 200 100
DRAWING SCALES TRUE AT A3

HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
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ABN 63 145 429 063

DESIGN: AJF
VERIFIED: -
DRAWING: BNC
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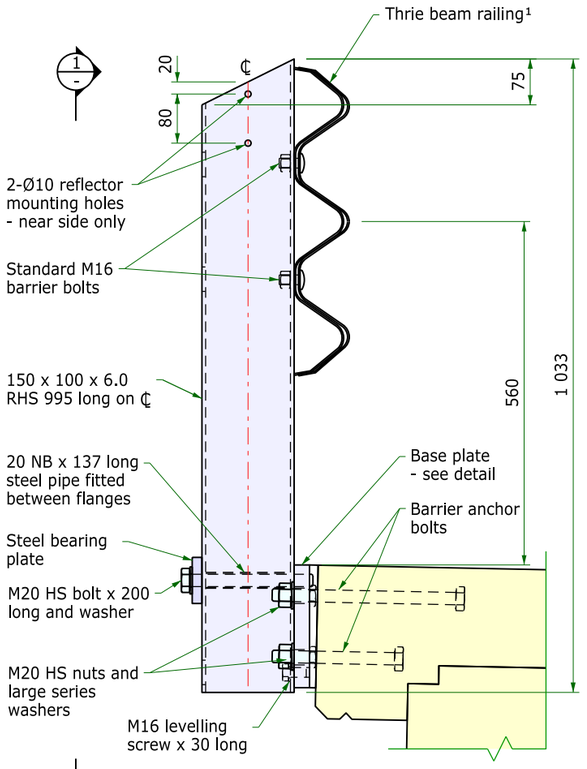
Brooman Road — Shoalhaven City

BOONDABAH CREEK BRIDGE

DECK REINFORCEMENT DETAILS

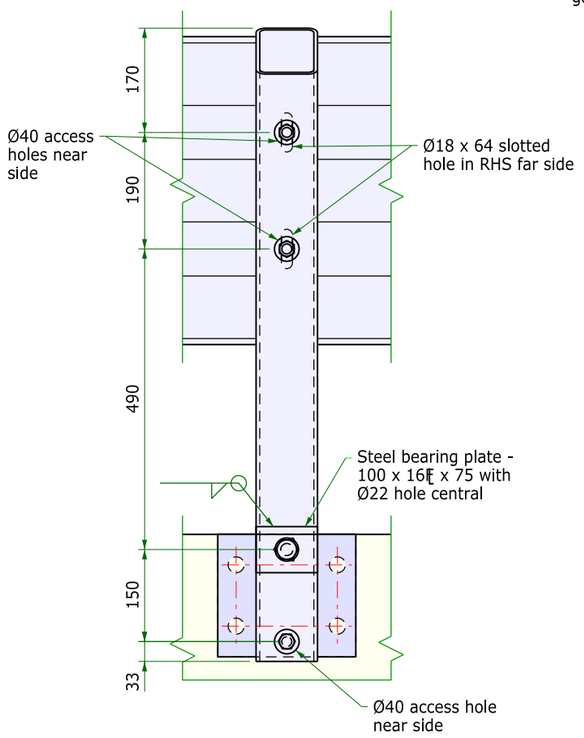
JOB NUMBER B2343-1
DOCUMENT NUMBER D09
SHEET 9 OF 10
REVISION A1

100mm on original
200mm on original



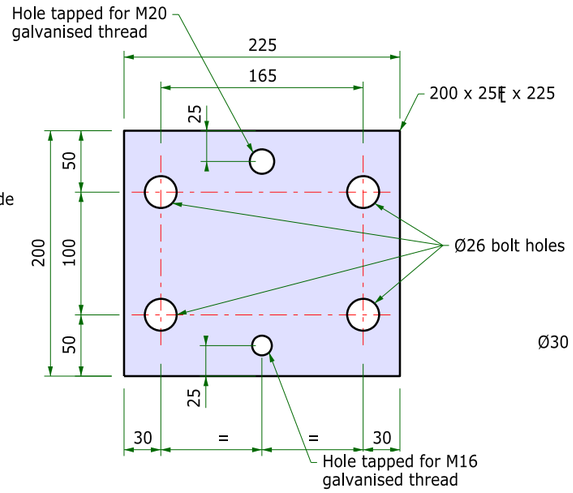
EDGE MOUNTED BARRIER POST - ELEVATION

1:10 10 off post assemblies required. (cut posts from stock lengths by reversing diagonal cuts)



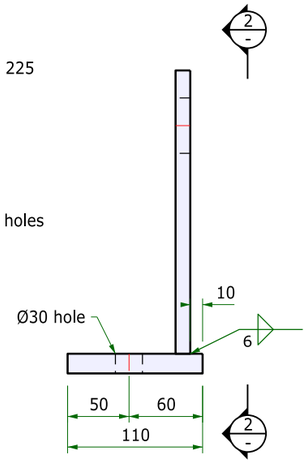
VIEW 1

1:10



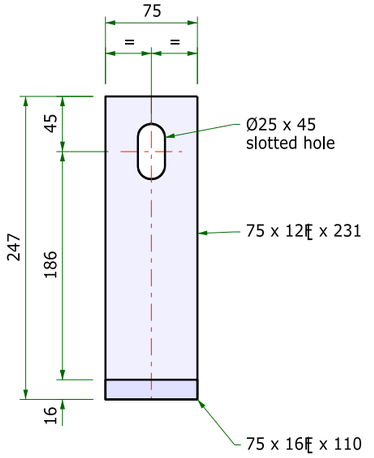
BARRIER BASE PLATE - DETAIL

1:5 10 off required



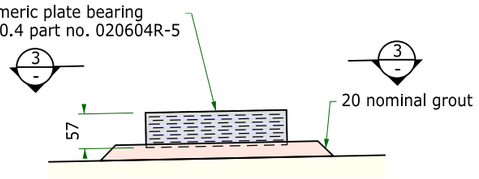
BEAM ANCHOR DETAIL

1:5 4 off required



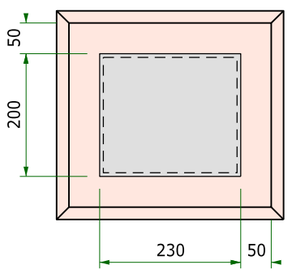
VIEW 2

1:5



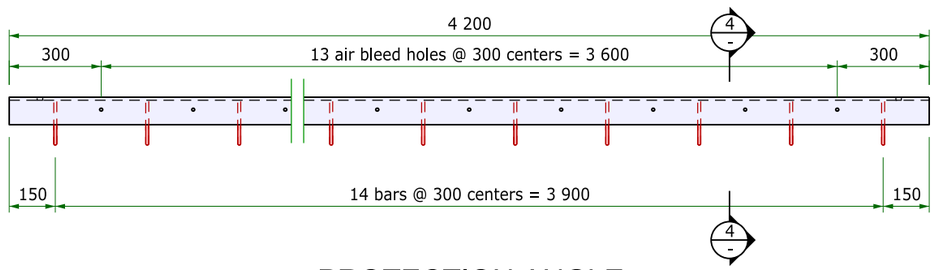
BEARING - DETAIL

1:10 8 off required



VIEW 3

1:10



PROTECTION ANGLE

1:20 2 off required

SECTION 4

1:5

General Notes

Dimensions in millimetres.
Dimensions are given to the nearest millimetre after fabrication.
Steel plates minimum grade 250 to AS3678.
Steel sections minimum grade 300 to AS3679.2.
Steel hollow sections grade C350L0 or C450L0 to AS1163.
Steel circular hollow sections grade C250L0 or C350L0 to AS1163.
Reinforcing bars to AS4671.
HS denotes bolting category 8.8/S to AS5100.6.
Surface treatment: hot dip galvanised to AS4680 after fabrication.
Bolts, nuts and washers hot dip galvanised to AS1214.
Round edges to be protective treated to a radius of 1.5mm after fabrication.
Welding symbols to AS1101.3.
Welding category SP to AS1554.1 USO.
Welds to be 5mm continuous fillet USO.
USO denotes unless specified otherwise.
Construct in accordance with the requirements of TfNSW Specification B201, B240, B264 and B281.
¹ Thrie beam railings required in nominal lengths of;
6 x 4m.
2 x 2m.

BEARING INSTALLATION

Not more than 7 days before forming bearing pads obtain the average slope of the beams at the bearing points with a level able to read to an accuracy of 0.1%. If this varies from the anticipated 28 day value the slope of the mortar pads given on sheet 4 are to be adjusted for the difference. Where the same type of beam is installed at more than one location and end slopes vary, mark each girder and assign it to a location before making this adjustment.
Construct mortar pads with a surface suitable for fixity by friction in accordance with the requirements of TfNSW Specification B284.

1:5 0 25 50 75 100 125 (25 12.5)
1:10 0 50 100 150 200 250 (50 25)
1:20 0 100 200 300 400 500 (100 50)

DRAWING SCALES TRUE AT A3

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

HD CIVIL
Bridge Design Pty Ltd
ISO 9001:2015
CONSULT AUSTRALIA Member Firm
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN: AJF
VERIFIED: -
DRAWING: BNC
CHECKED: AJF

DIRECTOR, BRIDGE DESIGN PTY LTD

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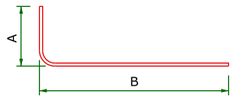
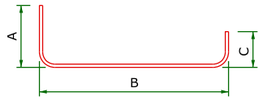
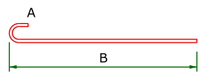
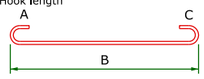
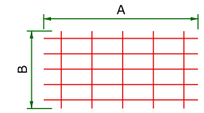
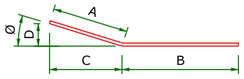
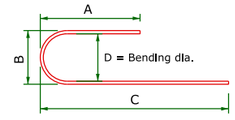
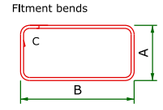
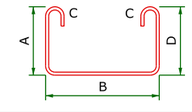
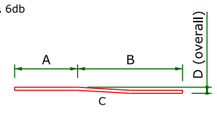
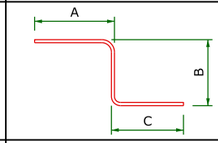
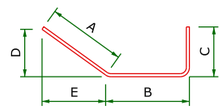
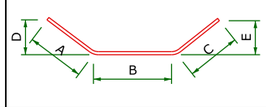
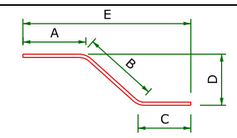
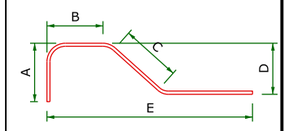
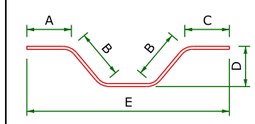
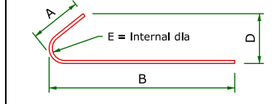
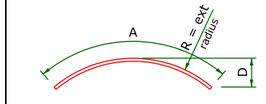
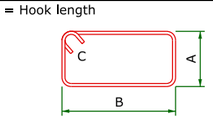
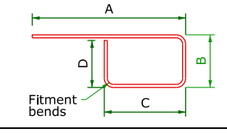
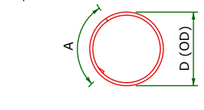
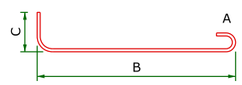
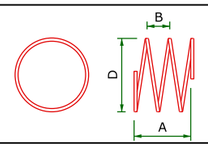
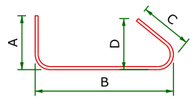
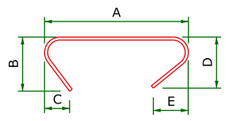
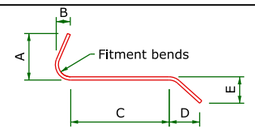
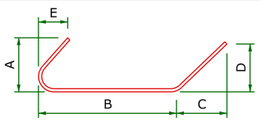
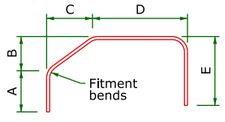
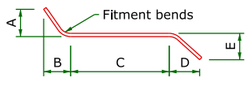
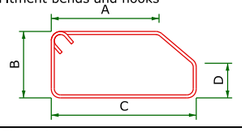
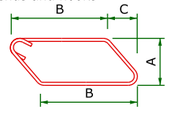
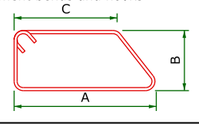
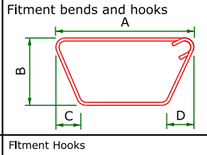
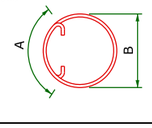
Brooman Road Shoalhaven City
BOONDABAH CREEK BRIDGE
BARRIERS, BEARINGS AND MISCELLANEOUS STEELWORK DETAILS

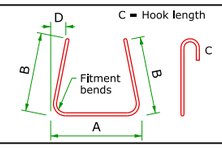
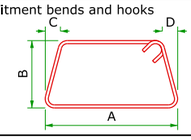
JOB NUMBER B2343-1
DOCUMENT NUMBER D09
SHEET 9 OF 10
REVISION A2

Shape Code	Australian Standard Bar Shape
S	
L	
LL	
H	A = Hook length 
HH	A = Hook length C = Hook length 
F	 "A" is in the direction of the main bars
V	
U	
T	Fitment bends 
SH	C = Hook length 
CC	c ≥ 6db 

Shape Code	Australian Standard Bar Shape
RC	
VL	
VV	
J	
LJ	
JJ	
A	
R	
HT	C = Hook length 
XT	
CT	A = Lap 

Shape Code	Australian Standard Bar Shape
LH	
SP	
LA	
AA	
KL	
AV	
LG	
KH	
GT	Fitment bends and hooks 
TT	Fitment bends and hooks 

Shape Code	Non standard shape - TfNSW Code
PT	Fitment bends and hooks 
QT	Fitment bends and hooks 
ST	Fitment Hooks 

Shape Code	Non standard shape - TfNSW Code
NS1	C = Hook length 
NS2	Fitment bends and hooks 

Shape Code	Non standard shape

Shape Code	Non standard shape

GENERAL NOTES

Australian standard bar shapes are in accordance with AS1100.501.
Bar size is the nominal diameter in millimetres or the AS4671 fabric size.
All bars deformed bar grade D500N to AS4671 USO.
Dimensions are measured on the outside face of the bars.
Do note rebend bars with a diameter over 24mm.
Bar bending and hooks in accordance with AS5100

Bar Marking

The reinforcement on the drawings is described by the following notation:
A2 10-N16-S-300FF

- Placing information
- Spacing along limit line
- Bar shape code
- Bar type and size in millimetres
- Number of bars in the set
- Bar number in tag sequence
- Structure element notation

W denotes plain bar grade D500L to AS4671.
R denotes plain bar grade R250N to AS47671.
RL and SL denotes welded reinforcing fabric, rectangular and square respectively.

Welding of Reinforcement

Welding required to develop full strength laps to AS1554.3 Section 3.2 and Table F4.
Weld material; E48xx, W50x or W50xx minimum.
Throat depth is minimum and includes "S" plus reinforcment. For "S" and "W" refer to AS1554.3
Testing - 100% visual. Inspect each layer of multi-pass welds.

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

DRAWING SCALES TRUE AT A3

HD CIVIL

Bridge Design Pty Ltd
PO Box 9140, Wyoming, NSW 2250
ph 02 4322 0011
ABN 63 145 429 063

DESIGN:	AJF
VERIFIED:	-
DRAWING:	AJF
CHECKED:	AJF

DIRECTOR, BRIDGE DESIGN PTY LTD

THIS DRAWING IS NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED DIGITALLY ON THIS SHEET OR THE FIRST SHEET IN THIS SET OF DRAWINGS.

Brooman Road — Shoalhaven City

BOONDABAH CREEK BRIDGE

REINFORCEMENT BAR SHAPES

JOB NUMBER	B2343-1
DOCUMENT NUMBER	D10
SHEET	10 OF 10
REVISION	A1

100mm on original

200mm on original