Internal Memo

City of Newcastle

TO: Executive Manager Project Management Office

CC: Planning Advisor

FROM: Dean MacMillan

DATE: 16 February 2024

SUBJECT: Review of Environmental Factors – Memorial Drive, The Hill Road Embankment.

Memorial Drive, The Hill Road Embankment between Memorial Drive 2 Fenton Avenue and 32 Memorial Drive The Hill is subject to Part 5 of *Environmental Planning and Assessment Act 1979,* and therefore requires the preparation of a Review of Environmental Factors (REF). The attached project REF has been prepared by RPS dated 01 February 2024. I certify that to the best of my knowledge, the attached REF:

- accurately describes the proposed project works
- has been prepared by suitably qualified and competent people
- meets the requirements of section 5.5 and 5.7 and Part 5 of the *Environmental Planning and Assessment Act 1979*, and section 171 of the *Environmental Planning and Assessment Regulation 2021.*

	Dean MacMillan	[redacted]	15 February 2024
Project Manager	*Name*	*Signature*	*Date*
Senior Project Manager / Coordinator	David Grejsen	[redacted]	19 February 2024
	Name	*Signature*	*Date*

Should you have further questions regarding the determination of the project please contact Dean MacMillan on 024974 2921.

Dean MacMillan
PROJECT MANAGER

Delegated Officer Determination of REF

Under delegated authority, as City of Newcastle's representative as a determining authority under Part 5 of the *Environmental Planning and Assessment Act 1979*, I determine the proposed Memorial Drive, The Hill Road Embankment **will not** significantly impact the environment, and the proposal can proceed subject to the mitigation measures outlined in the attached REF and the conditions of any relevant approvals, licences or permits.

Executive Manager	Robert Dudgeon	[redacted]	23/02/2024
Project Management Office	*Name*	*Signature*	*Date*

REVIEW OF ENVIRONMENTAL FACTORS

Memorial Drive Embankment Remediation Works

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01 February 2024

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Document status

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Approval for issue

Ian Richardson [redacted] 1 February 2024

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EXECUTIVE SUMMARY

This Review of Environmental Factors (REF) has been prepared in support of road embankment remediation works along Memorial Drive, The Hill.

The activity will involve stabilisation of the road embankment and other improvements along the nominated section of Memorial Drive. It will involve the construction of a retaining wall, re-establishment of the footpath, kerb and guttering improvements, installation of a handrail along the full length of the retaining wall and road pavement renewal. It will also involve the extension of the existing stormwater pit and pipe system further within the adjoining Nesca Park Reserve (Lot 4 DP 222421) and the construction of a rock lined channel at the open end of the extended stormwater pipe.

In approval terms, the proposed activity is classed as development without consent pursuant to Division 15, Clause 2.109 (3)(a)(ii), (c) and (d) and Division 20, Clause 2.137 (2)(c) of *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Transport and Infrastructure SEPP) which enables the activity to occur without development consent.

The proposed activity will result in minimal adverse effect upon the environment. Various minor environmental impacts have been identified in this REF and these are generally temporary in nature.

Based upon the information provided in this REF, there are no long-term adverse effects created by carrying out the activity. Construction impacts will be minor and minimised through appropriate mitigation and management. Therefore, no long-term operational impacts from the proposed activity are anticipated.

The REF examined and considered all relevant Commonwealth, NSW and local legislation and policies, along all matters affecting or likely to affect the environment by reason of the proposed activity. The proposed activity as described in the REF best meets the project objectives.

This REF was prepared in accordance with Section 5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It has concluded that the proposed activity is unlikely to significantly affect the environment and hence an EIS is not required to be prepared under section 5.7 of the EP&A Act. The proposed activity is also unlikely to affect Commonwealth land or have an impact on any MNES.

The proposed activity is unlikely to present a significant risk of harm to the environment and approval would be in the public interest.

1 INTRODUCTION

1.1 Background

An embankment remediation project is being planned by the City of Newcastle (CN), to prevent further slumping of land adjacent to the road reserve of Memorial Drive and the vicinity of 32 Memorial Drive, The Hill.

The project, herein referred to as to as the “activity” will involve stabilisation of the road embankment and other improvements along the nominated section of Memorial Drive to provide long term stability of the batter. It will involve the construction of a retaining wall, re-establishment of the footpath, kerb and guttering improvements, installation of a handrail along the full length of the retaining wall and road pavement renewal. It will also involve the extension of the existing stormwater pit and pipe system further within the adjoining Nesca Park Reserve (Lot 4 DP 222421) and the construction of a rock lined channel at the open end of the extended stormwater pipe.

In approval terms, the proposed activity is classed as development without consent pursuant to Division 15, Clause 2.109 (3)(a)(ii), (c) and (d) and Division 20, Clause 2.137 (2)(c) of *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Transport and Infrastructure SEPP) which enables the activity to occur without development consent.

The proposed activity will require the preparation of an REF pursuant to Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This obliges the determining authority, being CN, to assess all matters affecting, or likely to affect, the environment by the installation and construction of the proposed activity. This REF has been prepared for this purpose.

1.2 Location and description of existing environment

The proposed activity area is shown in **Figure 1** and **Figure 2**, with details of the proposed activity area outlined in **Table 1** below.

Table 1 Activity area details

Item	Details
Activity Area	Approximately 6,525m2
Zoning	RE1 – Public Recreation under *Newcastle Local Environmental Plan 2012.*
Cadastre	Lot 4 DP 222421 and Memorial Drive road reserve, The Hill.
Site Context and Existing Environment	The proposed works are located within the road reserve of Memorial Drive and the adjacent Lot 4 DP 222421 which is a land parcel associated with the larger Nesca Park located north of the activity area. Memorial Drive is a well-used coastal road, approximately 1.5 km in length, commencing from Merewether in the south to Cliff Street, The Hill in the north. The activity area is adjacent to existing residential development to the west and the east, Nesca Park to the north and Shepherds Hill / Khanterin Reserve to the south. The activity area slopes steeply to the north from the top of the Memorial Drive road reserve, where a number of small overland flow lines converge into a main first order channel fed by a stormwater pipe in the Southeast corner of the activity area. The activity area has been regenerated by volunteers and CN, restoring it from a weedy slope to a dense shrubland, containing native vegetation, with improving habitat value and slope stability. The steep slope lends itself to erosion, soil slumping and weed invasion.

Photographs showing the character of the activity area are provided in **Plate 1** to **Plate 10**.

Figure 1–1 Site Context and Location

Source: Bing Maps.

Figure 1–2 Proposed Activity Area (red)

Source: Bing Maps.

Plate 1 **Top of Memorial Drive looking west with temporary slope stabilisation measures**

Plate 2 **Top of Memorial Drive looking east with temporary slope stabilisation measures**

Plate 3 **Area where stabilisation and remediation will occur, looking north from Memorial Drive**

Plate 4 **Area where stabilisation and remediation will occur, looking south towards Memorial Drive**

Plate 5 Location of existing stormwater pipe headwall

Plate 6 Location point for temporary access way off Nesca Parade

Plate 7 **Looking south towards Lot 4 DP222421 off Nesca Parade**

Plate 8 **Existing inlet to pit and pipe stormwater system which conveys water across Nesca Parade into Nesca Park**

Plate 9 **Existing natural watercourse below the proposed rock lined open channel**

Plate 10 **Existing vegetation within Lot 4 DP222421**

2 NEEDS AND OPTIONS CONSIDERED

2.1 Strategic need for the proposed activity

CN has identified the need to stabilise the steep embankment associated with the Memorial Drive roadway (including footpath) and stabilise land surrounding the existing stormwater outlet on Lot 4 DP 222421. Works involve constructing a retaining wall, footpath, kerb, gutter, stormwater pit and pipe system and a rock lined open channel with an energy dissipator outlet.

The works will provide long term stability within the activity area, improve traffic and pedestrian safety, and improve the management of stormwater on site and downstream.

2.2 Project objectives

The project objectives of the embankment remediation works are to design and deliver better street infrastructure that:

- Increases public safety.
- Improves accessibility and comfort for pedestrians and vehicles.
- Upgrades existing road surfaces.
- Upgrades existing stormwater treatment.

2.3 Other options

The only other option would be “do nothing”. This option is considered to be sub-optimal as it does not address the current stabilisation issues and could lead to the exacerbation of land slumping and asset deterioration.

3 DESCRIPTION OF THE PROPOSED ACTIVITY

3.1 Introduction

The activity will entail stabilisation of the road embankment along the nominated section of Memorial Drive. It will involve the construction of a retaining wall, re-establishment of the footpath, kerb and guttering, installation of a handrail along the full length of the retaining wall, road pavement renewal and the removal and reinstallation of the existing guardrail along Memorial Drive. It will also involve the extension of the existing stormwater pit and pipe system into Nesca Park Reserve (Lot 4 DP 222421) and the construction of a rock lined channel at the open end of the extended stormwater pipe. The rock lined channel will create a meandering low-flow channel and connect with the existing natural water channel immediately below.

Concept plans for the Activity are contained in **Appendix B**.

3.2 Outline of construction works

It is understood that construction works will be completed by an external principal contractor. Works are scheduled to commence following approval of the proposed activity with completion within approximately twelve (12) weeks of commencement. Works are expected to commence in early 2023. The proposed works will include:

- Establishment of temporary works compound. Indicative locations outlined in **Figure 1**, with more detailed plans shown in **Figure 3–3**.
- Mobilisation of plant and equipment to the site.
- Physical establishment of activity area prior to works commencing, including site signage, barricades, fencing, stabilised site access, and temporary tree hoardings.
- Installation of temporary erosion and soil conservation measures prior to works commencing and maintenance throughout the project.
- Vegetation clearing for access and installation of new drainage infrastructure. A site access track from Nesca Parade will be established and traverse along the eastern boundary of the activity area adjacent to 32 Memorial Drive and 77 Nesca Parade.
- Disposal of vegetation and sediment material either off-site via rigid trucks to an approved waste exchange facility or distributed elsewhere on-site.
- Earthworks to enable suitable access for concrete piling, blockwork retaining wall construction, stormwater pipe extension and rock lined channel with an energy dissipator outlet.
- Re-construction of the existing 1200mm wide within the road reserve of Memorial Drive.
- Construction of a concrete retaining wall of varying heights up to a maximum of 1.8m, with associated 600mm concrete piling up to a depth of approximately 2 metres and associated backfill material and 100mm aggregate piping.
- Extension of an existing 450mm stormwater pipe, concrete headwall, and associated drop pits.
- Installation of a de-energising rock revetment immediately below the new concrete headwall.
- Associated safety upgrades, including reinstallation of W-beam safety beam, handrailing atop retaining wall, and kerb and guttering works.
- Revegetation/landscaping of disturbed areas as required.

3.3 Construction plant and equipment

The proposed activity will require the use of a range of equipment, including:

- General handheld power tools.
- Chain saws and mulchers.
- Truck mounted crane.

- Truck mounted piling equipment.
- Concrete truck.
- 8t and 20t excavator.
- Pozi track.
- 12t rigid truck.
- 10t front dump truck.

3.4 Construction hours

- Generally, construction will be undertaken during the following hours:
- Monday to Friday 7am to 6pm.

No construction work or deliveries will occur on weekends.

3.5 Temporary work compound establishment

A temporary stockpile and storage area would be situated within an eastern part of Nesca Park, north-west of the activity area, and will be confined to a small footprint. The extent and location of the temporary stockpile and storage area will retain safe pedestrian access within the Nesca Park area.

The indicative location of the temporary stockpile and storage areas is shown in **Figure 1**, with more detailed layout shown in **Figure 1–2**.

A temporary site compound is proposed in Nesca Park opposite 5 Greenslope Street as shown in Figure 3–1 below. The site compound will include a site office, crib rooms, ablutions, and a laydown facility. The site compound is proposed to be utilised from Approx March 2024 to October 2024.

Figure 3–1 Nesca Park Temporary work compound

In addition to the Nesca Park temporary work compound, alternate areas have been proposed. These include the Eastern end of Bar Beach Carpark (**Figure 3–2**) and Nesca Parade (**Figure 3–3**) as shown below

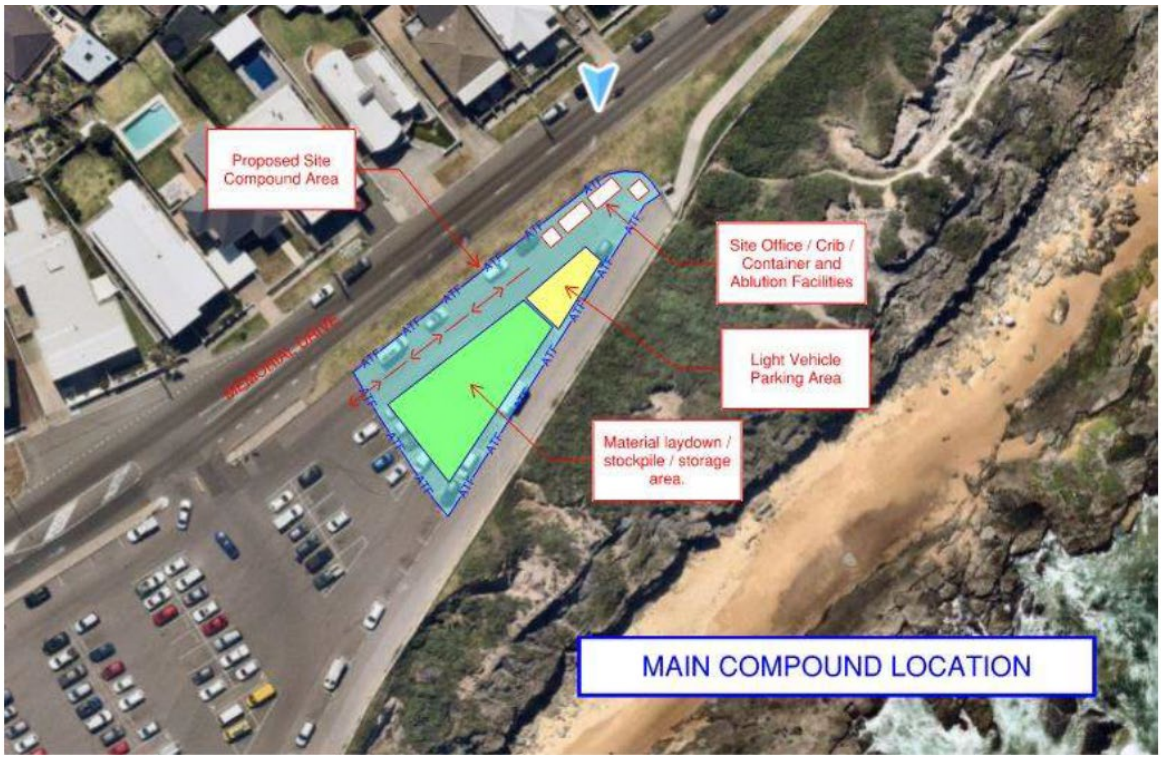

Figure 3–2 Bar Beach carpark temporary work compound

Figure 3–3 Nesca Parade temporary compound (North of Activity area)

3.5.1 Environmental Controls for erection of temporary compound

Prior to the establishment of temporary compound areas, suitable environmental controls will be implemented and will generally include the following:

- Erect site fencing to the full perimeter to delineate work areas.
- Establish “No go” zones for vegetation and tree protection and install tree protection as required.
- Stormwater management: siltation socks will be used at all stormwater outlets.
- Drainage swales (where required).
- Stockpile management including silt fencing around stockpiles to protect against runoff if necessary.
- Dedicated concrete washout facility within a bunded area.
- Designated refuelling area within a bunded area
- Vehicle wash down procedures.
- Correct storage of all chemicals and fuel on site.
- Spill containment equipment readily available and employees trained on how to use it.
- Appropriate signage.
- Dust suppression through the use of a watercart as required.
- Instream sediment controls and/or flow diversion measures as required.

Re-establishment of surface cover such as mulch, jute mesh or turf will be undertaken as soon as practical on completion of works.

Personal car parking will not be available on site or at the site compound therefore normal street parking will be utilised.

Additional environmental controls are provided for in **Section 6**.

3.6 Material import / export

The proposed activity is expected to generate waste requiring offsite disposal. Expected materials requiring offsite disposal include excess spoil, concrete, general worker waste, and construction materials excess. It is expected that some cleared vegetation and soil would be able to be re-used elsewhere within the activity area.

All materials requiring offsite disposal will be classified in accordance with the NSW EPA Waste Classification Guidelines, tracked, and disposed of at an appropriate licensed waste facility.

3.7 Construction environmental management plan

During construction, environmental safeguards and management measures referred to and detailed in this REF will be implemented. A Construction Environmental Management Plan (CEMP) will be prepared to ensure that all safeguards and management measures are implemented, and that construction impacts on the locality are managed.

3.8 Site access and security

Access to the site will be from Memorial Drive and via a temporary site access track running from Nesca Parade along the eastern boundary of the activity area adjacent to 32 Memorial Drive and 77 Nesca Parade.

Access from Memorial Drive will enable the retaining wall construction, the reconstruction and improvement works of Memorial Drive itself and slope stabilisation works. It will require the import of materials to the site, notably concrete, concrete blocks, piling material and suitable backfill material and the export excess earth spoil.

The temporary access track will enable access to the area for proposed extended stormwater pipe and the area for the proposed rock lined channel with energy dissipator outlet.

3.9 Land acquisition and access arrangements

No land acquisition is required for the construction of the proposed works.

4 KEY LEGISLATION

4.1 Environmental Planning & Assessment Act 1979

The *Environmental Planning & Assessment Act 1979* (EP&A Act) establishes the statutory for planning and environmental assessment in New South Wales. Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils. The EP&A Act contains two parts which impose requirements for planning approval, namely:

- Part 4 generally provides for the control of local development that requires development consent from the local Council. Part 4 also provides for State Significant Development; and
- Part 5 provides for the control of 'activities' that do not require development consent under Part 4 and are undertaken or approved by approved authorities.

The applicable approval process is generally determined by reference to the relevant environmental planning instruments and other controls. These include local environmental plans (LEPs) and State Environmental Planning Policies (SEPPs). Pursuant to Section 3.28 of the EP&A Act there is a general presumption that a SEPP prevails over a LEP in the event of an inconsistency.

This REF has been prepared for works not requiring development consent under Part 5 of the EP&A Act.

Sections 5.5 and 5.7 of the EP&A Act and section 171(2) of the EP&A Regulations identify the factors required to be taken into account by a determining authority when assessing the environmental impact of the proposed activity.

4.2 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the approval of the Minister for the Environment (Commonwealth) for actions that may have a significant impact on Matters of National Environmental Significance (MNES). The MNES under this Act are:

- World Heritage properties,
- National heritage places,
- Wetlands of international importance (Ramsar wetlands),
- Threatened species and ecological communities,
- Migratory species,
- Great Barrier Reef Marine Park,
- Commonwealth marine areas,
- Nuclear actions (including uranium mining),
- A water resource, in relation to coal seam gas development and large coal mining development.

The REF has assessed the above matters with respect to the proposed activity will not result in a significant impact on any MNES, and, as such, does not require a referral to the Minister for the Environment.

4.3 State Environmental Planning Policies (SEPPs)

4.3.1 State Environmental Planning Policy (Resilience and Hazards) 2021

Remediation of land

Chapter 3 of the *State Environmental Planning Policy (Resilience and Hazards) 2021* dictates that no development should be undertaken without investigation and appropriate action into the remediation of land, in order to improve the health of the natural and human environment. Hence, consent authorities must not grant approval unless it has assessed if the land is contaminated, and, if it is, that the land is suitable (or will be suitable after remediation) for its proposed use.

There is limited potential for the proposed activity to encounter contamination. If unexpected contamination is encountered and remediation is required, then the principal construction contractor of the proposed activity will need to undertake site investigations, in accordance with NSW EPA Guidelines. All contamination incidents or suspected contamination incidents will be notified to the EPA.

4.3.2 State Environmental Planning Policy (Biodiversity and Conservation) 2021

Chapter 3 of State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP) aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in Councils listed in Schedule 2 of the Biodiversity and Conservation SEPP. Chapter 3 is relevant to the study area though no Koala Feed Tree Species are present within the activity area. Therefore, the site would not be considered to constitute 'Potential Koala Habitat' and accordingly no further provisions of this policy would apply.

4.3.3 State Environmental Planning Policy (Transport and Infrastructure) 2021

Chapter 2 of the Transport and Infrastructure SEPP provides a planning regime for infrastructure and the provision of services across NSW, along with providing for consultation with relevant public authorities during the assessment process. The Transport and Infrastructure SEPP supports greater flexibility in the location of infrastructure and service facilities along with improved regulatory certainty and efficiency. Clauses 109 and 137 of the Transport and Infrastructure SEPP are applicable to the proposed activities, and are as follows:

Road Infrastructure Facilities

2.109 Development permitted without consent – general

(3) In this section and section 2.112, a reference to development for the purpose of road infrastructure facilities includes a reference to development for any of the following purposes if the development is in connection with a road or road infrastructure facilities-

(b) emergency works or routine maintenance works,

(d) environmental management works, if the works are in or adjacent to a road corridor.

Stormwater Management Systems

2.137 Development permitted without consent

(2) A reference in this section to development for the purpose of stormwater management systems includes a reference to development for any of the following purposes if the development is in connection with a stormwater management system-

(c) environmental management works

The proposed activities meet the definition of road infrastructure facilities and stormwater management systems under Section 2.109 and 2.137 of the Transport and Infrastructure SEPP respectively. Each clause provides that the proposed project is development permitted without consent and Part 5 of the EP&A Act is applicable. Therefore, the project REF is required for the works.

4.4 Local Planning Policies

4.4.1 Newcastle Local Environmental Plan 2012

Newcastle Local Environment Plan 2012 (NLEP 2012) is a legal document that provides controls for development within Newcastle City to control the uses of private and public land through zoning. The area where the works are proposed is zoned as RE1 Public Recreation, refer to **Figure 3.**

R2 Low Density Residential

R3 Medium Density Residential

RE1 Public Recreation

W2 Recreational Waterways

Figure 4–1 Zoning map extract. ***Source: ePlanning Spatial Viewer.***

This REF has been prepared under the conditions of Part 5 of the EP&A Act and consequently the provisions of the NLEP 2012 do not apply. As a point of reference, however, the objectives of the RE1 Public Recreation zoning are as follows:

- To enable land to be used for public open space or recreational purposes.
- To provide a range of recreational settings and activities and compatible land uses.
- To protect and enhance the natural environment for recreational purposes.

The activity will enable the continuation of a road which is a compatible land use within the RE1 zoning and through the proposed stormwater upgrades protect and enhance Nesca Park for recreational purposes.

4.5 Other legislative requirements

4.5.1 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) and supporting regulations establish a modern and integrated legislative framework for land management and conservation in NSW. The purpose of the BC Act, with reference to the assessment of development (Part 4 of the EP&A Act) or activities (Part 5 of the EP&A Act), is:

(k) to establish a framework to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity

(l) to establish a scientific method for assessing the likely impacts on biodiversity values of proposed development and land use change, for calculating measures to offset those impacts and for assessing improvements in biodiversity values

(m) to establish market-based conservation mechanisms through which the biodiversity impacts of development and land use change can be offset at landscape and site scales

The assessment requirement for Proponents acting under Part 5 of the EP&A is described in Section 7.3 of the BC Act (i.e. Assessment of Significance or Five-Part Test). This assessment is performed to determine if the proposal is likely to significantly affect threatened species or ecological communities, or their habitats. If it is determined that a Proposal is likely to significantly affect threatened species or ecological communities, or their habitats, then one of the following two assessments are required:

- Species Impact Statement (SIS) under Part 7 Division 5 of the BC Act or;
- Biodiversity Development Assessment Report (BDAR) under Section 7.13 of the BC Act (optional).

The activity area does not occur on an area mapped on the NSW Biodiversity Values Map. The proposed activity is not expected to significantly affect threatened species or ecological communities, or their habitats.

A Biodiversity Report has been prepared to assess the impact of vegetation clearing associated with the activity and the Report is contained in **Appendix C**.

4.5.2 Fisheries Management Act 1994

Clause 221ZZ of the *Fisheries Management Act 1994*, sets out concurrence or consultation requirements if a Minister is not a consent authority under Part 4 or determining authority under Part 5 of the EP&A Act. Clause 221ZZ (3) is relevant and is set out as follows:

(3) The determining authority is not to carry out the activity, or grant an approval to carry out the activity, if the activity is likely to significantly affect threatened species, populations or ecological communities, unless the determining authority has obtained the concurrence of the Fisheries Agency Head.

The proposed activity is unlikely to significantly affect threatened species, populations or ecological communities and concurrence or consultation under this act is not applicable to the proposed works.

4.5.3 Water Management Act 2000

Section 91 of the *Water Management Act 2000* sets out requirements relating to approvals required to undertake controlled activities on waterfront land. Public authorities are exempt from the need to obtain a controlled activities approval under the *Water Management (General) Regulation 2018*.

4.5.4 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* (CLM Act) is administered by the NSW Environment Protection Authority (EPA) and local councils. It provides a regime for investigating and, where appropriate, remediating land affected by contamination which represents a significant risk of harm to human health or the environment. The CLM Act specifies responsibilities for managing contaminated land and the role of the EPA in the assessment of contamination and the supervision of the investigation, remediation, and management of contaminated sites.

There is limited potential for the proposed activity to encounter contamination. If unexpected contamination is encountered and remediation is required, then the principal construction contractor of the proposed activity will need to undertake site investigations, in accordance with NSW EPA Guidelines. All contamination incidents or suspected contamination incidents will be notified to the EPA.

4.5.5 Heritage Act 1977

The *Heritage Act 1977* is concerned with the protection of scheduled heritage items, sites and relics. The NSW Heritage Office administers this Act. It is an offence under the *Heritage Act 1977* to disturb any relics. Relics, as defined in the *Heritage Act 1977* means any deposit, artefact, object or material evidence that:

- Relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
- Is of State or local heritage significance.

The proposed works are not located in a heritage conservation area, nor do they affect any items of heritage significance listed in Schedule 5 of NLEP 2012. Notwithstanding this, an unexpected finds protocol shall be implemented in the event that any potential heritage items are uncovered during excavations.

4.5.6 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is relevant to the protection of Aboriginal artefacts and the protection of native flora and fauna. Consent is required under Section 90 (2) of the NPW Act to destroy an Aboriginal artefact.

A basic AHIMS search was undertaken on 6 September 2022 encompassing Lot 4 DP 222421 with a 200m buffer. This search identified no sites within the search parameters or located within the proposed activity area. The AHIMS search is contained in **Appendix D**.

Due to there being no Aboriginal sites identified, it is considered unlikely the activity will impact upon an Aboriginal site or place, but notwithstanding this, it is recommended that an unexpected finds protocol be implemented in the event that any potential heritage items are uncovered during the works.

4.5.7 Protection of the Environment Operations Act 1997

One of the aims of the *Protection of Environment Operations Act 1997* (PoEO Act) is to reduce risks to human health and prevent the degradation of the environment by the use of mechanisms that promote the following:

- Pollution prevention and cleaner production.
- The reduction to harmless levels of the discharge of substances likely to cause harm to the environment.
- The elimination of harmful wastes.
- The reduction in the use of materials and the re-use, recovery or recycling of materials.

- The making of progressive environmental improvements, including the reduction of pollution at source.
- The monitoring and reporting of environmental quality on a regular basis.

The proposed works are not a scheduled activity pursuant to Schedule 1 of the PoEO Act.

4.6 Summary

Section 6 and **Appendix A** of this REF provide an assessment of the environmental issues associated with the proposed activity, in line with the requirements of the EP&A Act and relevant Commonwealth legislation.

5 CONSULTATION

5.1 Community consultation

Project neighbours will need to be kept informed of the project work particularly during the construction stage.

Individual consultation will be undertaken with landowners / occupiers of:

- 30 and 32 Memorial Drive, The Hill.
- 2 and 4 Fenton Avenue, Bar Beach.
- 73, 73A, 75, 77, 79 and 81, Nesca Parade, The Hill.
- Any other applicable community sporting group.

Communication methods may include emails, weekly meetings, website updates, letter box drops and face to face meetings. Landowners in the locality will be advised by letter prior to the works commencing.

5.2 Consultation under State Environmental Planning Policy (Transport and Infrastructure) 2021

Requirements for consultation with public authorities for such activities are set out in Part 2, Division 1 of the Transport and Infrastructure SEPP.

Clause 2.15 of the Transport and Infrastructure SEPP identifies 'specified development' that should be referred to 'specified authorities. However, this REF is not specified for the following reasons:

- The subject site is not land nor adjacent to land reserved under the NPW Act and therefore does not require referral to the NSW Office of Environment and Heritage (OEH) for this purpose,
- The development is not on land zoned E1 National Parks and Nature Reserves,
- The subject site is not adjacent to an aquatic reserve under the *Marine Estate Management Act 2014* and therefore does not require referral to the Department of Industry for this purpose,
- The subject site is not development in the foreshore area within the meaning of the *Sydney Harbour Foreshore Authority Act 1998 and* therefore does not require referral to the Sydney Harbour Foreshore Authority,
- The development does not comprise a fixed or floating structure in or over navigable waters and therefore does not require referral to the Maritime Authority of NSW,
- The development is not for the purposes of an education establishment, health services facility, correctional centre, or group home, or for residential purposes in an area that is bush fire prone land (as defined by the EP&A Act), and therefore does not require referral to the Rural Fire Service.

Therefore, consultation with public authorities under the Transport and Infrastructure SEPP is not required for this REF.

5.3 Government agency and stakeholder involvement

The nature of the proposed activity has not required consultation at this point with the above-mentioned agencies nor other government agencies.

5.4 Aboriginal community consultation

Before a proposed activity commences, the potential impacts on Aboriginal cultural heritage should be identified and managed appropriately. A desktop risk assessment to determine whether a proposed activity is likely to harm Aboriginal cultural heritage or not and whether further assessment or investigation is required has occurred. A search was undertaken of the Aboriginal Heritage Information Management System (AHIMS) on 6 September 2022 to determine if there were any registered sites within the subject site and the

broader area and the results are contained in **Appendix D**. No registered sites or places were found within the proposed activity area or within a buffer of 200m from the site.

Based upon the above information the proposed activity does not present any potential impacts on Aboriginal cultural heritage and no further Aboriginal cultural heritage consultation or investigation is required. Notwithstanding this, it is recommended that an unexpected finds protocol be implemented in the event that any potential heritage items are uncovered during the works.

5.5 Ongoing or future consultation

As the proposed activity area is located within a mine subsidence district, approval is required from the Subsidence Advisory NSW prior to works. No future consultation, aside from the above, is required

6 ENVIRONMENTAL ASSESSMENT

This section of the REF provides a description of the potential environmental impacts associated with the proposed activity during both construction and operation and provides site-specific mitigation measures to ameliorate the identified potential impacts.

6.1 Potential impacts

6.1.1 Construction

Potential construction impacts include:

- Biodiversity.
- Water quality, soils, hydrology and flooding.
- Air quality.
- Noise.
- Aboriginal heritage.
- Non-Aboriginal heritage.
- Visual amenity.
- Bushfire.
- Waste.
- Traffic and access.
- Socio-economic.
- Contamination.
- Climate change and hazards.
- Cumulative impacts.
- Ecologically sustainable development.

6.1.2 Operation

There will be no ongoing negative operational impacts resulting from the proposed works. Overall, the works will have a positive impact.

6.2 Biodiversity

The activity area has not been identified as within an area of significant Biodiversity Value, as according to the NSW online mapping tool. The site consists of coastal bushland with limited weed presence, with a relatively consistent north facing slope. The existing drainage system consists of a 450mm stormwater pipe with a dilapidated concrete headwall, and no water de-energising solution, leaving the existing gully in a heavily eroded state. The southeast of the site additionally suffers from slope instability, with land slips having necessitated the establishment of temporary environmental protection measures, closing a section of the footpath along Memorial Drive.

A Biodiversity Report for the site was prepared by Litoria and is contained in **Appendix C**. This report undertook a flora and fauna assessment and a 5-part test for the grey-headed flying fox, which utilise the Date Palm Trees onsite as a food source.

6.2.1 Construction impacts

The activity includes the creation of a temporary 4m wide pathway for the ingress and egress of construction vehicles. Vegetation considered to be of low retention value is proposed to be cleared for this pathway, as shown in **Figure 6**–1.

The activity would not produce a loss of vegetation cover that would have a significant impact on a threatened species, ecological community or its habitat listed under the BC Act (ie. No loss of habitat for a threatened species or ecological community).

EPBC Considerations

MNES likely to be impacted by the activity have been assessed in accordance with the *Matters of National Environmental Significance – Significant Impact Guidelines 1.1* (Department of the Environment 2013). The MNES relevant considerations are addressed in **Appendix A**.

No nationally listed Threatened Ecological Communities were considered to be present within the activity area. Species such as the Grey-headed Flying-fox would likely utilise the study area for foraging. The proposal will result in a small incremental loss of habitat foraging and roosting/nesting habitat for a small number of these species in the local area, however it is not likely to have a significant impact and require referral. The primary food source within the activity area for the Grey-headed Flying-fox, Date palms, will be protected by timber hoardings onsite, though may require a limited amount of pruning due to their overhang over the proposed pathway. The 5-part test carried out as a result of this within the Biodiversity Report demonstrated that there will be no significant impact to the Grey-headed Flying-fox as a result of the proposed vegetation removal.

Additionally, Magenta Lilly Pilly (*Syzygium paniculatum*) was found planted throughout the site, likely as a regrowth effort, and care must be taken to protect and retain these plantings.

Considering the relatively small impact on habitat in the locality it is unlikely that any threatened ecological community, threatened species or any of the listed migratory species would be significantly affected by the proposal.

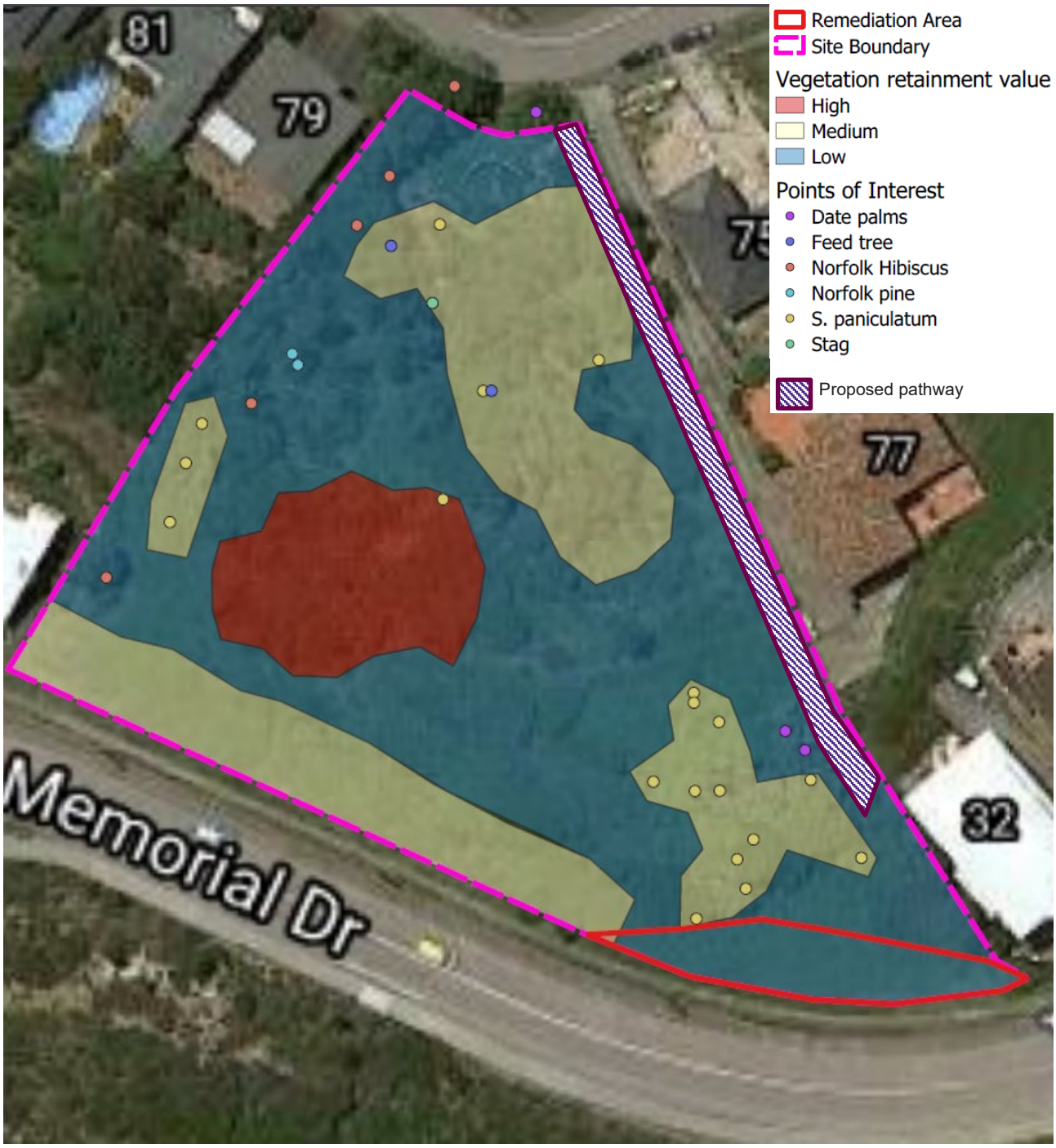

Figure 6–1 Site Vegetation Map.

Source: Litoria.

6.2.2 Operational impacts

There will be a positive long-term operational impact in that the activity will deliver an environmentally sensitive drainage infrastructure that marries with the environmental condition of the bushland parcel. Proposed works will improve the headwall resilience and follow up bush regeneration work will restore disturbed areas created during construction back to bushland condition. Additionally, the proposed retaining wall will protect the vegetation onsite from future soil erosion and slope instability.

6.2.3 Safeguards and management measures

The following measures are recommended to manage impacts to vegetation:

- Any cleared access ways or vegetation removal should be restricted to areas of low vegetation retainment value.
  - If areas of medium vegetation retainment value need to be cleared, canopy trees should be avoided due to the concentrated numbers of fauna observed feeding and roosting in these trees.
- Magenta Lilly Pilly plants should be retained and flagged. If they are required to be removed, the entire root ball and surrounding soil should be removed and translocated into a low disturbance area and watered until re-established.
- Access with machinery into high vegetation retainment value areas should be avoided.
- Dead standing timber and logs should be retained as habitat where practical.
- All trees with the potential to be affected by works will be protected by timber hoardings to avoid impacts.
- Revegetation should be done using species from local provenance stock, including the addition of fleshy fruited species.
  - Species along the embankment should have complex root systems with both shallow and deep roots for long term soil stability.
- A Project Arborist should be on-site during access track construction (tree removal and tree pruning) to ensure the design is sensitive to the protection requirements of trees worthy of retention and that these trees will not be compromised by the activity.
- Dispose of all rubbish and surplus material within 24 hours of completion.

6.3 Water quality, soils, hydrology and flooding.

The activity area is not located within a water catchment area, nor does it drain into any Hunter Water special areas. The proposed works will primarily be located at the top of the existing catchment and at the end of an existing stormwater drainage headwall which drains into an unnamed gully.

The activity area is located within a Mine Subsidence District. The nature of the work is confined to an area of historically disturbed ground and impacts from mine subsidence are unlikely. It is suggested that consultation with the Subsidence Advisory NSW occur prior to commencement of works.

The site is located in area wholly contained within an area affected by Class 5 Acid Sulfate Soils. The proposed works are not within 500m of another Acid Sulfate Soils Class, nor does the activity require works by which the water table is likely to be lowered below 1m AHD. The site is not subject to flooding.

A Geotechnical Assessment of options for the long-term stability of the batter below Memorial Drive has been carried out and is contained in **Appendix E.**

6.3.1 Construction impacts

The proposed activity involves excavation and reshaping works, along with concrete piling up to a depth of approximately 5 metres and associated backfill with suitable material. Works also includes the extension of an existing 450mm stormwater pipe, concrete headwall, and associated drop pits and the installation of a de-energising rock revetment immediately below the new concrete headwall.

The site is moderately vegetated and hence works may require disturbance of vegetation to enable the construction of an access route along the eastern boundary of the activity area.

Construction activities may generate dust and surface water from site preparation activities and from vehicles driving in and out of the area during construction and the proposed temporary site compound and laydown areas.

As there is no need to undertake deep excavation for construction, there will be no impact to groundwater resources. Surface water across the activity area will be managed in accordance with Landcom *Managing*

Urban Stormwater – Soils and Construction (the Blue Book) to ensure any impacts to surface water are minimised.

6.3.2 Operational impacts

The proposed activity will provide support to the existing stormwater system at the site. It will provide erosion stabilisation works at the end of the proposed extended stormwater pipe and create a meandering low-flow channel using selected rocks at differing heights. At it's lowest point the proposed rock lined channel will connect with the existing natural ground level and drainage line.

6.3.3 Safeguards and management measures

The following measures are recommended to minimise impacts associated with soil, water and stormwater runoff during construction:

- Sediment and nutrient controls, prepared in accordance with the *Landcom Managing Urban Stormwater - Soils and Construction* (the Blue Book), will be implemented to reduce the impacts of stormwater, erosion, and sedimentation on water quality. Specific erosion and sediment controls are to be contained within the site CEMP. All erosion and sediment control measures will be established before excavation and vegetation clearance begins. Control measures are to remain in place until all surfaces have been fully restored and stabilised.
- Sediment and erosion control devices will be inspected regularly, maintained to ensure effectiveness over the entire duration of the project, and cleaned out before 30% capacity is reached.
- Any temporary stockpiles and laydown area will have appropriate erosion control devices installed to control runoff and prevent sedimentation, including siltation socks to be used at all stormwater outlets, drainage swales (where required), and instream sediment controls and/or flow diversion measures as required.
- Upslope surface runoff will be redirected around work areas by using diversion drains or other methods.
- Sediment fences down slope of all disturbed areas and material stockpile areas.
- Site disturbance will be minimised by containing machinery access to site areas required for approved construction works.
- Erosion potential would be limited by managing runoff fetches and velocities, with measures such as contour drains, silt fences and level spreaders.
- Sediment filters such as silt fences and coir bales will be located downstream of disturbed areas.
- No chemicals, fuels, and/or waste will be stored or collected for disposal within or adjacent to drainage lines or unsealed surfaces. Nevertheless a 'spill kit' will be always kept on site for potential chemical or fuel spills.
- Drainage systems will be checked at regular intervals and maintained to ensure they are operating at full capacity (e.g., clearance of debris from drainage lines).
- Options for the long-term stability of the batter below Memorial Drive are to be consistent with the recommendations of the Geotechnical Assessment (Douglas Partners, 13 May 2022).
- Consultation with the Subsidence Advisory NSW should occur prior to commencement of works.

6.4 Air quality

The activity is not located within an area that typically experiences poor air quality.

6.4.1 Construction impacts

Construction of the proposed activity will involve ground disturbance and will have the potential to generate dust. Dust emissions associated with the proposed activity would be consistent with dust emissions from routine street maintenance works and would be temporary and short-lived in duration. Dust from the activities can be adequately minimised and managed using a suite of controls typically adopted to manage

dust on construction sites, and these are included below. Any air quality impacts associated with the emissions from vehicles and plant associated with the proposed activity would be minor, highly localised, temporary, and short-lived in duration.

6.4.2 Operational impacts

It is unlikely that any air quality issues would be experienced during operation.

6.4.3 Safeguards and management measures

The following mitigation measures are recommended to minimise impacts associated with air quality during construction:

- All vehicles and machinery will be fitted with approved exhaust systems to maintain exhaust emissions within accepted standards.
- Machinery and vehicles will not be left running or idling when not in use for long periods.
- Odour or air pollutant emission complaints will be dealt with promptly and the source will be eliminated wherever practicable.
- All loads of excavated material, soil, fill and other erodible matter that are transported to or from the work site will be kept covered at all times during transportation and will remain covered until they are reused or disposed of at an EPA licensed waste disposal facility.
- All work sites, general work areas and stockpiles will be closely monitored for dust generation and watered down (with clean water) or covered (via seeding or tarpaulins) in the event of dry and/or windy conditions.
- Dust suppression through the use of a watercart as required

6.5 Noise

The site is predominantly regrowth bushland within a residential context. The nearest residential receivers are immediately adjacent to the site along the eastern and western boundaries. The northern and southern boundaries have immediate road frontage with vegetated areas being situated across from the site along both sides.

6.5.1 Construction impacts

The primary source of construction noise will be from machinery associated with the works. These impacts will be short term and would include associated traffic movements. Works will include the use of a 20t excavator, heavy trucks, and potentially portable generators. The noise generated by this equipment would be consistent with and generally indistinguishable from other construction noise sources expected on private construction sites.

6.5.2 Operational impacts

Noise during operation would be similar to noise which is currently experienced on the site.

6.5.3 Safeguards and management measures

In line with industry best practice, the following mitigation measures are recommended to minimise the impact of potential construction noise from the proposed activity on residential receivers:

- All equipment used will comply with AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites.
- Work and deliveries will only occur during the following times: Monday to Friday 7am to 6pm. No construction work or deliveries will occur on weekends.

- Regular and effective maintenance of all equipment, including vehicles moving on and off the site, will be conducted.
- Plant and equipment which is used intermittently will either be shut down in the intervening periods between works or throttled down to a minimum.
- Any portable equipment with the potential to create high levels of noise (e.g. generators) will only be selected for use if it incorporates effective noise control. This equipment should be located, where practical, so that natural ground barriers are between it and the nearest potentially affected receivers.

6.6 Aboriginal heritage

A search was undertaken on the Aboriginal Heritage Information Management System (AHIMS) to determine if there were any registered sites within the activity area (and a 200m buffer around the activity area), with the results provided in **Appendix D**. No Aboriginal site or places of significance are recorded within 200m of the activity area.

It is recommended that the CEMP for the works include an unexpected finds protocol to be developed and implemented in the event that any potential heritage items are uncovered during excavation.

6.6.1 Construction and operational impacts

Based upon the above information the proposed activity does not present any potential impacts on Aboriginal cultural heritage and no further Aboriginal cultural heritage consultation or investigation should be required. There is unlikely to be any impacts on Aboriginal heritage during operation.

6.6.2 Safeguards and management measures

The following mitigation measures should be applied throughout the duration of works:

- If suspected Aboriginal objects are identified during construction the following procedures must be followed.
  - Immediately cease all activity at the location.
  - Ensure no further harm occurs, secure the area.
  - Notify Environment Protection Authority's Enviro Line on 131 555, Awabakal LALC on +61 2 4965 4532 and an archaeologist (RPS +61 2 4940 4200).
  - No further action to be undertaken until Heritage NSW provides written consent.
- It is recommended that the CEMP for the works include an unexpected finds protocol to be developed and implemented in the event that any potential heritage items are uncovered during excavation.

6.7 Non-Aboriginal heritage

A search of the following registers was undertaken to identify heritage sites within the vicinity or within the activity area.

- NLEP 2012.
- New South Wales State Heritage Register.
- Australian Heritage Database.

The search of NLEP 2012 did not identify the activity area to be within an area of historical interest. The search of both the Australian Heritage Database and the New South Wales State Heritage Register did not identify any heritage items in the area. The nearest site of non-Aboriginal heritage significance is the State Heritage listed 'Shepherds Hill Defence Group Military Installations' (listing no. 01806), located roughly 90m from the activity area.

6.7.1 Construction and operational impacts

The activity has a limited impact area and is considered unlikely to have any impact on non-Aboriginal heritage at the construction or operational stage. Nevertheless, due to the depth of the works for the retaining wall, an unexpected finds protocol for suspected archaeological items is suggested as an appropriate mitigation measure during the construction phase.

6.7.2 Safeguards and management measures

If, during the course of development works, cultural heritage material is uncovered, work should cease in that area immediately. The NSW Heritage Branch should be notified and works only recommence when an appropriate and approved management strategy instigated.

6.8 Visual amenity

The visual amenity of the activity area is characterised by regrowth and natural bushland within a residential environment, refer to Plate 1 to Plate 10. Memorial Road represents the southern boundary of the activity area. From Memorial Drive the land slopes steeply to the north, where a number of small overland flow lines converge into the main first order channel fed by a stormwater pipe in the Southeast corner of the site. The site has been regenerated by volunteers and City of Newcastle, restoring it from a weedy slope to a dense shrubland, containing native vegetation, with improving habitat value and slope stability. The steep slope lends itself to erosion, soil slumping and weed invasion.

6.8.1 Construction impacts

The proposed works would create temporary visual impacts due to ground disturbance including installation of safety fences, weed clearing, soil disturbance, presence of machinery and movement of vehicles. The works will be short term and once completed will result in an improved visual amenity.

6.8.2 Operational impacts

The proposed works are limited in scale and once installed will either not be visible from publicly accessible areas or will be an improvement to the existing streetscape, which is currently disturbed by slope instability.

6.8.3 Safeguards and management measures

The following mitigation measure is recommended during construction:

- During construction works the site shall be kept in a clean and orderly manner to reduce the visual impact to reserve users.

6.9 Bushfire

The activity area is not located within an area considered to be Bushfire Prone Land.

6.9.1 Construction impacts

Some activities, such as the use of grinders and saws, have the potential to start spot fires during abnormally dry and windy conditions. Due to this, spark-generating activities should not occur during abnormally dry and windy conditions.

6.9.2 Operational impacts

Once in operation it is unlikely that the activity will be more susceptible to bush fire events.

6.9.3 Safeguards and management measures

The following mitigation measure is recommended during construction:

- Spark-generating activities should not occur during abnormally dry and windy conditions.

6.10 Waste

6.10.1 Construction impacts

The majority of waste produced as a result of the proposed activity is expected during the construction period. Potential waste streams include:

- Construction waste (Spoil).
- Domestic waste generated by site personnel.
- Waste oils and liquids from vehicles / machinery.
- Vegetation offcuts and cleared materials.

An effort would be made during the construction phase to minimise waste by reusing and recycling materials wherever possible. The guard rail to be removed will be reinstalled and reused where possible unless damaged. All waste produced as a result of the proposed works would be disposed of in an appropriate manner. Waste material generated as part of the proposed works would not have an adverse impact on any other environmental systems.

6.10.2 Operational impacts

It is not anticipated that there will be any operational waste associated with the project.

6.10.3 Safeguards and management measures

Management of waste during the construction phase should be in accordance with the principles of the waste hierarchy as detailed in the *Waste Avoidance and Resource Recovery Act 2001.* Any waste generated during construction will be classified in accordance the NSW EPA Waste Classification Guidelines (2014). Waste that cannot be avoided, reused, or recycled will be classified in accordance with the Waste Classification Guidelines and disposed of at appropriately licensed facilities.

The following mitigation measures should be applied throughout the duration of the works:

- Wherever possible waste generated during site preparation and construction will be reused. Waste that cannot be avoided, re-used, or recycled will be managed in accordance with the principles of the *Waste Avoidance and Resource Recovery Act 2001* and classified in accordance with the Waste Classification Guidelines and disposed of at appropriately licenced facilities.
- All waste generated during the works will be reused or removed from the work areas as soon as practicable and disposed of in accordance with the waste disposal safeguards.
- All vessels used for contaminated or hazardous waste should be sealed, labelled according to their contents, and stored within bunded areas until their removal from the work site.
- Any fuel, lubricant or hydraulic fluid spillages will be collected using absorbent material and the contaminated material disposed of at an EPA licensed waste depot.
- In the unlikely event of a pollution incident, the relevant authorities will be notified in accordance with Clause 148 of the POEO Act and remedial actions undertaken. Environmental incident response and notification procedures will be detailed in the CEMP prior to the commencement of construction.
- The work site will be left clean and free of debris and other rubbish at the end of works.
- All hazardous wastes on site will be removed and disposed in accordance with the state and national regulations and guidelines and best practice for the removal of these materials.
- Off-cuts of materials used will be recycled where possible.

- Treatment, handling and disposal methods for contaminated soils, when encountered, will be done in accordance with NSW EPA Guidelines. Contaminated soils will be disposed of at an EPA licensed waste depot.

6.11 Traffic and access

6.11.1 Construction impacts

The activity area is immediately bordered by two roads, Nesca Parade in the north, and the classified road Memorial Drive to the south. Access from Nesca Parade to the south of the site will be facilitated by a temporary access track running along the eastern boundary of the site, which will be cleared as a part of the initial site preparation works. A temporary work compound will be established in the eastern part of Nesca Park along Nesca Parade, as shown in **Figure 1**–1 and **Figure 1–2**, from which workers and light equipment will access the site via the cleared access track. Heavy vehicles, including concrete trucks and 20t excavator, will access the site from the south via Memorial Drive. Due to the presence of these vehicles there may be disruptions to pedestrian and vehicle traffic during this period of works, including pedestrian footpath closures and partial lane closures.

In addition, alternate temporary construction and laydown areas proposed in Section 3.5 are expected to experience similar impacts as those described above.

Temporary access restrictions or diversions may be required during construction due to excavation. The proposed activity is unlikely to have significant impacts on the existing environment due to the temporary nature of the works.

6.11.2 Operational impacts

It is not anticipated that there will be any operational impacts to traffic associated with the project. Pedestrian traffic will benefit from the improved footpath quality.

6.11.3 Safeguards and management measures

The following measures are recommended to manage traffic disruption:

- CN will maintain a complaint register. Any complaints received will be responded to as soon as possible.
- A traffic control plan shall be prepared by a suitably qualified person, detailing construction movements and controls, prior to commencement of work on the site.
- Work areas shall be bounded by fencing or barriers to prevent pedestrian access. Including:
  - The erection of site fencing to the full perimeter to delineate work areas; and
  - The establishment of “No go” zones for vegetation and tree protection.
- Safe, alternative access should be provided for pedestrians where required.

6.12 Socio-economic

6.12.1 Construction and operational impacts

There will be minor short term impacts during construction on the users of Nesca Park and the alternate stockpile laydown area at the northern end of Bar beach car park and on Nesca parade. This may include the presence of machinery and associated traffic movements, and the minor visual impacts of these, moving between the stockpile area and the activity area. Impacts will be for a short period of time and will not create any long-term socio-economic issues. Minor visual impacts during construction will be confined to soil disturbance, and the presence of machinery and associated noise and workers’ vehicles.

The proposed activity will not result in any substantial social or economic impacts during operation.

6.12.2 Safeguards and management measures

Provided that the mitigation measures documented in this REF are implemented there will be no significant socio-economic impacts other than the positive impact of delivering an environmentally sensitive constructed stormwater solution, retaining wall and footpath restoration that is commensurate with the environmental condition of the surrounding bushland and roadway.

6.13 Contamination

Council records do not indicate the presence of contamination of the site. The sub-surface of the site may contain contaminants due to historic use of industrial soil waste as fill within the region and air borne industrial emissions. The proposed activity itself is unlikely to create contamination.

6.13.1 Construction impacts

Construction activities such as earthworks will increase the risk of soil erosion and sediment laden runoff, though such impacts will be minimized through the implementation of the safeguards and management measures detailed in Section 6.3. Construction activities may disturb existing but as yet unknown contaminants beneath the ground surface.

6.13.2 Operational impacts

There is unlikely to be any contamination issues during operation, the activity will retain what is existing at the site.

6.13.3 Safeguards and management measures

The following measures are recommended:

- An unexpected finds protocol shall be developed and implemented in the event that any potentially contaminated soils or materials are uncovered during excavations.
- Treatment, handling, and disposal methods for contamination, when encountered, will be done in accordance with EPA Guidelines.
- All potentially contaminated soil excavated must be stockpiled in a secure area and be assessed and classified in accordance with the Waste Classification Guidelines (EPA, 2014) before being transported from the site for disposal at an appropriately licensed waste facility.
- Following excavation, validation sampling of the footprint of the activity area is to occur to determine the suitability of the land for the purpose of the activity.

6.14 Climate change and hazards

An increase in the global concentration of greenhouse gas has led to an increase in the earth's average surface temperature and has contributed to the phenomenon of 'climate change'. The State of the Climate 2020 (CSIRO and Bureau of Meteorology 2020) report confirms that Australia's climate has warmed on average by 1.44 ± 0.24 °C since national records began in 1910, leading to an increase in the frequency of extreme heat events.

Other findings from the report indicate that in the southeast of Australia there has been a decline of around 12 per cent in April to October rainfall since the late 1990s. There has been a decrease in streamflow at the majority of streamflow gauges across southern Australia since 1975. Rainfall and streamflow have increased across parts of northern Australia since the 1970s. There has been an increase in extreme fire weather, and in the length of the fire season, across large parts of the country since the 1950s, especially in southern Australia.

Oceans around Australia are acidifying and have warmed by around 1°C since 1910, contributing to longer and more frequent marine heatwaves. Sea levels are rising around Australia, including more frequent extremes, that are increasing the risk of inundation and damage to coastal infrastructure and communities.

The NSW and ACT Regional Climate Modelling (NARCliM) is a partnership between the NSW, ACT and South Australian governments and the Climate Change Research Centre at the University of NSW. NARCliM provides high resolution climate projections at a scale that supports local decision makers.

Based on long-term (1910–2011) observations, temperatures in the Hunter Region have been increasing since about 1960, with higher temperatures experienced in recent decades.

The region is projected to continue to warm during the near future (2020–2039) and far future (2060–2079), compared to recent years (1990–2009). The warming is projected to be on average about 0.7°C in the near future, increasing to about 2°C in the far future. The number of high temperature days is projected to increase in parts of the region, with fewer potential frost risk nights anticipated.

The warming trend projected for the region is large compared to natural variability in temperature and is of a similar order to the rate of warming projected for other regions of NSW. The Hunter Valley currently experiences considerable rainfall variability across the region, seasons and from year-to-year and this variability is also reflected in the projections. However, most models agree that autumn rainfall will increase.

With the implementation of management measures identified below there are not expected to be any significant impacts associated with climate change during construction.

- The use of alternative fuels and power sources for construction plant and equipment will be investigated and implemented, where appropriate.
- Recycled materials will be incorporated where possible.
- The energy efficiency and related carbon emissions will be considered in the selection of vehicle and plant equipment.

During operation, routine inspections, and maintenance would be carried out to ensure any issues are identified and appropriately managed. There are not expected to be any significant impacts associated with climate change during operation.

6.15 Cumulative impacts

The impacts on the environment due to the construction of the proposed activity are considered to be minor. There will be a change in the type of vehicles entering the activity during construction due to work trucks and employee vehicles.

Cumulative impacts could occur if the construction of the proposed activity coincided with the construction of other projects particularly any that may be contemplated within adjacent land.

It is anticipated that potential adverse cumulative impacts would relate to the temporary increase in construction traffic and cumulative noise and air impacts. These impacts would be largely avoidable through consulting with respective divisions within Council, if necessary, to ensure that the proposed construction works do not coincide with other as yet unknown developments and/or routine maintenance activities. Where conflicting construction schedules are unavoidable, cumulative construction impacts would be manageable through the implementation of the safeguards and mitigation measures identified in this REF.

It is considered unlikely that the construction of the proposed activity would result in adverse cumulative impacts with respect to vegetation loss. The proposed works will deliver road rehabilitation that will benefit the community and minimise impact on surrounding natural vegetation. Additionally, vegetation that is cleared on site will be replaced with native vegetation upon the completion of the works.

Positive cumulative social impacts will result from the proposed activity as it will restore a segment of footpath along Memorial Drive and decrease soil erosion and instability.

The assessment within this REF indicates that the activity is not likely to have a significant effect on the environment. A range of environmental factors as listed in Clause 171 of the *Environmental Planning and Assessment Regulation 2021* (as amended) and Commonwealth Matters of National Environmental Significance have been considered as contained in **Appendix A**.

Implementation of the mitigation measures and safeguards identified above will minimise the risk of any impact and therefore further reduce the significance of any effect of cumulative impacts.

6.16 Ecologically sustainable development

Ecologically Sustainable Development (ESD) is a primary objective of environmental protection in NSW, ESD is an objective of the EP&A Act under Section 1.3(b), is defined under Section 1.4 of the EP&A Act, and is a required assessment consideration under Schedule 2, Part 3, clause 7 of the *Environmental Planning and Assessment Regulation 2021*. This clause requires environmental assessments to include the reasons justifying the carrying out of the proposed activity in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development set out in subclause (4): Subclause (4) defines ecologically sustainable development as:

a. *the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*

    i. *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*

    ii. *an assessment of the risk-weighted consequences of various options,*

b. *inter-generational equity – namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,*

c. *conservation of biological diversity and ecological integrity – namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,*

d. *improved valuation, pricing and incentive mechanisms – namely, that environmental factors should be included in the valuation of assets and services, such as:*

    i. *polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*

    ii. *the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*

    iii. *environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

The overall objectives of ESD are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained, facilitating improved quality of life, now and into the future.

Council is committed to the principles of ESD and understands that social, economic, and environmental objectives are interdependent. The proposed activity will be effectively managed to avoid significant and/or costly environmental impact or degradation. This REF has been developed to appropriately identify, avoid, mitigate and manage environmental risk in line with the principles and objectives of ESD including:

- The Precautionary Principle.
- Social Equity, Inter-Generational Equity.
- Conservation of Biological Diversity and Ecological Integrity.
- Improved Valuation and Pricing of Environmental Resources.

Each of these principles is explained below:

6.16.1 The precautionary principle

The precautionary principle, in summary, holds that where there are threats of serious or irreversible environmental damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Specialist assessment for the design of the activity for impacts on the vegetation that will be removed has occurred. To this end, there has been careful evaluation

undertaken in order to avoid where possible, serious or irreversible damage to the environment. In the circumstances where avoidance was not possible, appropriate mitigated measures have been developed.

6.16.2 Social equity, inter-generational equity

Intergenerational equity is centred on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. There is a moral obligation to ensure that today's economic progress, which will benefit both current and future generations, is not offset by environmental deterioration.

The various consultation activities, internally within Council and with the community and the engagement of suitably qualified and experienced consultants have ensure that the planning, design and environmental assessment phases of the activity have been transparent. The contents of this REF (including appendices) has enabled Council to understand the potential implications of the activity and therefore identify the required management strategies and mitigation measures to ensure potential for impact is appropriately minimized.

6.16.3 Conservation of biological diversity and ecological integrity

The principle of conservation of biological diversity and ecological integrity holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for the proposed activity.

6.16.4 Improved valuation and pricing of environmental resources

The principle of improved valuation, pricing and incentive mechanisms deems that environmental factors should be included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to protect that resource. Bases for evaluating costs relating to issues of biodiversity, noise, air quality, soil and water, traffic and transport, heritage and visual impacts have been considered in the preparation of the REF.

The approach taken in the REF acknowledges and accepts the financial costs associated with all the measures required for the activity to avoid, minimize, mitigate, and manage potential environmental and social impacts for the proposed activity.

7 SUMMARY OF MITIGATION MEASURES

Mitigation measures outlined in this document will avoid or reduce the potential impacts of the proposed activity. These mitigation measures have been designed to minimise and / or mitigate, as far as practical, the potential impacts. A summary of the mitigation measures can be viewed in **Table 2** below.

Table 2 Impact and Mitigation Measures

Impact	Mitigation Measures
Biodiversity.	• Any cleared access ways or vegetation removal should be restricted to areas of low vegetation retainment value. – If areas of medium vegetation retainment value need to be cleared, canopy trees should be avoided due to the concentrated numbers of fauna observed feeding and roosting in these trees. • Magenta Lilly Pilli plants should be retained and flagged. If they are required to be removed, the entire root ball and surrounding soil should be removed and translocated into a low disturbance area and watered until re-established. • Access with machinery into high vegetation retainment value areas should be avoided. • Dead standing timber and logs should be retained as habitat where practical. • All trees with the potential to be affected by works will be protected by timber hoardings to avoid impacts. • Revegetation should be done using species from local provenance stock, including the addition of fleshy fruited species. – Species along the embankment should have complex root systems with both shallow and deep roots for long term soil stability. • A Project Arborist should be on-site during access track construction (tree removal and tree pruning) to ensure the design is sensitive to the protection requirements of trees worthy of retention and that these trees will not be compromised by the activity. • Dispose of all rubbish and surplus material within 24 hours of completion.
Water quality, soils, hydrology and flooding.	• Sediment and nutrient controls, prepared in accordance with the Landcôm *Managing Urban Stormwater - Soils and Construction* (the Blue Book), will be implemented to reduce the impacts of stormwater, erosion, and sedimentation on water quality. Specific erosion and sediment controls are to be contained within the site CEMP. All erosion and sediment control measures will be established before excavation and vegetation clearance begins. Control measures are to remain in place until all surfaces have been fully restored and stabilised. • Sediment and erosion control devices will be inspected regularly, maintained to ensure effectiveness over the entire duration of the project, and cleaned out before 30% capacity is reached. • Any temporary stockpiles and laydown area will have appropriate erosion control devices installed to control runoff and prevent sedimentation, including siltation socks to be used at all stormwater outlets, drainage swales (where required), and instream sediment controls and/or flow diversion measures as required. • Upslope surface runoff will be redirected around work areas by using diversion drains or other methods. • Sediment fences down slope of all disturbed areas and material stockpile areas. • Site disturbance will be minimised by containing machinery access to site areas required for approved construction works. • Erosion potential would be limited by managing runoff fetches and velocities, with measures such as contour drains, silt fences and level spreaders. • Sediment filters such as silt fences and coir bales will be located downstream of disturbed areas. • No chemicals, fuels, and/or waste will be stored or collected for disposal within or adjacent to drainage lines or unsealed surfaces. Nevertheless a 'spill kit' will be always kept on site for potential chemical or fuel spills. • Drainage systems will be checked at regular intervals and maintained to ensure they are operating at full capacity (e.g., clearance of debris from drainage lines). • Options for the long-term stability of the batter below Memorial Drive are to be consistent with the recommendations of the Geotechnical Assessment (Douglas Partners, 13 May 2022). • Consultation with the Subsidence Advisory NSW should occur prior to commencement of works.

Impact	Mitigation Measures
Air quality.	• All vehicles and machinery will be fitted with approved exhaust systems to maintain exhaust emissions within accepted standards. • Machinery and vehicles will not be left running or idling when not in use for long periods. • Odour or air pollutant emission complaints will be dealt with promptly and the source will be eliminated wherever practicable. • All loads of excavated material, soil, fill and other erodible matter that are transported to or from the work site will be kept covered at all times during transportation and will remain covered until they are reused or disposed of at an EPA licensed waste disposal facility. • All work sites, general work areas and stockpiles will be closely monitored for dust generation and watered down (with clean water) or covered (via seeding or tarpaulins) in the event of dry and/or windy conditions.
Noise.	• All equipment used will comply with AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites. • Work and deliveries will only occur during the following times: Monday to Friday 7am to 6pm. No construction work or deliveries will occur on weekends. • Regular and effective maintenance of all equipment, including vehicles moving on and off the site, will be conducted. • Plant and equipment which is used intermittently will either be shut down in the intervening periods between works or throttled down to a minimum. • Any portable equipment with the potential to create high levels of noise (e.g. generators) will only be selected for use if it incorporates effective noise control. This equipment should be located, where practical, so that natural ground barriers are between it and the nearest potentially affected receivers.
Aboriginal heritage.	• If suspected Aboriginal objects are identified during construction the following procedures must be followed. – Immediately cease all activity at the location. – Ensure no further harm occurs, secure the area. – Notify Environment Protection Authority's Enviro Line on 131 555, Awabakal LALC on +61 2 4965 4532 and an archaeologist (RPS +61 2 4940 4200). – No further action to be undertaken until Heritage NSW provides written consent. • It is recommended that the CEMP for the works include an unexpected finds protocol to be developed and implemented in the event that any potential heritage items are uncovered during excavation.
Non-Aboriginal heritage	• If, during the course of development works, cultural heritage material is uncovered, work should cease in that area immediately. The NSW Heritage Branch should be notified and works only recommence when an appropriate and approved management strategy instigated.
Visual amenity	• During construction works the site shall be kept in a clean and orderly manner to reduce the visual impact to reserve users.
Bushfire	• Spark-generating activities should not occur during abnormally dry and windy conditions.
Waste	• Wherever possible waste generated during site preparation and construction will be reused. Waste that cannot be avoided, re-used, or recycled will be managed in accordance with the principles of the *Waste Avoidance and Resource Recovery Act 2001* and classified in accordance with the Waste Classification Guidelines and disposed of at appropriately licenced facilities. • All waste generated during the works will be reused or removed from the work areas as soon as practicable and disposed of in accordance with the waste disposal safeguards. • All vessels used for contaminated or hazardous waste should be sealed, labelled according to their contents, and stored within bunded areas until their removal from the work site. • Any fuel, lubricant or hydraulic fluid spillages will be collected using absorbent material and the contaminated material disposed of at an EPA licensed waste depot.

Impact	Mitigation Measures
	• In the unlikely event of a pollution incident, the relevant authorities will be notified in accordance with Clause 148 of the POEO Act and remedial actions undertaken. Environmental incident response and notification procedures will be detailed in the CEMP prior to the commencement of construction. • The work site will be left clean and free of debris and other rubbish at the end of works. • All hazardous wastes on site will be removed and disposed in accordance with the state and national regulations and guidelines and best practice for the removal of these materials. • Off-cuts of materials used will be recycled where possible. • Treatment, handling and disposal methods for contaminated soils, when encountered, will be done in accordance with NSW EPA Guidelines. Contaminated soils will be disposed of at an EPA licensed waste depot.
Traffic and access	• Work areas shall be bounded by fencing or barriers to prevent pedestrian access. Including: – The erection of site fencing to the full perimeter to delineate work areas; and – The establishment of “No go” zones for vegetation and tree protection. • Safe, alternative access should be provided for pedestrians where required.
Contamination	• An unexpected finds protocol shall be developed and implemented in the event that any potentially contaminated soils or materials are uncovered during excavations. • Treatment, handling, and disposal methods for contamination, when encountered, will be done in accordance with EPA Guidelines. • All potentially contaminated soil excavated must be stockpiled in a secure area and be assessed and classified in accordance with the Waste Classification Guidelines (EPA, 2014) before being transported from the site for disposal at an appropriately licensed waste facility. • Following excavation, validation sampling of the footprint of the activity area is to occur to determine the suitability of the land for the purpose of the activity.

8 CONCLUSIONS

8.1 Summary of beneficial effects

The activity will involve stabilisation of the road embankment and other improvements along the nominated section of Memorial Drive. It will involve the construction of a retaining wall, re-establishment of the footpath, kerb and guttering improvements, installation of a handrail along the full length of the retaining wall and road pavement renewal. It will also involve the extension of the existing stormwater pit and pipe system further within the adjoining Nesca Park Reserve (Lot 4 DP 222421) and the construction of a rock lined channel at the open end of the extended stormwater pipe.

The works will provide long term stability within the activity area, improve traffic and pedestrian safety and improve the management of stormwater on site and downstream.

8.2 Summary of adverse effects

The proposed activity will result in minimal adverse effect upon the environment. Various minor environmental impacts have been identified in this REF and these are generally temporary in nature.

Based upon the information provided in this REF, there are no long-term adverse effects created by carrying out the activity. Construction impacts will be minor and minimised through appropriate mitigation and management. Therefore, no long-term operational impacts from the proposed activity are anticipated.

8.3 Conclusion

This REF has been prepared in support of the proposed works to remediate the embankment of Memorial Drive and other downstream works.

The REF has examined and considered all relevant Commonwealth, NSW and local legislation and policies, along all matters affecting or likely to affect the environment by reason of the proposed activity. The proposed activity as described in the REF best meets the project objectives.

This REF has been prepared in accordance with Section 5.5 of the EP&A Act. It has concluded that the proposed activity is unlikely to significantly affect the environment and hence an EIS is not required to be prepared under section 5.7 of the EP&A Act. The proposed activity is also unlikely to affect Commonwealth land or have an impact on any MNES.

The proposed activity is unlikely to present a significant risk of harm to the environment and approval would be in the public interest.

9 DECLARATION

I certify that I have prepared the contents of this REF and to the best of my knowledge:

- It is in accordance with section 5.5 of the EP&A Act and Clause 171(2) of the *Environmental Planning and Assessment Regulation 2021.*
- It examines and takes into account all matters affecting or likely to affect the environment as a result of the activities associated with this project.
- It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

The proposed activity is not likely to significantly affect the environment and may be approved subject to mitigation measures detailed in this document. No EIS is required.

The proposed activity is unlikely to present a significant risk of harm to the environment and approval would be in the public interest.

Signed:

Name: Tam Durney

Position: Environmental Scientist / Planner, RPS Newcastle

Date: 09 May 2023

10 REFERENCES

- Bureau of Meteorology/CSRIO - State of the Climate 2014 Report.
- Australian Standard (AS) 2436: 2010 Guide to noise and vibration control on construction, demolition and maintenance sites.
- Landcom - Managing Urban Stormwater: Soils and construction - Volume 1 (Blue Book), 2004.
- NSW EPA Local government air quality toolkit – Module 3 Module 3: Guidelines for managing air pollution.
- NSW EPA (2014). Waste Classification Guidelines – Part 1: Classification of waste.
- NSW EPA (2009). Interim Construction Noise Guideline.
- NSW EPA (2020). Draft Construction Noise Guideline.
- NSW ePlanning Portal.
- NSW Rural Fire Service 2019 – Planning for Bush Fire Protection - A guide for councils, planners, fire authorities and developers November 2019.

Appendix A
Consideration of Clause 171 Factors and Matters of National Environmental Significance

Consideration of Clause 171 Factors and Matters of National Environmental Significance

The following factors, listed in Clause 171 of the *Environmental Planning and Assessment Regulation 2021,* are required to be considered to assess the likely impacts of the proposed activity on the natural and built environment.

Factor	Impact
The environmental impact on a community. The proposed activity includes the construction of new stormwater infrastructure and slope stabilising elements, including a retaining wall and resurfacing of the northern concrete footpath along Memorial Drive. The activity will result in positive long-term benefits for the local community. There may be temporary construction impacts resulting from the proposed activity. Deliveries and vehicle movements will only occur during the following times: Monday to Friday 7am to 6pm and Saturday 8am to 1pm. No construction work or deliveries will occur on Sundays or public holidays. A CEMP will be prepared prior to commencement of works.	Positive long-term benefits. Council and the principal contractor will manage short-term negative impacts.
The transformation of a locality. The proposed activity will be sympathetic and environmentally conscious of the locality.	Positive – long term impacts that will accommodate existing and future development.
The environmental impact on the ecosystems of the locality. Minor impacts on the ecosystems of the locality. Mitigation measures will be incorporated into the CEMP for the site to ensure that the impact of the proposed activity on the environment is minimised.	There will be no long-term negative impacts related to vegetation. Mitigation measures will reduce environmental impact on ecosystems.
Reduction of the aesthetic, recreational, scientific, or other environmental quality or value of a locality. The proposed activity will not reduce the aesthetic values of the site, but rather will enhance the environmental qualities of the locality.	Positive impact – consistent with desired future outcomes.
The 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. The proposed activity does not impact on any identified areas of anthropological, cultural, scientific, or social significance. The design of the upgrade works will complement the surrounding environment. An unexpected finds protocol shall be developed and implemented in the event that any potential heritage items are uncovered during works.	Neutral impact.
The impact on the habitat of protected fauna, within the meaning of the *Biodiversity Conservation Act 2016.* The proposed works are to occur in a within bushland surrounded by a suburban environment. The proposed activity is unlikely to have a significant impact on any threatened species, populations, ecological communities or migratory species in the locality. A 5-part test and Test of Significance for the Grey-headed Flying Fox found that it would not be adversely affected should the Date Palms on site be affected or removed. Each of the above matters will be incorporated into the CEMP for the site to ensure that the impact of the proposed activity on the environment is minimised.	No impact identified within the meaning of the NPW Act 1974.
The endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air. Known endangered species on the site, including the Magenta Lilly Pilly, will be appropriately marked and protected during works, along with clear demarcation for areas of medium and high biodiversity value. The proposed activity is unlikely to have a significant impact on any threatened species, populations, ecological communities or migratory species in the locality should these measures be followed, and these matters will be incorporated into the CEMP for the activity.	Impact unlikely and will be reduced through recommended mitigation measures.

Factor	Impact
Long-term effects on the environment. The development of the proposed activity will not result in any long-term effects on the environment additional to those which have been addressed in the REF.	Unlikely to be any long-term impacts. Short-term impacts will be reduced through appropriate mitigation and management.
Degradation of the quality of the environment. The proposed works will have a positive impact on the quality of the existing environment. Any degradation of the environment will be limited to the construction phase. Possible future degradation of the site will be limited by the new slope stabilisation structures.	Degradation will be mitigated through appropriate management.
Risk to the safety of the environment. The proposed activity may pose a minor risk during construction to the environment. This risk is considered minimal, and the occurrence of environmental hazards is considered to be low. Impacts on the environment will be reduced by implementing effective storage of hazardous materials, erosion and sediment controls, appropriate stormwater, and nutrient control systems to reduce the effects of runoff and ensure water flowing off the proposed activity area is of a suitable quality, ensuring that there are no accidental incursions into areas which are not subject to the proposed activity.	Risks will be managed through appropriate controls.
Reduction in the range of beneficial uses of the environment. The proposed activity will result in a restoration of the range of previous uses of the environment, protecting future amenity and access while strengthening environmental protection.	Neutral - restoration of previous beneficial uses.
Pollution of the environment. The proposed activity may pose a minor risk during construction to the environment if the necessary use of fuels, oils, greases, and chemicals are discharged into the stormwater system if they are inappropriately stored, or spill within the unstable sloped area of the site. This risk is considered limited, and the occurrence of environmental hazards is considered to be low.	The risk will be managed through appropriate controls.
Environmental problems associated with the disposal of waste. No environmental problems associated with the disposal of waste are likely to result from the proposed activity.	No waste disposal issues likely.
Increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply. The proposed activity would not increase demands on resources, natural or otherwise that are or are likely to become in short supply in the future.	No impact identified.
The cumulative environmental effect with other existing or likely future activities. The proposal will not result in any cumulative environmental effects on existing or likely future activities. Impacts will be temporary and related to construction.	Long term positive impact.
The impact on coastal processes and coastal hazards, including those under projected climate change conditions. The impact of coastal processes and hazards have been considered along with projected climate change conditions. There are not expected to be any significant impacts associated with coastal processes, coastal hazards, and climate change as a result of the activity.	No impact identified.
Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1. Applicable plans made under the Act, Division 3.1 are: • Newcastle Local Environmental Plan 2012 The above plans have been considered in the preparation of this REF and it is concluded that the activity is not inconsistent with the vision and planning priorities set out within each plan.	Neutral impact
Other relevant environmental factors No other environmental factors are considered relevant.	No impact identified

Matters of National Environmental Significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999,* the following Matters of National Environmental Significance are required to be considered to assist in determining whether the proposed activity should be referred to the Australian Government Department of the Environment and Water Resources.

Factor	Impact
Any impact on a World Heritage property? There are no world heritage properties within the vicinity of the proposed activity.	Nil
Any impact on a National Heritage place? There are no National Heritage places within the vicinity of the proposed activity.	Nil
Any impact on a wetland of international importance? There are no RAMSAR listed wetlands located within 5km of the proposed activity.	Nil
Any impact on a listed threatened species or communities? Magenta Lilly Pilly (*Syzygium paniculatum*) was found in various stages of growth throughout the site, some evidently part of a regrowth effort due to stake markers. Care will be taken to ensure any growths are clearly marked and physical hoardings established to protect any plants. No plantings are proposed for removal and workers will be educated on their importance.	No significant impact
Any impacts on listed migratory species? Two Date Palms are present on site, which is a known food source for the Grey-headed Flying-fox (*Pteropus poliocephalus*). A 5-part test and Test of Significance was undertaken by Litoria as a component of the site's Biodiversity Report, which found that there would be no significant impact on the food source for the Grey-headed Flying-fox should these trees be affected or removed.	No significant impact
Any impact on a Commonwealth marine area? No Commonwealth marine areas are located within 10km of the Proposed activity.	Nil
Any impact on the Great Barrier Reef Marine Park? The proposed activity will not have a significant adverse effect on the Great Barrier Reef Marine Park, as this area is not within the region.	Nil
Does the proposal involve a nuclear action (including uranium mining)? The proposed activity will not involve a nuclear action.	Nil
Water resource, in relation to coal seam gas development and large coal mining development. The proposed activity is not considered to significantly impact upon a water resource, and thus does not contribute to this MNES.	Nil
Additionally, any impact (direct or indirect) on Commonwealth land? No Commonwealth Land is located in proximity to the activity area.	Nil

Appendix B
Concept Design Plans

MEMORIAL DRIVE , THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

N

LOCALITY PLAN

SCALE 1:1000

SOURCE: NEARMAP

SHEET NAME	SHEET DESCRIPTION
CI-0000	COVER SHEET, LOCALITY PLAN AND DRAWING INDEX
CI-0001	GENERAL NOTES
CI-0010	GENERAL ARRANGEMENT PLAN
CI-0205	TYPICAL CROSS SECTIONS
CI-0210	ROAD LONGITUDINAL SECTION
CI-0220	CROSS SECTIONS
CI-0280	PAVEMENT, KERB & GUTTER, FOOTPATH DETAILS
CI-0310	LONGITUDINAL DETAILED PLAN STORMWATER PIPE AND ROCK CHANNEL
CI-0350	DRAINAGE TYPICAL DETAILS SHEET 01 OF 02
CI-0351	DRAINAGE TYPICAL DETAILS SHEET 02 OF 02
CI-0380	RETAINING WALLS DETAILED SECTION AND ELEVATION
CI-0700	EROSION AND SEDIMENT CONTROL PLAN
CI-0710	EROSION AND SEDIMENT CONTROL DETAILS

DIAL BEFORE YOU DIG www.1100.com.au

0 10 20 30 40 50 60m
SCALE 1:1000 AT A1 SIZE

REV	DATE	DESCRIPTION	RVD
B	19.04.2023	80% DETAIL DESIGN ISSUE	DW
A	19.08.2022	DRAFT ISSUE	DW

REVISIONS

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CLIENT: City of Newcastle

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PROJECT: MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	1:1000	AT A1 SIZE

TITLE: COVER SHEET, LOCALITY PLAN AND DRAWING INDEX

PROJECT No.	DRAWING No.	REV.
N22001	CI-0000	B

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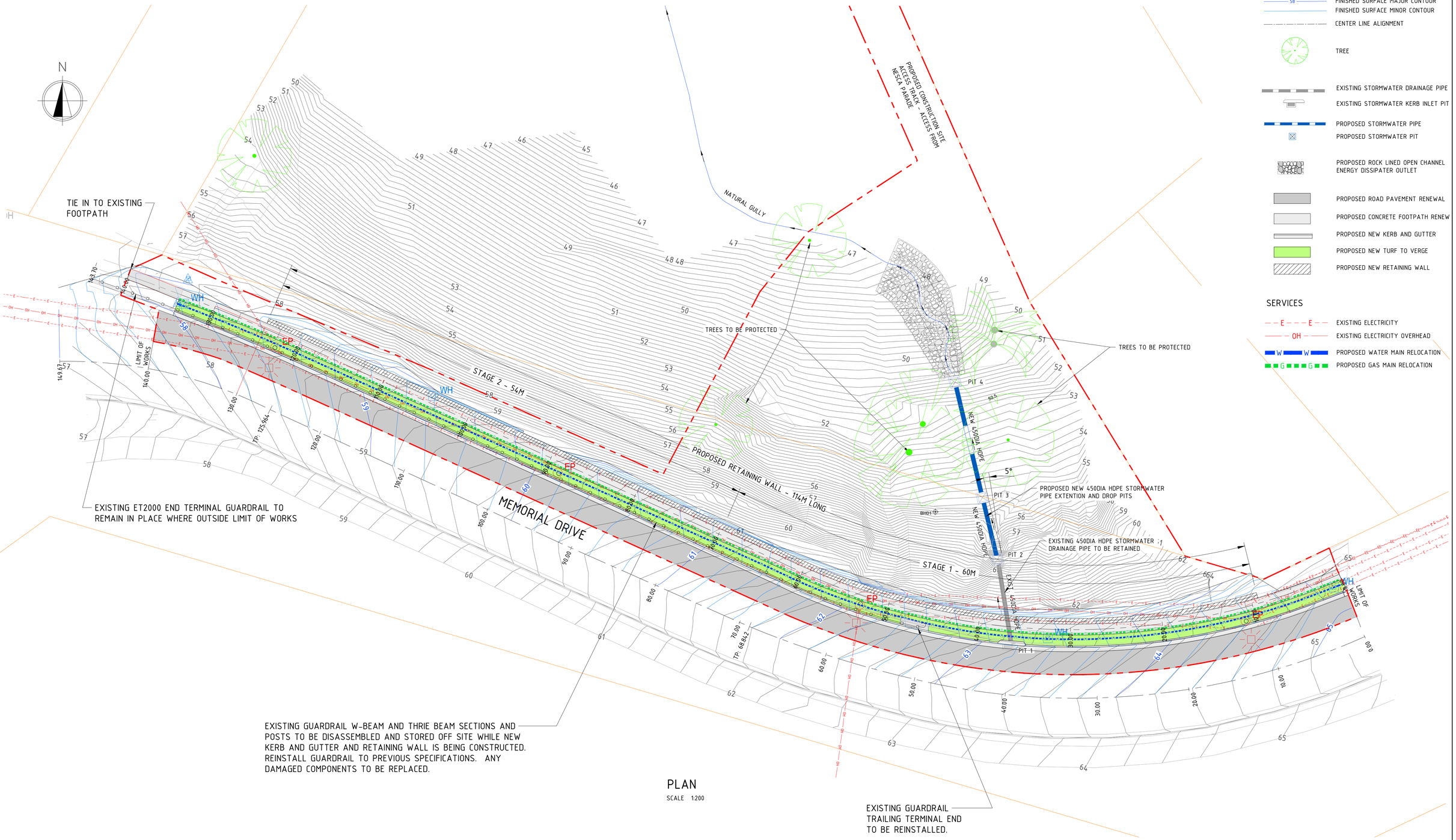

PLAN

SCALE 1:200

LEGEND

- SITE BOUNDARY
- CADASTRAL BOUNDARIES
- EXISTING MAJOR CONTOUR SURVEY
- EXISTING MINOR CONTOUR SURVEY
- FINISHED SURFACE MAJOR CONTOUR
- FINISHED SURFACE MINOR CONTOUR
- CENTER LINE ALIGNMENT
- TREE
- EXISTING STORMWATER DRAINAGE PIPE
- EXISTING STORMWATER KERB INLET PIT
- PROPOSED STORMWATER PIPE
- PROPOSED STORMWATER PIT
- PROPOSED ROCK LINED OPEN CHANNEL ENERGY DISSIPATER OUTLET
- PROPOSED ROAD PAVEMENT RENEWAL
- PROPOSED CONCRETE FOOTPATH RENEW
- PROPOSED NEW KERB AND GUTTER
- PROPOSED NEW TURF TO VERGE
- PROPOSED NEW RETAINING WALL

SERVICES

- EXISTING ELECTRICITY
- EXISTING ELECTRICITY OVERHEAD
- PROPOSED WATER MAIN RELOCATION
- PROPOSED GAS MAIN RELOCATION

REV	DATE	DESCRIPTION	RVD
C	19.04.2023	80% DETAILED DESIGN ISSUE	DW
B	29.11.2022	DRAFT ISSUE - GAS MAIN LOCATION CONFIRMED	DW
A	19.08.2022	DRAFT ISSUE	DW

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PROJECT: MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE
AHD	MGA-56	1:200 AT A1 SIZE

TITLE: GENERAL ARRANGEMENT PLAN

PROJECT No. N22001 | DRAWING No. CI-0010 | REV. C

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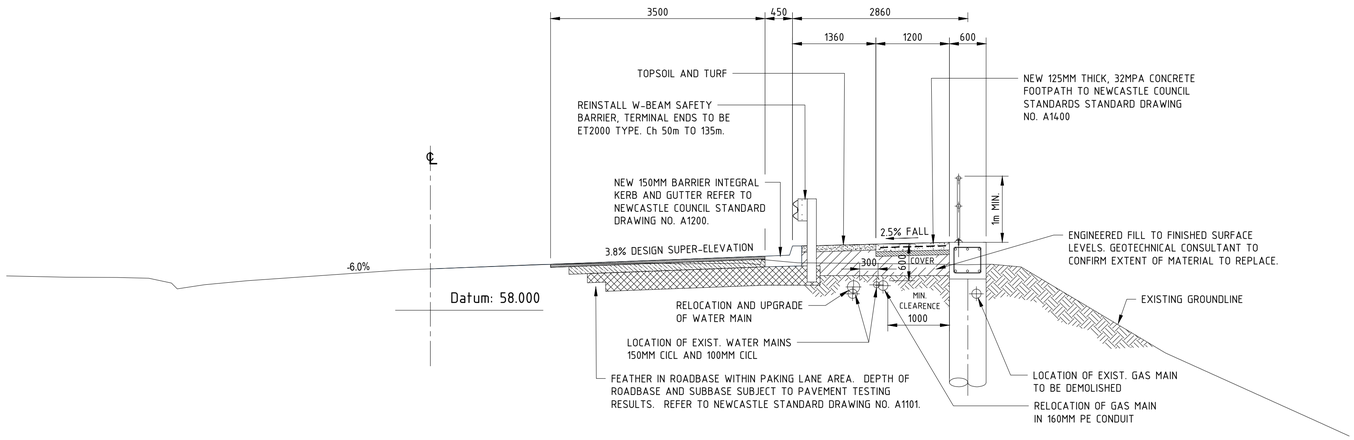

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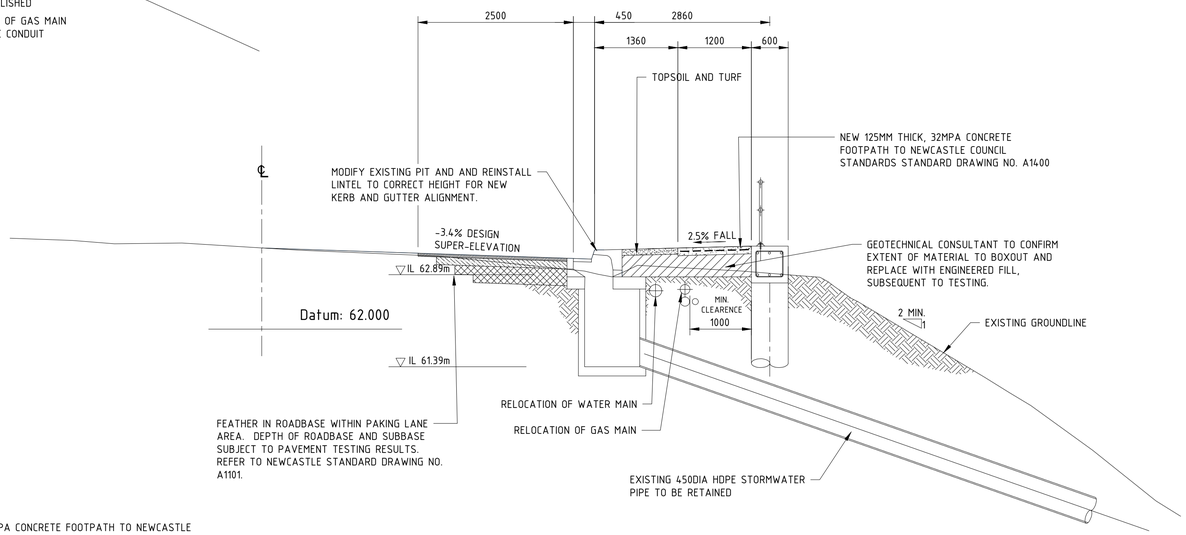

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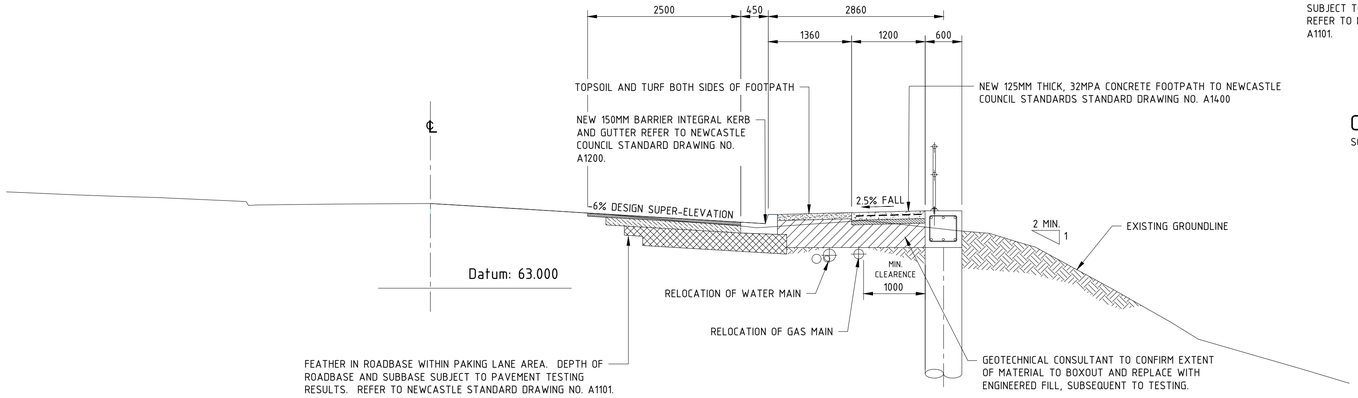

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B	19.04.2023	80% DETAILED DESIGN ISSUE	DW
A	19.08.2022	DRAFT ISSUE	DW

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PROJECT: MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	1:50	AT A1 SIZE

TITLE: TYPICAL CROSS SECTIONS

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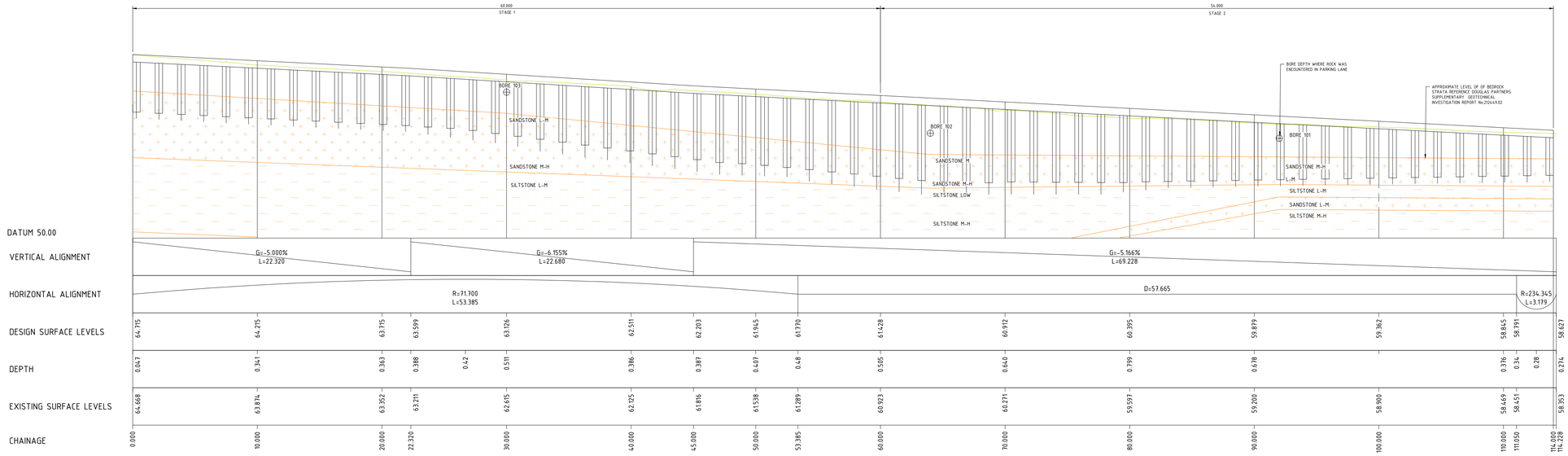

RETAINING WALL LONGITUDINAL SECTION

SCALE HORIZONTAL 1:200 VERTICAL 1:200

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SCALE 1:200 AT A1 SIZE

REV	DATE	DESCRIPTION	RVD
B	19.04.2023	80% DETAILED DESIGN ISSUE	DW
A	19.08.2022	DRAFT ISSUE	DW

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CLIENT: City of Newcastle

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PROJECT: MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	1:200	AT A1 SIZE

TITLE: RETAINING WALL LONGITUDINAL SECTION

PROJECT No.	DRAWING No.	REV.
N22001	CI-0210	B

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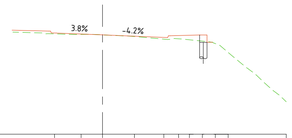
RL 60.000

PROPOSED LEVELS		64.595	64.382		64.078		
EXISTING LEVELS		64.459	64.382		64.015	64.091	64.234
						63.999	64.264
DEPTH		0.06	0.00		0.06	0.14	0.27	0.34	63.975	64.251
						0.024	0.131	0.103	63.693	63.727
OFFSETS	-3.983		0.000		5.067	6.867	8.067	8.902	9.804	

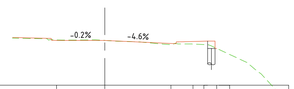
CH:20.000



RL 55.000

PROPOSED LEVELS		63.258	63.201	63.135	63.047	62.925	63.071	63.101	63.154	62.537
EXISTING LEVELS		63.188	63.146	63.107	62.976	62.761	62.787	62.669	62.638	62.398
DEPTH		0.07	0.05	0.03	0.07	0.16	0.28	0.43	0.54	0.14
OFFSETS	-3.976	-1.750	0.000	2.601	5.000	6.235	7.414	8.231	9.094	9.188

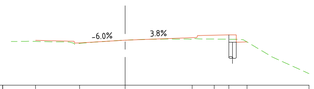
CH:45.000



RL 58.000

PROPOSED LEVELS		61.648	61.654		61.406	61.568	61.598	61.001	61.063
EXISTING LEVELS		61.701	61.654		61.300	61.359	61.306	61.001	60.959
DEPTH		-0.05	0.00		0.11	0.21	0.29	0.00	0.14
OFFSETS	-3.938		0.000		5.392	7.192	8.392	9.134	9.310	

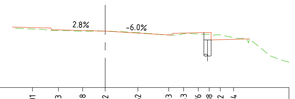
CH:70.000



RL 55.000

PROPOSED LEVELS		58.662	58.452	58.676	58.884	59.079	59.109	58.531	
EXISTING LEVELS		58.570	58.413	58.676	58.823	58.763	58.749	58.531	
DEPTH		0.09	0.04	0.00	0.06	0.32	0.36	0.00	
OFFSETS	-7.320		-3.720	0.000	5.463	7.263	8.463	9.941	

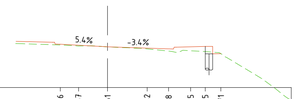
CH:120.000



RL 60.000

PROPOSED LEVELS		64.901	64.713	64.618	64.612	64.462	64.303	64.443	64.476	64.488	64.292	64.192	63.934
EXISTING LEVELS		64.780	64.658	64.607	64.609	64.478	64.303	64.400	64.372	64.352	64.292	64.192	64.082
DEPTH		0.12	0.05	0.01	0.00	-0.02	0.00	0.04	0.10	0.14	0.00	0.00	-0.15
OFFSETS	-5.932	-3.822	-1.837	0.000	2.673	5.187	6.401	7.596	8.396	9.402	10.478	

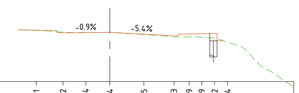
CH:15.000



RL 60.000

PROPOSED LEVELS		63.536	63.457	63.361	63.242	63.158	63.206	63.325	63.355	62.771
EXISTING LEVELS		63.475	63.395	63.327	63.158	62.978	63.006	62.937	62.771
DEPTH		0.06	0.06	0.03	0.08	0.18	0.32	0.42	0.00
OFFSETS	-3.856	-2.362	0.000	3.233	4.984	6.784	7.984	9.249	

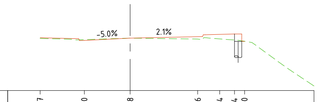
CH:40.000



RL 58.000

PROPOSED LEVELS		62.191	61.982	62.004	62.014	61.855	61.733	61.879	61.909	61.922	61.334	
EXISTING LEVELS		62.176	62.040	62.001	62.017	61.838	61.647	61.640	61.609	61.545	61.308	
DEPTH		0.01	-0.06	0.00	0.00	0.02	0.09	0.24	0.30	0.38	0.03	
OFFSETS	-6.001	-3.819	-1.962	0.000	2.782	5.231	6.472	7.672	8.549	9.326		

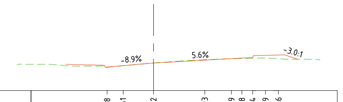
CH:65.000



RL 55.000

PROPOSED LEVELS		59.307	59.090	59.278	59.396	59.584	59.344	59.120	59.020	
EXISTING LEVELS		59.258	59.159	59.278	59.204	59.215	59.158	59.120	59.020	
DEPTH		0.05	-0.07	0.00	0.19	0.37	0.43	0.00	0.00	
OFFSETS	-7.345	-3.145	0.000	5.513	7.313	8.513	9.339			

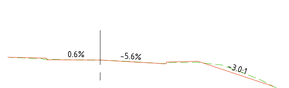
CH:110.000



RL 55.000

PROPOSED LEVELS		57.018	57.061	57.252	57.493	57.569	57.538	57.464	57.578	57.446	
EXISTING LEVELS		56.890	57.029	57.252	57.518	57.583	57.653	57.656	57.656	57.578	
DEPTH		0.13	0.03	0.00	-0.03	-0.07	-0.08	0.01	0.00	-0.16	
OFFSETS	-3.783	-2.473	0.000	4.189	6.367	7.214	8.378	9.145	9.758		

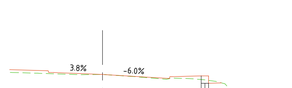
CH:145.000



RL 60.000

PROPOSED LEVELS		64.909	64.830	64.529	64.685	64.715	64.710		
EXISTING LEVELS		64.914	64.830	64.647	64.673	64.685	64.710		
DEPTH		0.00	0.00	-0.12	0.01	0.03	0.00		
OFFSETS	-3.987	0.000	5.016	6.816	8.016	10.841			

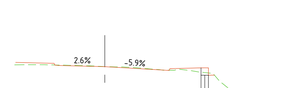
CH:10.000



RL 60.000

PROPOSED LEVELS		63.802	63.751	63.614	63.504	63.405	63.557	63.587	63.599	63.018	62.994
EXISTING LEVELS		63.612	63.627	63.654	63.521	63.249	63.335	63.285	63.155	62.707	62.247
DEPTH		0.19	0.12	-0.04	-0.02	0.16	0.22	0.30	0.44	0.31	0.75
OFFSETS	-3.857	-2.405	0.000	1.952	5.107	6.486	7.684	8.703	9.449	9.626	

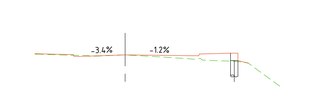
CH:35.000



RL 58.000

PROPOSED LEVELS		62.312	62.314	62.017	62.173	62.203	61.847	61.621	
EXISTING LEVELS		62.257	62.314	61.975	61.963	61.847	62.203	61.621	
DEPTH		0.06	0.00	0.04	0.21	0.36	-0.06	0.00	
OFFSETS	-3.807	0.000	4.954	6.754	7.954	9.275			

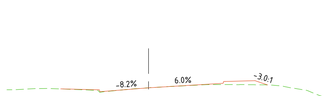
CH:60.000



RL 55.000

PROPOSED LEVELS		59.729	59.789	59.815	59.997	60.023	59.433		
EXISTING LEVELS		59.752	59.789	59.656	59.617	59.548	59.433		
DEPTH		-0.02	0.00	0.16	0.38	0.48	0.00		
OFFSETS	-3.754	0.000	5.562	7.362	8.562	9.418			

CH:100.000



RL 55.000

PROPOSED LEVELS		57.433	57.232	57.522	57.969	58.113	58.143	57.821		
EXISTING LEVELS		57.364	57.323	57.522	57.866	57.886	57.842	57.821		
DEPTH		0.07	-0.09	0.00	0.04	0.23	0.30	0.00		
OFFSETS	-7.143	-3.543	0.000	6.458	8.258	9.458	10.426			

CH:140.000

RL 60.000

PROPOSED LEVELS		65.267	65.099	65.058	65.039	64.937	64.759	64.899	64.916	64.933	64.946	
EXISTING LEVELS		65.229	65.132	65.089	65.075	64.976	64.793	64.883	64.881	64.890	64.879	
DEPTH		0.04	-0.03	-0.03	-0.04	-0.04	-0.03	0.02	0.03	0.04	0.07	
OFFSETS	-5.694	-3.914	-1.482	0.000	2.107	5.010	6.096	6.809	7.532	8.008		

CH:05.000

RL 60.000

PROPOSED LEVELS		64.059	63.906	63.603	63.759	63.789	63.215	
EXISTING LEVELS		63.959	63.907	63.523	63.577	63.489	63.215	
DEPTH		0.10	0.00	0.08	0.18	0.30	0.00	
OFFSETS	-3.990	0.000	5.056	6.856	8.056	9.714		

CH:30.000

RL 58.000

PROPOSED LEVELS		62.659	62.632	62.563	62.305	62.253	62.433	62.063	61.964	61.936	
EXISTING LEVELS		62.677	62.656	62.544	62.305	62.251	62.253	62.063	62.001	61.573	
DEPTH		-0.02	-0.02	0.02	0.00	0.00	0.18	0.00	-0.06	0.36	
OFFSETS	-4.022	-3.183	0.000	4.283	5.277	6.877	8.077	8.767	9.179		

CH:55.000

RL 55.000

PROPOSED LEVELS		60.371	60.498	60.431	60.606	59.823			
EXISTING LEVELS		60.462	60.498	60.153	60.032	59.987	59.823		
DEPTH		-0.09	0.00	0.28	0.57	0.65	0.00		
OFFSETS	-3.774	0.000	5.603	7.403	8.603	10.056			

CH:90.000

RL 55.000

PROPOSED LEVELS		57.658	57.528	57.688	57.898	58.000	58.160	58.351	58.381	58.219		
EXISTING LEVELS		57.630	57.498	57.701	57.819	57.990	58.082	58.074	58.013	58.093		
DEPTH		0.02	0.03	-0.01	0.06	0.01	0.08	0.28	0.31	0.22		
OFFSETS	-5.455	-3.623	-1.518	0.000	3.143	5.679	7.003	8.202	9.037			

CH:135.000

RL 60.000

PROPOSED LEVELS		65.288	65.143	64.928	65.088	65.118	65.002		
EXISTING LEVELS		65.289	65.143	64.988	65.088	65.053	65.002		
DEPTH		0.00	0.00	-0.06	0.00	0.07	0.00		
OFFSETS	-3.975	0.000	4.905	6.705	7.905	8.253			

CH:00.000

RL 60.000

PROPOSED LEVELS		64.297	64.272	64.138	63.833	63.982	63.980	64.089	63.517	63.444	
EXISTING LEVELS		64.159	64.109	64.134	63.769	63.779	63.815	63.716	63.449	63.419	
DEPTH		0.14	0.16	0.00	0.06	0.18	0.17	0.30	0.07	0.02	
OFFSETS	-4.308	-3.424	0.000	0.713	5.091	6.291	7.491	8.090	9.574	9.708		

CH:25.000

RL 58.000

PROPOSED LEVELS		62.952	62.897	62.652	62.812	62.842	62.255		
EXISTING LEVELS		62.956	62.898	62.526	62.520	62.417	62.253		
DEPTH		0.00	0.00	0.13	0.29	0.43	0.00		
OFFSETS	-3.752	0.000	4.855	6.655	7.855	8.803			

CH:50.000

RL 55.000

PROPOSED LEVELS		61.070	60.993	60.836	61.005	61.035	60.443	60.425		
EXISTING LEVELS		61.095	60.993	60.800	60.786	60.716	60.443	60.409		
DEPTH		-0.09	0.00	0.04	0.22	0.32	0.00	0.02		
OFFSETS	-3.931	0.000	5.498	7.298	8.498	9.433	9.550			

CH:80.000

RL 55.000

PROPOSED LEVELS		58.026	57.823	58.100	58.395	58.597	58.627	58.380		
EXISTING LEVELS		57.995	57.814	58.101	58.378	58.344	58.345	58.298		
DEPTH		0.03	0.01	0.00	0.02	0.25	0.28	0.08		
OFFSETS	-7.235	-3.635	0.000	5.378	7.178	8.378	9.384			

CH:130.000

0 2 4 6 8 10 12m
SCALE 1:200 AT A1 SIZE

REV	DATE	DESCRIPTION	RVD
B	19.04.2023	80% DETAILED DESIGN ISSUE	DW
A	19.08.2022	DRAFT ISSUE	DW

REVISIONS

REVISIONS

CLIENT: City of Newcastle

Newcastle *Office—*
Suite 2, Level 3, 426 King St
Newcastle West NSW 2302
P /+61 2 4902 3000 *E /* newcastle@bgeeng.com
bgeeng.com—

PROJECT: MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

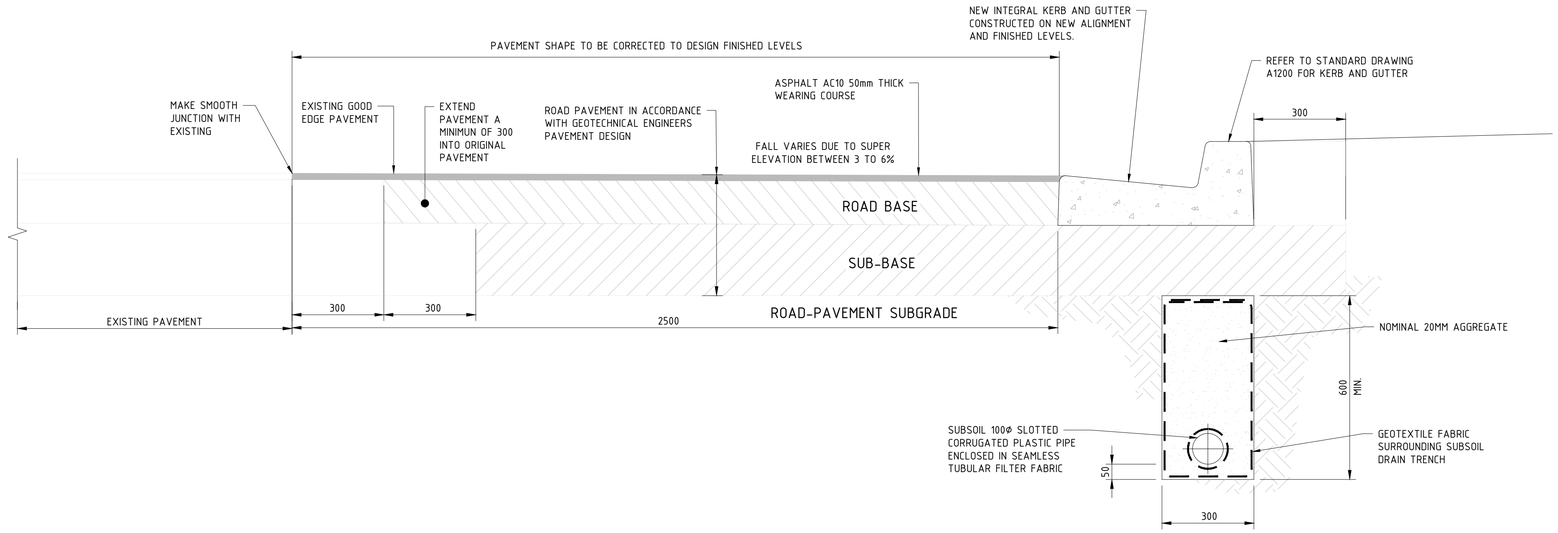
DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	1:200	AT A1 SIZE

TITLE: CROSS SECTIONS

PROJECT No: N22001
DRAWING No: CI-0220
REV: B

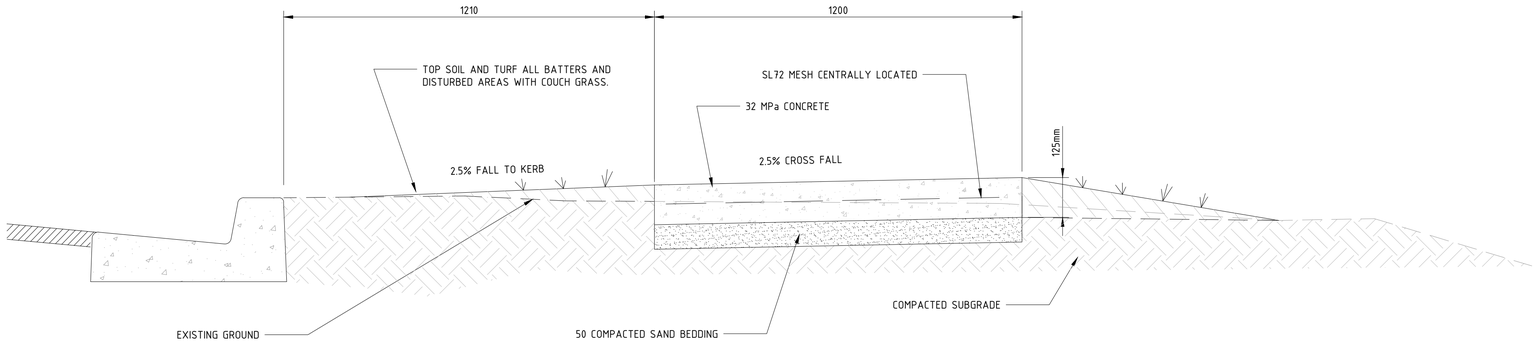
P:\BGE\NTL\N22001 MEMORIAL DR SLOPE STABILISATION\100 DRAW\100 2 CIVIL\AUTOCAD\N22001-DRG-CI-0220.DWG
19/04/2023 5:12:04 PM



NOTE:
DEPTH OF SUBSOIL DRAINAGE WILL DEPEND ON SITE CONDITIONS AND ADVICE SOUGHT FROM GEOTECHNICAL CONSULTANT PRIOR TO CONSTRUCTION.
FOR FLUSHING POINTS REFER TO CITY OF NEWCASTLE'S STANDARD DRAWING No. A2003.

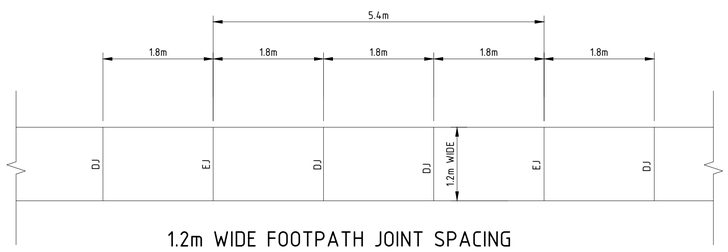
ROAD PAVEMENT AND KERB AND GUTTER RENEWAL DETAIL

SCALE 1:10



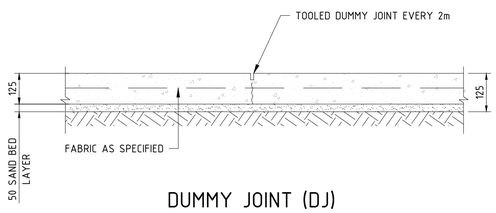
CONCRETE FOOTPATH RENEWAL DETAIL

SCALE 1:10



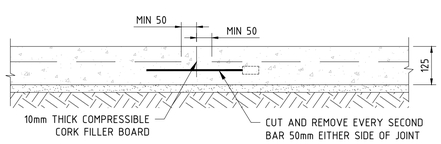
1.2m WIDE FOOTPATH JOINT SPACING

SCALE 1:50



DUMMY JOINT (DJ)

SCALE 1:10



EXPANSION JOINT (EJ)

SCALE 1:10

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

0 100 200 300 400 500 600mm
SCALE 1:10 AT A1 SIZE

REV	DATE	DESCRIPTION	RVD
B	19.04.2023	80% DETAILED DESIGN ISSUE	DW
A	19.08.2022	DRAFT ISSUE	DW

REVISIONS

REVISIONS

CLIENT: City of Newcastle

Newcastle *Office—*
Suite 2, Level 3, 426 King St
Newcastle West NSW 2302
P /+61 2 4902 3000 *E /* newcastle@bgeeng.com
bgeeng.com—

PROJECT: MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

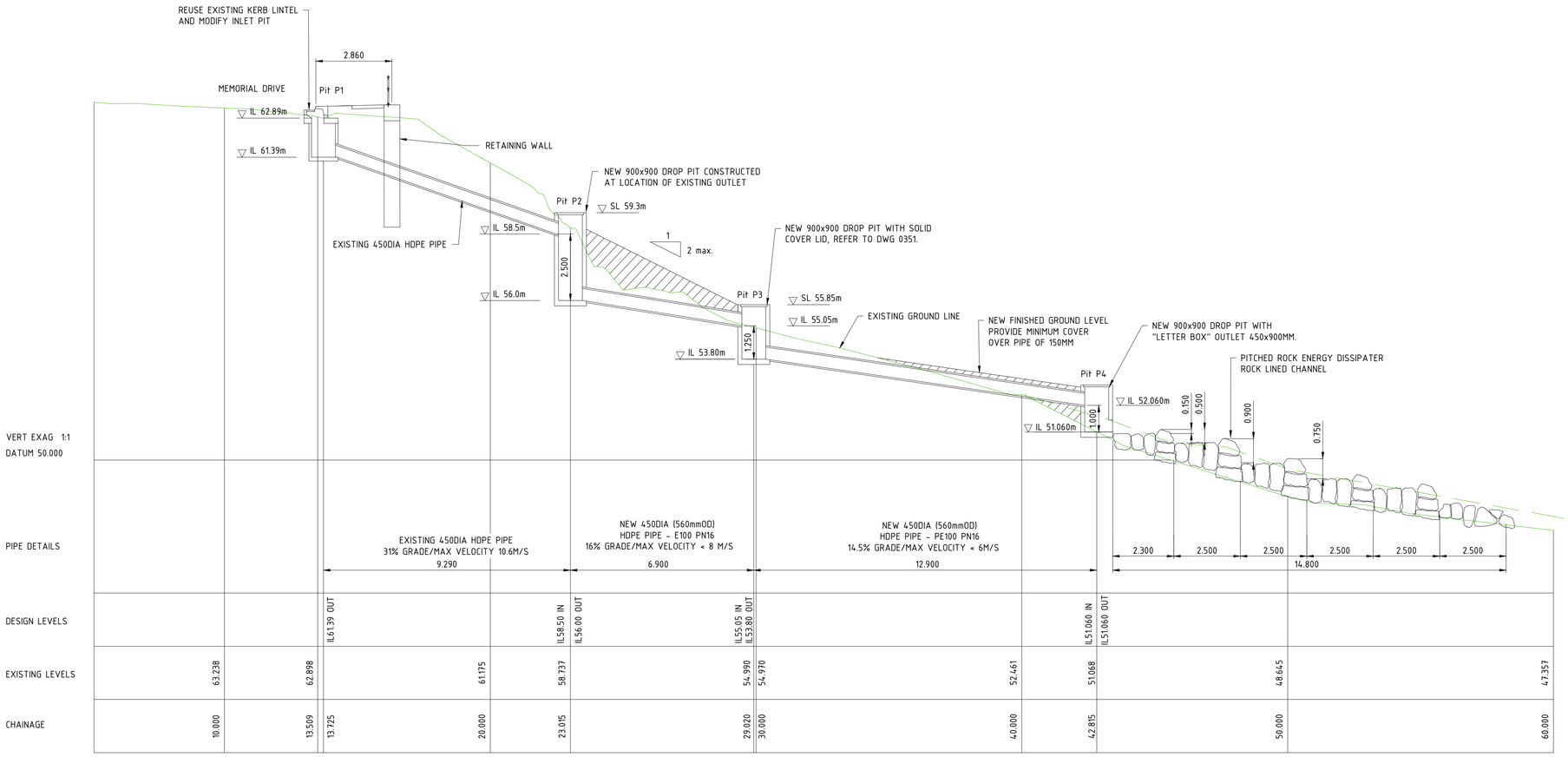
DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	1:10	AT A1 SIZE

TITLE: ROAD PAVEMENT, KERB AND GUTTER, FOOTPATH DETAILS

PROJECT No. N22001 | DRAWING No. CI-0280 | REV. B

P:\BGE\NTL\N22001 MEMORIAL DR SLOPE STABILISATION\100 DRAW\100.2 CIVIL\AUTOCAD\N22001-DRG-CI-0280.DWG
19/04/2023 4:54:47 PM



PIPE ALIGNMENT LONGITUDINAL SECTION

SCALE 1:100

0 1 2 3 4 5 6m
SCALE 1:100 AT A1 SIZE

REV	DATE	DESCRIPTION	RVD
B	19.04.2023	80% DETAILED DESIGN ISSUE	DW
A	19.08.2022	DRAFT ISSUE	DW

REVISIONS

REV	DATE	DESCRIPTION	RVD

REVISIONS

CLIENT: City of Newcastle

Newcastle *Office*—
Suite 2, Level 3, 426 King St
Newcastle West NSW 2302
P /+61 2 4902 3000 *E* / newcastle@bgeeng.com
bgeeng.com—

PROJECT: MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	1:100	AT A1 SIZE

TITLE: STORMWATER PIPE AND ROCK CHANNEL LONGITUDINAL SECTION

PROJECT No.	DRAWING No.	REV.
N22001	CI-0310	B

P:\BGE\NTL\N22001 MEMORIAL DR SLOPE STABILISATION\100 DRAWING\100.2 CIVIL\AUTOCAD\N22001-DRG-CI-0310.DWG
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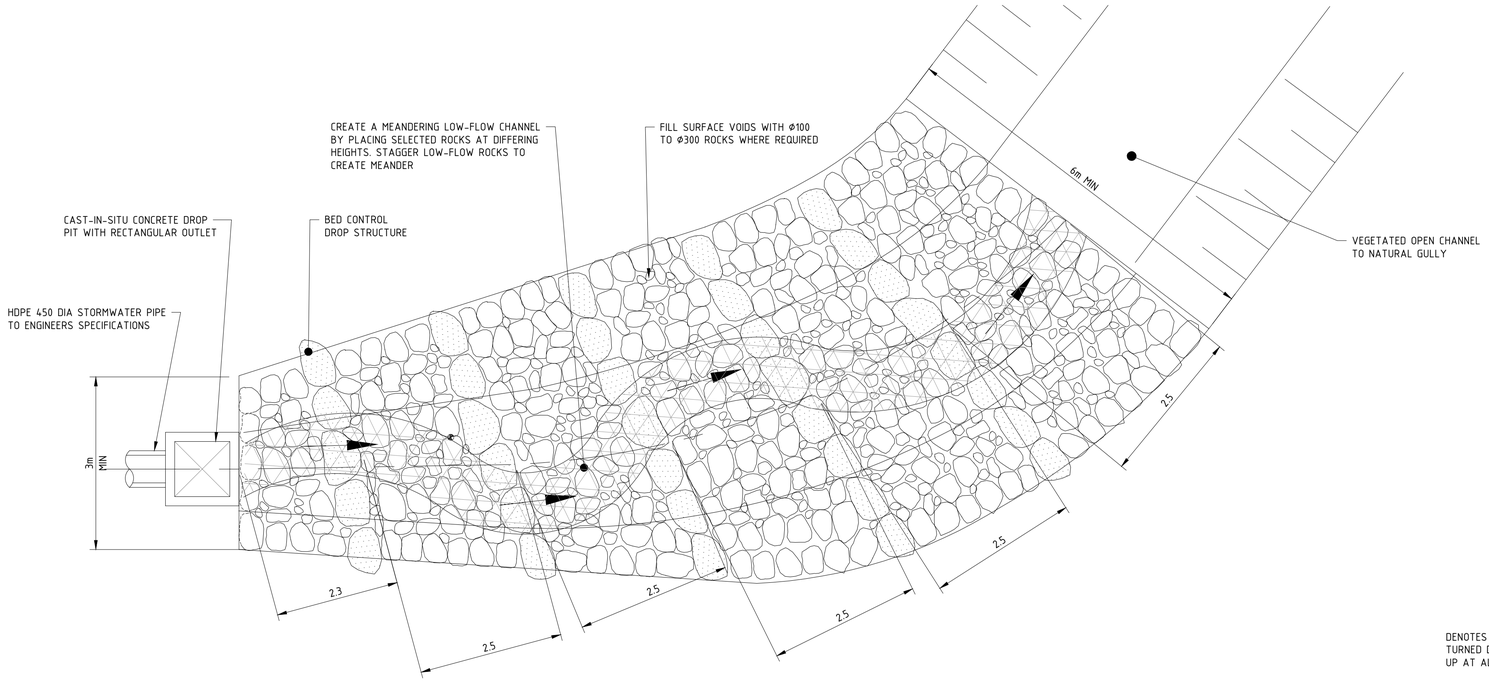
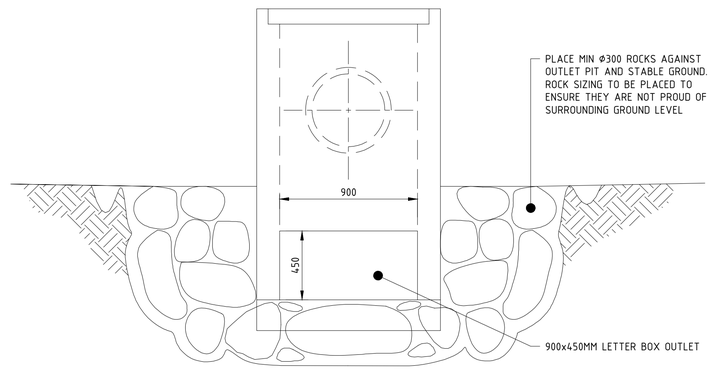
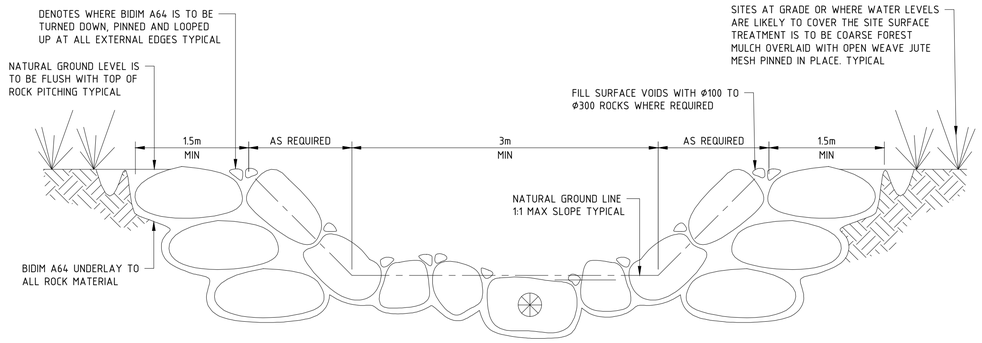


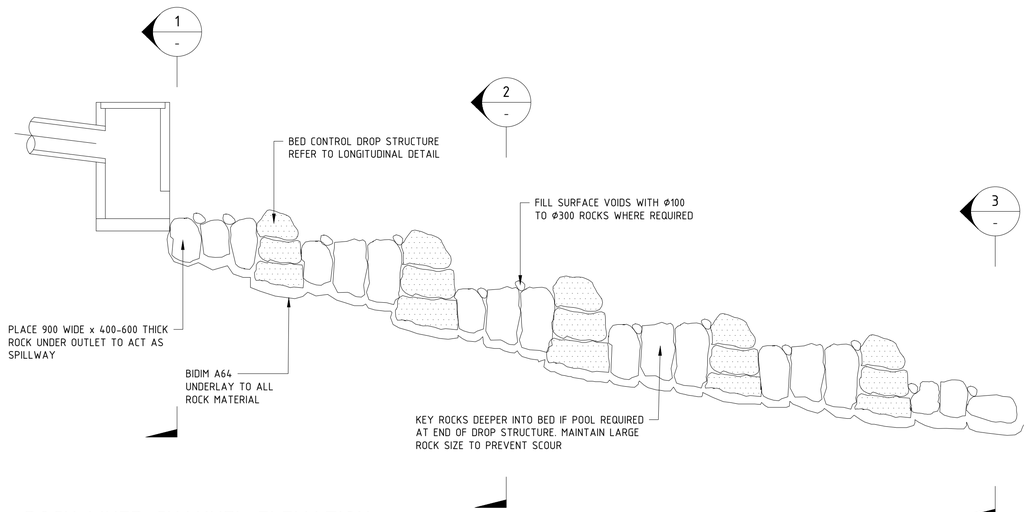
ROCK LINED CHANNEL DETAIL PLAN



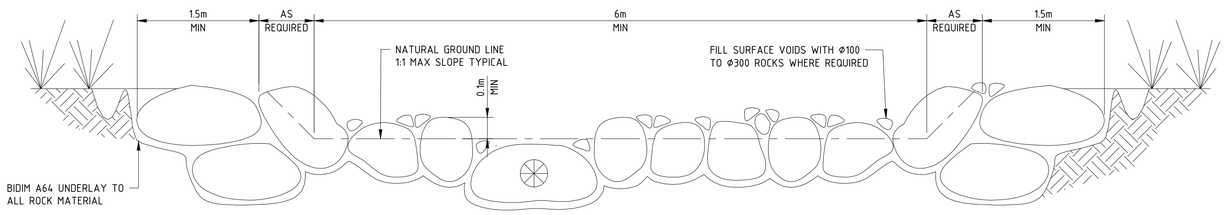
SECTION 1
SCALE 1:20 N-0280



SECTION 2
SCALE 1:20 N-0280



ROCK LINED CHANNEL ELEVATION



SECTION 3
SCALE 1:20 N-0280

0 0.2 0.4 0.6 0.8 1.0 1.2m
SCALE 1:20 AT A1 SIZE

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

REV	DATE	DESCRIPTION	RVD
B	19.04.2023	80% DETAILED DESIGN ISSUE	DW
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PROJECT
MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	AS SHOWN	AT A1 SIZE

TITLE
DRAINAGE DETAILS
SHEET 1 OF 2

PROJECT No.	DRAWING No.	REV.
N22001	CI-0350	B

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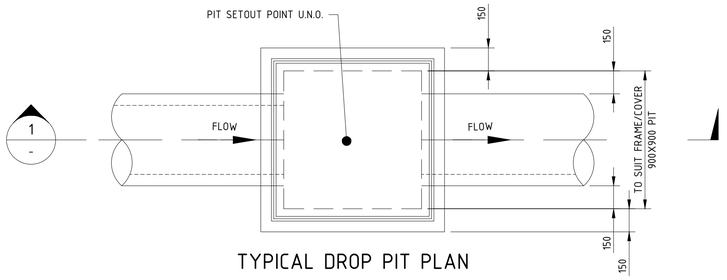
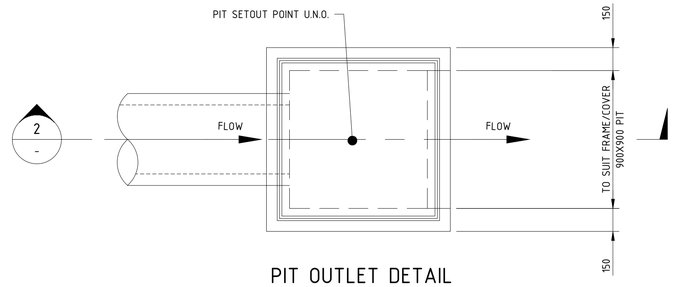
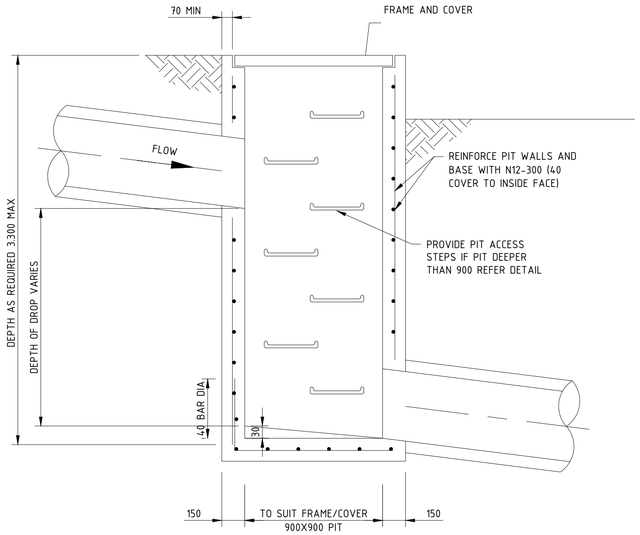


TYPICAL DROP PIT PLAN

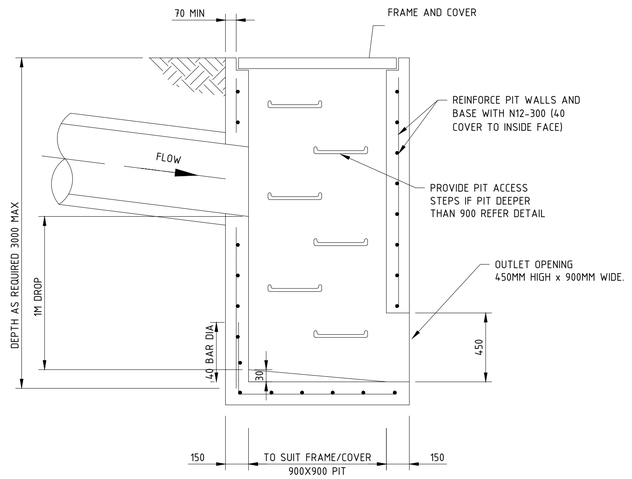


PIT OUTLET DETAIL



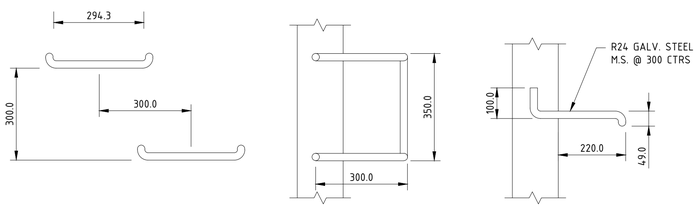
TYPICAL DROP PIT DETAIL

SECTION 1
SCALE 1:20



PIT OUTLET DETAIL

SECTION 2
SCALE 1:20



TYPICAL STEP IRON DETAILS

SCALE 1:10

0 100 200 300 400 500 600mm
SCALE 1:10 AT A1 SIZE

0 0.2 0.4 0.6 0.8 1.0 1.2m
SCALE 1:20 AT A1 SIZE

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ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

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DATUM	GRID	SCALE	
AHD	MGA-56	AS SHOWN	AT A1 SIZE

TITLE: DRAINAGE DETAILS
SHEET 2 OF 2

PROJECT No.	DRAWING No.	REV.
N22001	CI-0351	B

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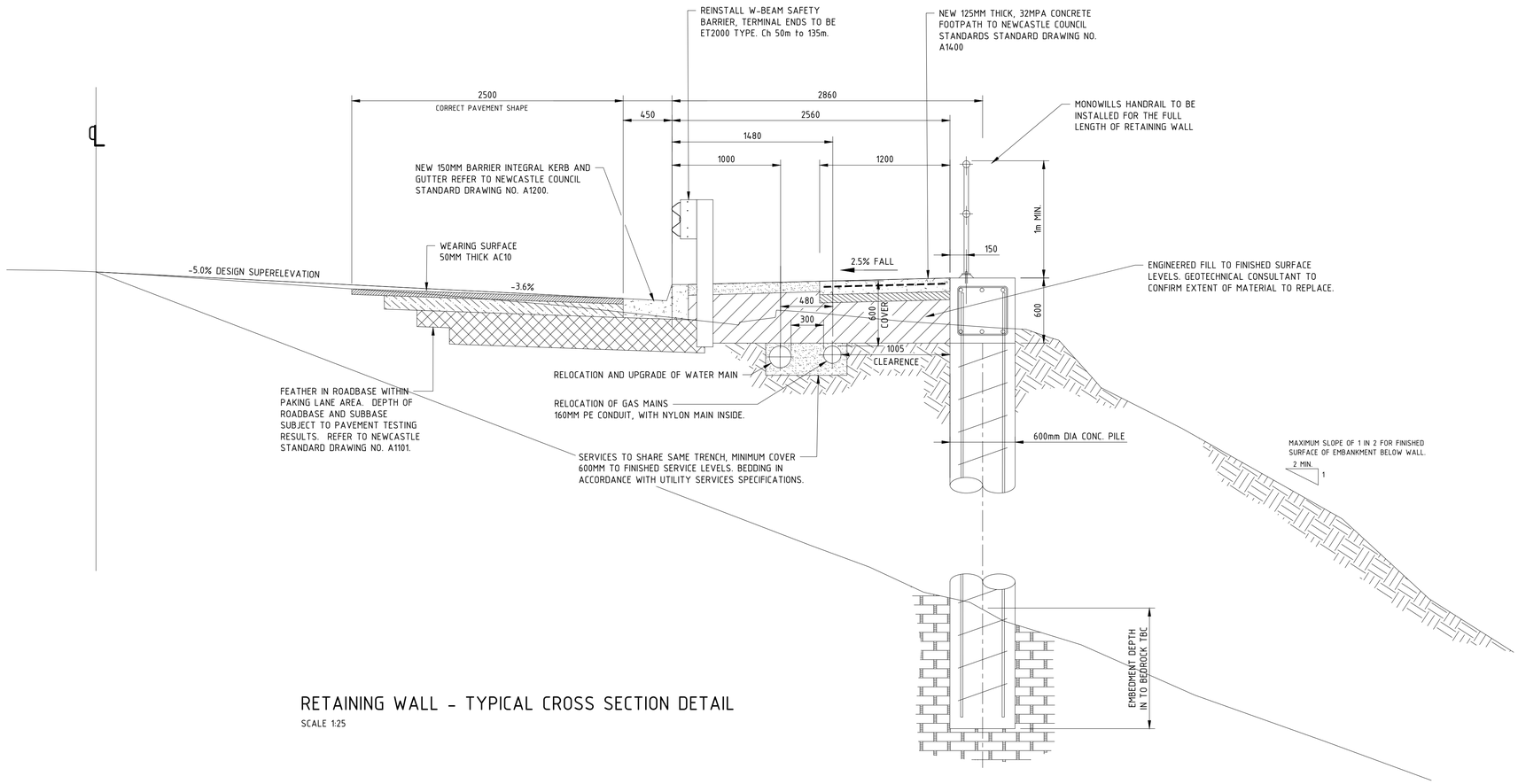
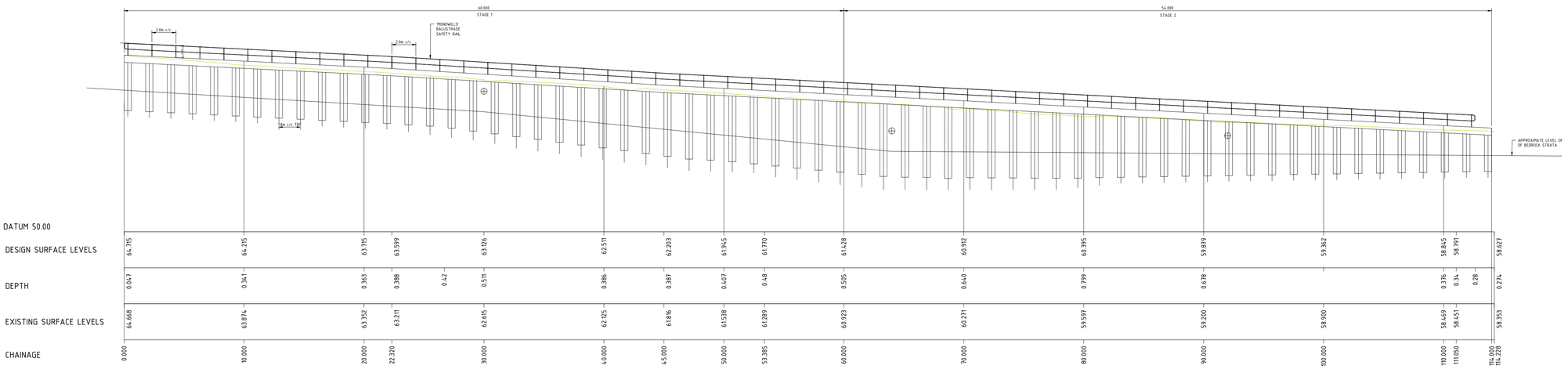


RETAINING WALL - TYPICAL CROSS SECTION DETAIL

SCALE 1:25



RETAINING WALL ELEVATION

SCALE HORIZONTAL 1:200 VERTICAL 1:200

0 0.25 0.5 0.75 1.0 1.25 1.5m
SCALE 1:25 AT A1 SIZE

0 2 4 6 8 10 12m
SCALE 1:200 AT A1 SIZE

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REV	DATE	DESCRIPTION	RVD

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PROJECT
MEMORIAL DRIVE, THE HILL
ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

STATUS: DRAFT

DRAWN	DESIGNED	CHECKED	APPROVED
DR	DW	BC	

DATUM	GRID	SCALE	
AHD	MGA-56	AS SHOWN	AT A1 SIZE

TITLE
RETAINING WALL TYPICAL SECTION AND ELEVATION

PROJECT No.	DRAWING No.	REV.
N22001	CI-0380	B

N

INSTALL AND MAINTAIN WIRE MESH AND GRAVEL SEDIMENT FILTERS TO ALL KERB INLET PIT.

NESCA PARADE

STABILISED SITE ACCESS

EXISTING STORMWATER HEADWALL FOR OPEN CHANNEL

PROPOSED CONSTRUCTION SITE ACCESS FROM NESCA PARADE - ACCESS POINT

NATURAL GULLY

DH

FENTON AVE

SILT FENCE

INSTALL AND MAINTAIN WIRE MESH AND GRAVEL SEDIMENT FILTERS TO ALL KERB AT END OF WORK ZONE

PLACE TIMBER HOARDING AROUND TREES FOR PROTECTION

PIT 4

PIT 3

PIT 2

PIT 1

NEW 450DIA HDPE

EXIST 450DIA HDPE

BH01

MEMORIAL DRIVE

INSTALL AN MAINTAIN SECURITY FENCE AROUND SITE INSTALL DUST CONTROL HESSIAN ALONG SECURITY FENCE (TYP)

INSTALL AND MAINTAIN WIRE MESH AND GRAVEL SEDIMENT FILTERS TO ALL KERB INLET PITS (TYPICAL)

PLAN

SCALE 1:250

LEGEND

- CADASTRAL
- 96.00 EXISTING CONTOURS
- EXISTING STORMWATER DRAINAGE PIPE
- EXISTING STORMWATER KERB INLET PIT
- PROPOSED STORMWATER PIPE
- PROPOSED STORMWATER PIT
- PROPOSED ROCK LINED OPEN CHANNEL ENERGY DISSIPATER OUTLET
- TIMBER HOARDING TREE PROTECTION
- STABILISED SITE ACCESS
- MESH & GRAVEL INLET FILTER
- SEDIMENT FENCE
- SECURITY FENCE

NOTES

1. CONTRACTOR TO PROVIDE 'SANDBAG SEDIMENT TRAP' TO ALL PAVED / ROAD AREAS (BOTH PROPOSED AND EXISTING) IN ACCORDANCE WITH THE 'BLUE BOOK'.
2. CONTRACTOR TO PROVIDE 'GEOTEXTILE INLET FILTER TRAPS' TO ALL STORMWATER DRAINAGE INLETS (BOTH PROPOSED AND EXISTING) IN ACCORDANCE WITH THE 'BLUE BOOK'.

0 2.5 5.0 7.5 10 12.5 15m
SCALE 1:250 AT A1 SIZE

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ROAD EMBANKMENT REMEDIATION WORKS
NEWCASTLE NSW

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DATUM	GRID	SCALE	
AHD	MGA-56	AS SHOWN	AT A1 SIZE

TITLE: EROSION AND SEDIMENT CONTROL PLAN

PROJECT No.	DRAWING No.	REV.
N22001	CI-0700	B

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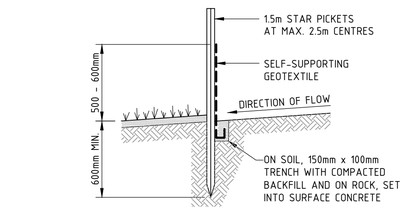

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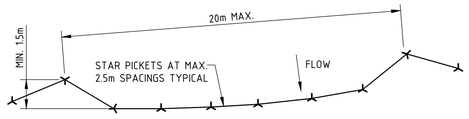
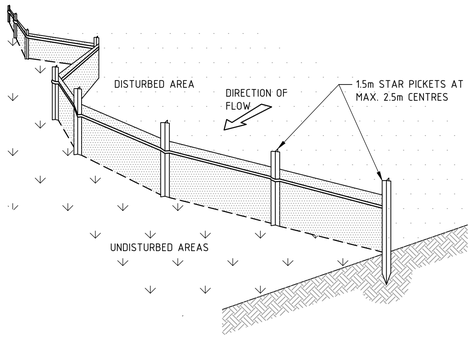


PLAN

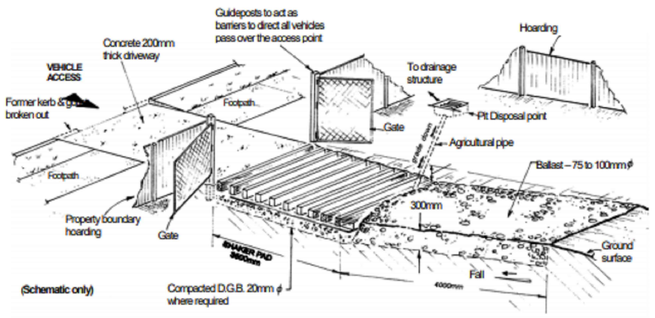


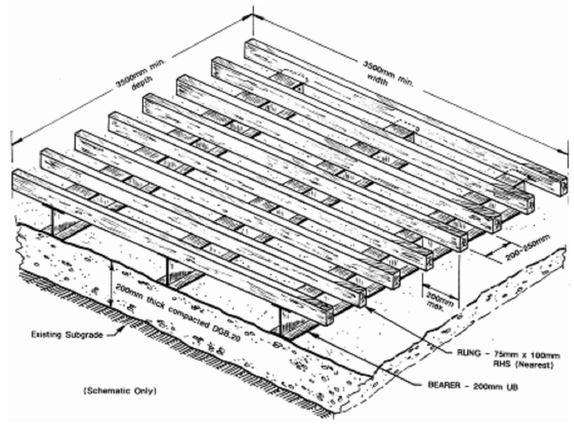
SEDIMENT FENCE CONSTRUCTION NOTES:

1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5m LONG STAR PICKETS INTO GROUND AT 2.5m INTERVALS (MAX.) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.

SEDIMENT FENCE

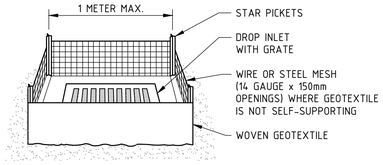
SCALE N.T.S

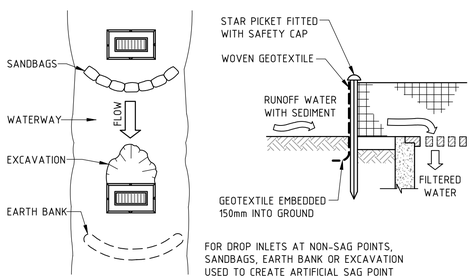




STABILISED SITE ACCESS - SHAKER GRID

SCALE N.T.S.





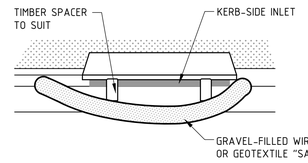
FOR DROP INLETS AT NON-SAG POINTS, SANDBAGS, EARTH BANK OR EXCAVATION USED TO CREATE ARTIFICIAL SAG POINT

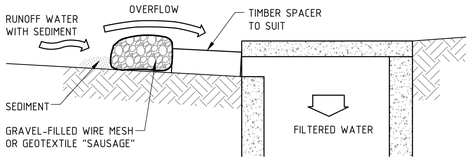
GEOTEXTILE INLET FILTER CONSTRUCTION NOTES:

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OR STRAW BALES.
2. PICKET SPACING TO BE A MAXIMUM 1.0m CENTRES.
3. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
4. DO NOT COVER THE INLET WITH GEOTEXTILES UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.

GEOTEXTILE INLET FILTER

SCALE N.T.S



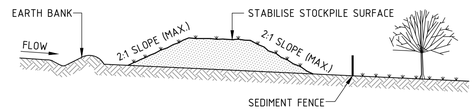


MESH & GRAVEL INLET FILTER CONSTRUCTION NOTES:

1. INSTALL FILTERS TO KERB INLETS ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH x 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET. MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING THE FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OR GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY CAN FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN.

MESH & GRAVEL INLET FILTER

SCALE N.T.S



STOCKPILE CONSTRUCTION NOTES:

1. PLACE STOCKPILES MORE THAN 2 (PREFERABLY 5) METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT.
4. WHERE THEY ARE TO BE PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LESS THAN 0.10.
5. CONSTRUCT EARTH BANKS ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES 1 TO 2 METRES DOWNSLOPE.

STOCKPILES

SCALE N.T.S

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DR	DW	BC	

DATUM	GRID	SCALE
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TITLE: EROSION AND SEDIMENT CONTROL DETAILS

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N22001	CI-0710	B

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Appendix C
Biodiversity Report

Memorial Drive, The Hill

Road Embankment Stabilisation Project

Biodiversity Report

January 2022

LITORIA
ECOLOGICAL RESTORATION SERVICES

Author	Reviewer
Name: Aaron Crotty (BEnvSci DipNRM) Title: Restoration Ecologist Phone: 0413 823 114 Email: aaron.crotty@litoriaers.com Signature: [redacted]	Name: Cheryl Crotty (BSc Earth Science) Title: Managing Director, Litoria Ecological Restoration Services Phone: 0411 407 655 Email: admin@litoriaers.com Signature:

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The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Litoria has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by Litoria described in this report. Litoria disclaims liability arising from any of the assumptions being incorrect.

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Litoria E R S Pty LTD

Document Name	Date Issued	Version	Author	Reviewer
Memorial Dr Biodiversity Report	23/12/2021	1	A Crotty	Julie Atkinson Miriam Buchorn Cheryl Crotty
Memorial Dr Biodiversity Report	23/01/2022	2	A Crotty	

Executive summary

The Memorial drive embankment rehabilitation works outlined in the RCA Geotechnical report, Date Palm removal and revegetation are proposed to be undertaken to stabilise the slope. A flora and fauna assessment was completed to understand the effect on biodiversity and threatened species on the subject site and the surrounding area. No significant species were detected during the pre-dawn nocturnal surveys, diurnal surveys or opportunistic surveys. A Likelihood of Occurrence table assessed the foraging and habitat requirements of nationally and NSW threatened flora and fauna which determined that the foraging of grey-headed flying foxes (Vulnerable- BC Act 2016) would be the only threatened species potentially impacted by the proposed works. As such, a 5-part test was included for the grey-headed flying fox which after assessing the extent of the impact on the foraging species, it was determined to have minimal impact on the species. The threatened species, Magenta Lilly Pilly, have been planted in several locations below the proposed works, and these plants have been mapped to limit the impact on these plants.

Overall, impacts to biodiversity, threatened ecological communities and threatened species from the proposed works are minor in nature if vegetation disturbance is confined to areas of low and medium vegetation retainment value. Appropriate mitigation measures, outlined in the recommendations, is likely to negate the impact in the short and long term, with great opportunity for improving biodiversity and habitat with the post stabilisation revegetation.

Contents

Biodiversity Report

1. Project description

An embankment stabilisation project is being planned by the City of Newcastle, to prevent further slumping of the slope near number 32 Memorial Drive within the Nesca Pde Reserve, The Hill. The proposed methods for stabilising the slope may require a degree of vegetation removal within the reserve for access to parts of the subject site. Two Canary Island Date Palms are found near the stabilisation slope, and these may be removed to make use of the machinery on site to lop and remove or to scatter vegetative matter for habitat and soil protection.

This biodiversity report has been prepared to ensure the location of important vegetation such as soil stabilisers, stags, habitat features and threatened species are known to the project staff to inform the design of the project, and its development footprint. The impact on fauna, especially potential threatened fauna, required assessment to ensure the impact of the proposed works will not be detrimental to populations or individuals, see figure 1.

Site: Memorial Dr
Client: Newcastle City Council
Author: Tasman Carr
Date: 23/01/2022

0 10 20 30 40 m

Remediation Area
Site Boundary

Vegetation retainment value
- High
- Medium
- Low

Points of Interest
- Date palms
- Feed tree
- Norfolk Hibiscus
- Norfolk pine
- S. paniculatum
- Stag

LITORIA
ECOLOGICAL RESTORATION SERVICES

2. Introduction

2.1 General description of site

The proposed slope stabilisation works are located within Nesca Park reserve, The Hill. The reserve slopes steeply to the north from the top of the catchment, where a number of small overland flow lines converge into the main first order channel fed by a stormwater pipe in the Southeast corner of the site. The site has been regenerated by volunteers and City of Newcastle, restoring it from a weedy slope to a dense shrubland, containing native vegetation, with improving habitat value and slope stability. The steep slope lends itself to erosion, soil slumping and weed invasion.

2.2 Description of proposal

Proposed works will aim to stabilise the steep embankment surrounding the stormwater outlet immediately to the west of 32 Memorial Drive, within the Nesca Park reserve. The RCA Geotechnical report recommends several options for remediating the batter, including reconstructing the batter, followed by soil nails or retaining walls. Access is challenging, however most of the works is likely to occur in the South-eastern corner of the reserve near 32 Memorial Drive, The Hill. The batter is to be planted with soil stabilising vegetation.

Some channel works between Memorial Drive and Nesca Pde are possible as part of this project which may include rock revetment. These works may lead to removal of vegetation along the flow line for machinery access. Geotextile and rocks are commonly used for stabilisation of these areas followed by revegetation of the footprint.

Other proposed works include removal of 2 large Date Palms along the eastern boundary near number 77 Nesca Pde. The Hill. This may require access by tree loppers to fell the trees in situ. The trunk can be secured across the slope in a suitable location and scatter the palm fronds to help stabilise the slope and slow surface flows. Alternatively, the trees will be removed from site with a crane.

3. Biodiversity assessment

3.1 Methodology and survey effort

A terrestrial flora survey was conducted on the 14th December 2021. The focus was on the areas surrounding the proposed development and radiating out through possible alternate access ways where vegetation may need to be cleared for access or potential channel stabilisation. High, medium and low value flora, threatened species, and habitat trees including stags were recorded to guide the design for access, and material storage, see figures 1 and 2. All species found are listed in appendix 1.

Fauna surveys were conducted pre-dawn and dawn as well as opportunistic records while surveying flora, on the 13th and 14th December 2021, to record nocturnal and diurnal fauna. Habitat structures were also surveyed and recorded. Faunal sightings are listed in appendix 2.

3.2 Vegetation Retainment Value

The vegetation on site contains a variety of native and exotic species, see appendix 1, with varying degrees of indigeneity, correlation with local vegetation communities and site suitability. To guide the planning of access routes and storage locations, which will likely require vegetation removal, the vegetation value has been assessed. Figure 1 divides the site into three vegetation retainment values categories.

Table 1 – Vegetation Retainment Value Description

Value	Description
Low	• Low amounts of indigenous flora (<20%) • Concentrated amounts of early succession plants • Low amounts of mature native vegetation (<10% canopy cover) • Low amounts of habitat providing vegetation • Plants providing minimal soil stability • Low amounts of remnant, or long-standing native vegetation • Contains (> 10% weed cover)
Medium	• Moderate amounts of indigenous flora (21-60%) • Variety of vegetation strata • Moderate amounts of mature native vegetation (>10%) • Moderate amounts of habitat providing vegetation • Vegetation providing soil stability • Contains long standing native vegetation • Low weed cover (<10% weed cover)
High	• High amounts of indigenous flora (>60%) • Variety of vegetation strata • High amounts of mature native vegetation (>50%) • Moderate to high amounts of habitat providing vegetation • Vegetation providing soil stability • Contains long standing native vegetation or remnant indigenous flora • Low weed cover (<5% weed cover)

*3.**3** Biodiversity assessment table*

Table 2 Biodiversity Assessment		
Criteria	**Yes/No**	**Details**
1. Does the proposed development involve the clearing or modification of any native vegetation (including trees, shrubs, grasses, aquatic species), that has not been regularly maintained or is highly disturbed?	Yes	Native trees are to be retained where possible. Native groundcovers and midstory are likely to be impacted by machinery to access and remediate the slope. Due to the small composition and diversity of native species to be cleared within the proposed development, the impact on biodiversity is likely to be minimal if accessed from Memorial Drive.
2. Will the proposed development require the removal of logs, dead trees, or rock from the site, or the removal of woody debris from creeks/waterways?	No	Dead standing trees and logs will be retained.
3. Will the proposed development involve any works within 20m of (the top of a bank) a watercourse (eg creek/river) or water body (eg wetland)?	No	
4. Is the development likely to impact on any threatened species, populations, ecological communities, or their habitats?	Yes	Ecology and threatened species surveys were undertaken on the 13th and 14th December 2021. No threatened fauna were observed and one planted threatened flora species was recorded. These plants are small and will be protected from being harmed during the process. A test of significance was carried out for **one** threatened fauna species likely to use this site for foraging. See section 5.3.6.
5. Is the development likely to impact any Matters of National Significance, which include the following? • nationally threatened species and ecological communities, migratory species • RAMSAR wetlands • Commonwealth marine environment • World Heritage properties • National Heritage places • nuclear actions?	No	
6. Will the development require the clearing of more than 1 hectare of native vegetation.	No	

7. Is the proposed development likely to impact on any of the following? • Any conservation agreement under the National Parks and Wildlife Act 1974 (NPW Act). • Any plan of management adopted under the NPW Act • Any joint management agreement under the **Biodiversity Conservation Act 2016** (BC Act, Previously TSC Act) • Any biobanking agreement under the **BC Act** • A Wilderness Area or critical habitat (none in LGA) • Protected fauna or native plants listed in the **BC Act**	Yes	Grey-headed flying fox is likely to experience a short-term reduction in foraging resources due to removal of two Date Palms. This is unlikely to be significant in the long-term with mitigation measures outlined in section 5.5; incorporating fleshy fruited flora species into the revegetation plan. Date palms will remain outside the subject site with over 25 mature trees in King Edward Park, and over 60 mature trees in Nesca Park.

4. Threatened species assessments

4.1 Method

A desktop assessment of the site was conducted, utilising NSW National Parks and Wildlife Service's 'Atlas of NSW Wildlife' Bionet to identify threatened flora and fauna within a 10 by 10-kilometre area. Listed species were assessed for likelihood of occurrence within the project scope. Any species likely to occur on the project site were searched for during ecological surveys and 5-part assessments conducted for species more likely to rely on this site.

4.2 Surrounding vegetation communities

The reserve is connected to The Trig Coastal Heath and Themeda Grassland. A narrow strip of coastal vegetation continues south to Glenrock SCA containing several vegetation communities and more Themeda Grassland and Coastal Heath in parts of King Edward Park to the north. Vegetation to the west and north is fragmented from this site.

4.3 Site vegetation

Site vegetation is predominately low and middle strata secondary planted and regrowth native vegetation. The vegetation is dense from Nesca Pde up to the base of the slope proposed to be remediated. There is a low abundance of weeds though the site due to an active Landcare group and recent ecological restoration projects conducted by CoN. See appendix 1 for species lists.

4.4 Fauna

Field surveys detected a low abundance of native birds and mammals utilising the site for foraging and habitat. See section 6 for recommendations to mitigate habitat loss in the short and long term. See appendix 2 for a complete fauna species list.

4.5 Threatened species assessments

Table 3 below provides the likelihood of occurrence assessment for threatened Fauna and Flora species to occur within the project site, based on Bionet records in a 10 by 10-kilometre area to the site. The preferred habitat and foraging habitat for each species has been assessed to consider the types of food sources and habitat features on the subject site focussing on areas likely to be impacted by the proposed development.

Magenta Lilly Pilly

Table 3 – Likelihood of Occurrence Assessment Threatened fauna recorded from NSW Threatened Species Atlas Bionet							
Group	**Scientific name**	**Common name**	**NSW status**	**Comm status**	**Potential habitat**	**Potential foraging**	**Impact**
Aves	*Anseranas semipalmata*	Magpie goose	V		U	U	U
	Ardenna carneipes	Flesh-footed Shearwater	V		U	U	U
	Burhinus grallarius	Bush Stone-curlew	E		U	U	U
	Calidris ferruginea	Curlew sandpiper	E	CE	U	U	U
	Calidris tenuirostris	Great Knot	V		U	U	U
	Charadrius leschenaultii	Greater Sand-plover	V	V	U	U	U
	Charadrius mongolus	Lesser sand-plover	V	E	U	U	U
	Daphoenositta chrysoptera	Varied sittella	V		P	U	U
	Diomedea exulans	Wandering Albatross	E	E	U	U	U
	Epthianura albifrons	White-fronted chat	V		U	U	U
	Glossopsitta pusilla	Little lorikeet	V		U	P	U
	Haematopus fuliginosus	Sooty Oystercatcher	V		U	U	U
	Haematopus longirostris	Pied Oystercatcher	E		U	U	U
	Haliaeetus leucogaster	White-bellied sea-eagle	V		U	P	U
	Hieraaetus morphnoides	Little eagle	V		U	P	U
	Hirundapus caudacutus	White-throated Needletail		V	U	U	U
	Lathamus discolor	Swift parrot	E	CE	U	U	U
	Limicola falcinellus	Broad-billed Sandpiper	V		U	U	U
	Limosa limosa	Black-tailed Godwit	V		U	U	U
	Lophoictinia isura	Square-tailed kite	V		U	P	U
	Macronectes giganteus	Southern Giant Petrel	E	E	U	U	U
	Neophema pulchella	Turquoise parrot	V		U	P	U
	Ninox strenua	Powerful owl	V		U	P	U
	Numenius madagascariensis	Eastern curlew		CE	U	U	U
	Onychopion fuscata	Sooty Tern	V		U	U	U
	Pandion cristatus	Eastern osprey	V		U	U	U

Table 3 – Likelihood of Occurrence Assessment Threatened fauna recorded from NSW Threatened Species Atlas Bionet							
Group	**Scientific name**	**Common name**	**NSW status**	**Comm status**	**Potential habitat**	**Potential foraging**	**Impact**
Aves	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V		U	U	U
	Ptilinopus magnificus	Wompoo fruit-dove	V		U	U	U
	Ptilinopus superbus	Superb fruit-dove	V		U	U	U
	Sternula albifrons	Little Tern	E		U	U	U
	Sula dactylatra	Masked Booby	V		U	U	U
	Thalassarche cauta	Shy Albatross	V	V	U	U	U
	Tyto longimembris	Eastern Grass Owl	V		U	U	U
	Tyto tenebricosa	Sooty Owl	V		U	P	U
	Xenus cinereus	Terek Sandpiper	V				
Mammalia	*Arctocephalus forsteri*	New Zealand Fur-seal	V		U	U	U
	Arctocephalus pusillus doriferus	Australian Fur-seal	V		U	U	U
	Cercartetus nanus	Eastern Pygmy-possum	V		U	**U**	U
	Dugong dugon	Dugong	E		U	U	U
	Megaptera novaeangliae	Humpback Whale	V	V	U	U	U
	Miniopterus orianae oceanensis	Large Bentwing-bat	V		P	U	U
	Nyctophilus bifax	Eastern Long-eared Bat	V		U	P	U
	Petaurus norfolcensis	Squirrel glider	V		U	P	U
	Phascolarctos cinereus	Koala	V	V	U	U	U
	Pteropus poliocephalus	Grey-headed flying-fox	V	V	U	P	P
	Scoteanax rueppellii	Greater broad-nosed bat	V		U	U	U
Reptilia	*Caretta caretta*	Loggerhead Turtle	E	E	U	U	U
	Chelonia mydas	Green Turtle	V	V	U	U	U
	Eretmochelys imbricata	Hawksbill Turtle		V	U	U	U
	Uvidicolus sphyrurus	Border Thick-tailed Gecko	V	V	U	U	U

E- Endangered V- Vulnerable U- Unlikely P- Possible L- Likely

Table 4 below provides the likelihood of occurrence assessment for threatened flora species to occur within the project site, based on Bionet records in a 10 by 10-kilometre area to the site. This was used to narrow down the ground survey search, focussing on areas likely to be impacted by the proposed development.

Table 4 – Likelihood of Occurrence Assessment Threatened Flora recorded from NSW Threatened Species Atlas Bionet						
Group	**Scientific name**	**Common name**	**NSW status**	**Comm status**	**Potential habitat**	**Impact**
Flora	*Diuris praecox*	Rough Doubletail	V	V	U	U
	Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	U	U
	Grevillea shiressii		E		U	U
	Pultenaea maritima	Coast Headland Pea	V		P	U
	Rhodamnia rubescens	Scrub Turpentine	E	CE	U	U
	Rutidosis heterogama	Heath Wrinklewort	V	V	U	U
	*Syzygium paniculatum***	Magenta lilly pilly	E	V	P	P
	Tetratheca juncea	Black-eyed susan	V	V	U	U
	Zannichellia palustris	Horned pondweed	E		U	U

E- Endangered V- Vulnerable U- Unlikely P- Possible L- Likely

*** Planted, possible cultivar*

4.6 Assessment of Impact on Threatened Species (5-part test)

The subject site is small, fragmented and contains relatively young native vegetation. As such it is unlikely to contain the habitat or foraging opportunities suitable for threatened species in the area. All potential foraging and habitat features are relatively insignificant and unlikely to support threatened fauna, and only fauna adapted to urban environments are likely to be found on this site. One threatened flora species, *Syzygium paniculatum* was found planted in several locations and is possibly a cultivar. There were no mature seed-bearing plants on site. These plants will be protected during the remediation works. A targeted search was undertaken for the Pultenaea maritima to determine if it is found on site, however none were located.

With an abundance of caution, one fauna species has been assessed below with a 5-part test to determine if the proposed development is likely to harm the species. The Grey Headed Flying Fox is likely to feed on the Date Palms on site.

The following species has been assessed with the 5-part test pursuant to section 7.3 of the *Biodiversity Conservation Act 2016.*

Section 5A Assessment – Fauna **Grey Headed Flying Fox (Vulnerable)**
a) 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,
No known camps or habitat is located within the project site. Pre-dawn nocturnal survey revealed no individuals on site. There are a number of temporarily occupied camps within the city, however this reserve appears to lack the vegetation suitable to establish a camp and preferred food is limited to some Canary Island Date Palms. Any flying fox utilising the site would be foraging outside project work hours. The project works would be unlikely to

Section 5A Assessment – Fauna Grey Headed Flying Fox (Vulnerable)
impact on the life cycle of the species apart from a small reduction in the food source. Mitigation measures for the long term include replacement of Canary Island Date palms with similar native trees such as Cabbage Tree Palms.
b) 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
No EEC or CEEC are found on the subject site or expected to be impacted by the proposed development.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
No EEC or CEEC are found on the subject site or expected to be impacted by the proposed development.
(c) 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
No habitat is expected to be impacted by the proposed development apart from foraging habitat in two Date Palms. The size of the site and vegetation structure is unlikely to support a colony of flying fox. A large amount of Date Palms are located in Nesca park down the hill from Nesca Pde and other roadside and parkland settings nearby. The two trees to be removed are unlikely to impact significantly on the foraging habitat for this species.
(ii) whether 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
The Date Palms on site are located at the fringe of the main cluster of Date Palms in the lower parts of Nesca Park, as such these plants do not appear to be part of a foraging corridor.
(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,
The two trees on the subject site comprise only a small percentage of Date Palms within The Hill suburb, as such is unlikely to be overly important for the flying fox diet.
(d) 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),
No
(e) whether 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.

Section 5A Assessment – Fauna Grey Headed Flying Fox (Vulnerable)
The loss of foraging sites is a key threatening process. By removing the Date Palms the foraging habitat is likely to be reduced marginally. Offset planting of native substitutes is recommended to mitigate the loss to habitat. The two trees on the subject site comprise only a small percentage of Date Palms within The Hill suburb, as such is unlikely to be overly important for the flying fox diet.

5. Matters of National Environmental Significance

5.1 Nationally threatened species and ecological communities

No nationally threatened fauna species were detected during survey work. Several nationally threatened species have been recorded nearby, see table 2 and 3. Due to the limited potential foraging and habitat features, the site is unlikely to support threatened fauna species in the area and only fauna adapted to urban environments are likely to be found on this site. One nationally threatened flora species was located on site, however there are no mature trees of this species located on site, only a number of planted specimens. These plants have been mapped and will be protected from the development activities.

The vegetation on site is mostly re-planted and regrowth vegetation and it does not conform with any threatened ecological communities.

5.2 Migratory Species

No migratory bird species were recorded during the fauna surveys. The nearby suitable habitat for migratory species is fragmented from this reserve. Many of the recorded migratory species are found in the Hunter Estuary. There is only limited potential habitat and suitable foraging habitat for these migratory species. Proposed works are not expected to have implications on species downstream from the site.

Table 6 – Likelihood of Occurrence Assessment
Migratory species recorded by NSW Threatened Species Atlas Bionet

Group	Scientific name	Common name	Comm status	Potential habitat	Potential foraging	Impact
Aves	*Ardenna carneipes*	Flesh-footed Shearwater	J, K	U	U	U
	Calidris acuminata	Sharp-tailed Sandpiper	C, J, K	U	U	U
	Calidris ferruginea	Curlew Sandpiper	CE, C, J, K	U	U	U
	Charadrius leschenaultii	Greater Sand-plover	V,C,J,K	U	U	U
	Charadrius mongolus	Lesser Sand-plover	E,C,J,K	U	U	U
	Calidris canutus	Red Knot	E,C,J,K	U	U	U
	Calidris ferruginea	Curlew Sandpiper	CE,C,J,K	U	U	U
	Calidris tenuirostris	Great Knot	CE,C,J,K	U	U	U
	Hirundapus caudacutus	White-throated Needletail	V,C, J, K	U	U	U
	Limicola falcinellus	Broad-billed Sandpiper	C,J,K	U	U	U
	Limosa limosa	Black-tailed Godwit	C, J, K	U	U	U
	Numenius madagascariensis	Eastern Curlew	CE, C, J, K	U	U	U
	Sternula albifrons	Little Tern	C,J,K	U	U	U
	Sula dactylatra	Masked Booby	J,K	U	U	U
	Xenus cinereus	Terek Sandpiper	C,J,K	U	U	U

C-CAMBA J-JAMBA K-ROKAMBA

5.3 RAMSAR wetlands

No RAMSAR wetlands exist on, adjacent to, or downstream from the proposed development site.

6. Recommendations

The following recommendations are outlined below to minimise the impact of biodiversity and threatened species found on site or possibly using this site;

- Any cleared access ways or vegetation removal should be restricted to areas of low vegetation retainment value. If areas of medium vegetation retainment value need to be cleared, canopy trees should be avoided due to the concentrated numbers of fauna observed feeding and roosting in these trees. *Syzygium paniculatum* plants should be retained, if they are required to be removed, the entire root ball and surrounding soil should be removed and translocated into a low disturbance area and watered until re-established. Access with machinery into high vegetation retainment value areas should be avoided. The least damaging access will be from Memorial Drive. See Figure 1 for locations of *Syzygium paniculatum*, vegetation retainment value areas and flora providing habitat to design work processes around and for locating suitable material storage areas.
- Dead standing timber and logs should be retained as habitat where practical. It is recommended to leave the Date Palm trunks standing to provide diversity in habitat structure. Alternatively, the trunks could be secured on the ground, where most practical to provide soil stability and to slow surface runoff.
- The *Syzygium paniculatum* plants are recommended to be flagged to prevent proposed activities from harming them.
- Erosion control measures should be implemented during the proposed works in accordance with Managing Urban Stormwater: Soils and Construction 4th Edition – Vol. 1 (the "blue book") published by Landcom, 2004.
- Revegetate using species from local provenance stock. Utilise fleshy fruited species to offset Date Palm food resource loss, such as *Livistona australis*. Species selection for the embankment should include species with vigorous root systems, both deep rooted and shallow fibrous roots, when planting into the blanket to stabilise the soil long term. Examples of these species include *Ficus rubiginosa, Ficus coronata, Goya semiglauca, Cupaniopsis anacardoides, Lomandra longifolia, Imperata cylindrica and Dianella caerulea.*
- Contractors are advised to prevent translocating exotic/weedy seeds, plant matter or plant pathogens where possible on vehicles, machinery and clothing.

Dead standing timber

7. Biodiversity Report Conclusion

The options for accessing and stabilising the slope have been assessed in terms of their impact on the ecology of the reserve and potential local threatened species listed under the BC Act 2016 and the EPBC Act of 1999. The assessment has identified one threatened species which is possibly impacted in the short-term. This is unlikely to be significant in the long-term when revegetated species begin to support high quality native habitat and foraging resources for the species. The least intrusive access to the site is from Memorial Drive, this will reduce the need for removing vegetation along the waterway and rehabilitating it.

The proposed batter reshaping and soil nails are likely to see minimal impact on the vegetation in the reserve when accessed from Memorial Drive. Revegetating the slope following completion of the work is likely to see a net gain in habitat for the fauna on site.

Date palms proposed to be removed

8. References

Local Land Services (2017) “Hunter Regional Strategic Weed Management Plan 2017-2022”. Reviewed June 2018, Resource available at https://hunter.lls.nsw.gov.au/__data/assets/pdf_file/0010/806509/Hunter_RSWMP_FINAL.pdf

NSW Office of Environment and Heritage (2018) “Bionet – Threatened species atlas”. Accessed 10th December, 2021; Resource available at http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx

Appendix 1 – Flora Species Lists

Flora Table	
Exotic Species	
Scientific Name	**Common Name**
Acetosa sagittate	Turkey rhubarb
Ageratina adenophora	Crofton weed
Anredera cordifolia	Madeira vine
Agapanthus sp	Agapanthus
Bidens pilsoa	Farmers friend
Bromus sp.	Brome grass
Coynza bonariensis	Fleabane
Cynodon dactylon	Couch
Lagunaria patersonia	Norfolk island hibiscus
Olea europaea	African olive
Paspalum dilatatum	Paspalum
Pennisetum clandestinum	Kikuyu
Phoenix canariensis	Canary island date palm
Senna pendula	Cassia
Sida rhombifolia	Paddys Lucerne
Solanum mauritianum	Wild tobacco
Solanum nigrum	Blackberry nightshade
Stenotaphrum secundatum	Buffalo grass
Verbena bonariensis	Purple top
Native Species	
Scientific Name	**Common Name**
Banksia integrifolia	Coastal banksia
Breynia oblongifolia	Coffee bush
Casaurina glauca	Swamp oak
Commelina cyanea	Scurvy weed
Cordyline stricta	Palm lily
Correa alba	White correa
Cayratia clematidea	Native grape
Cupaniopsis anacardioides	Tuckaroo
Dianella caerulea	Flax lily
Dichondra repens	Kidney weed
Dodonaea triquetra	Hop bush
Eucalyptus robusta	Swamp mahogany
Ficus coronata	Sandpaper fig
Ficus rubiginosa	Port Jackson fig
Glochidion ferdinandi	Cheese tree
Hibertia scandens	Guinea flower
Imperata cylindrical	Blady grass
Juncus usitatus	
Leptospermum laevegatunm	Coastal tea tree
Lomandra longifolia	Spiny rush mat
Melaleuca nodosa	Prickly leaved paperbark
Melaleuca stypheloides	Prickly leaved tea tree

Melia azedarach	White Cedar
Microlaena stipoides	Weeping grass
Pittosporum undulatum	Sweet pittosporum
Plectranthus sp.	
Poa labillardierei	Tussock grass
Pteridium esculentum	Hard bracken fern
Westringia fruiticosa	Coastal rosemary
Syzygium paniculatum	Magenta lily pily
Syzygium smithii	Lily pilly

Appendix 2 – Fauna Species List

Fauna Table	
Birds	
Scientific Name	**Common Name**
Acridotheres tristis	Common myna
Anthochaera carunculate	Red wattlebird
Anthochaera chrysoptera	Little wattlebird
Columba livia domestica	Rock dove
Corvus coronoides	Australian raven
Cracticus nigrogularis	Pied butcherbird
Cracticus torquatus	Grey butcherbird
Dacelo novaeguineae	Kookaburra
Eudynamys orientalis	Common Koel
Grallina cyanoleuca	Magpie lark
Gymnorhina tibicen	Magpie
Manorina melanocephala	Noisy miner
Ocyphaps lophotes	Crested dove
Ptilonorhynchus violaceus	Satin bowerbird (Heard)
Trichoglossus haematodus	Rainbow lorikeet

Appendix D
AHIMS Search

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : 38

Client Service ID : 714799

Arie Zuanic

2a/45 Fitzroy Street
Carrington New South Wales 2294

Attention: Arie Zuanic

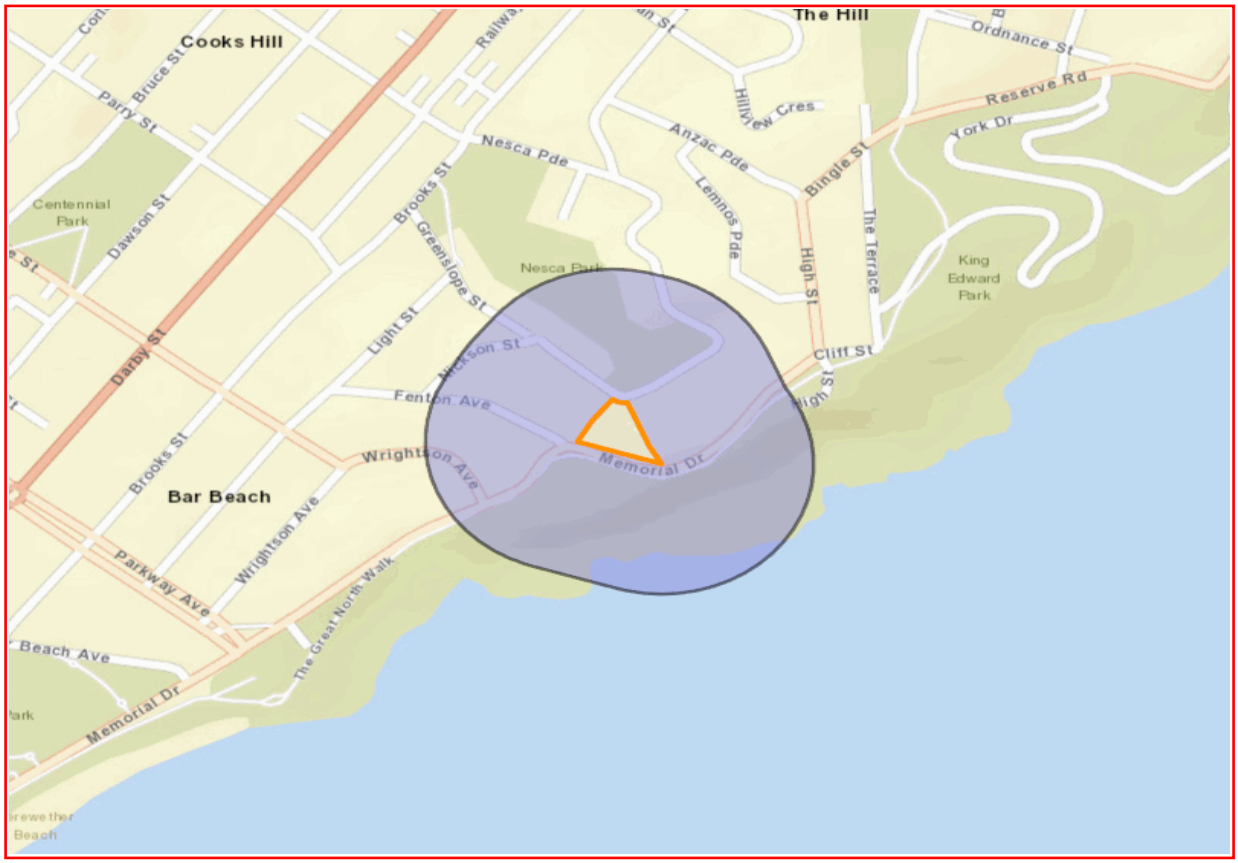
Email: arie.zuanic@rpsgroup.com.au

Date: 06 September 2022

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 4, DP:DP222421, Section : - with a Buffer of 200 meters, conducted by Arie Zuanic on 06 September 2022.

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 E
Geotechnical Assessment

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
15 Callistemon Close
Warabrook NSW 2304
PO Box 324
Hunter Region Mail Centre NSW 2310
Phone (02) 4960 9600

BG & E Pty Ltd
136 King Street
NEWCASTLE NSW 2300

Project 212449.00
13 May 2022
R.001.Rev0
CMF/DMB:lg

Attention: David Woodley

Email: david.woodley@bgeeng.com

Geotechnical Assessment
Proposed Road Embankment Remediation Works
Memorial Drive, The Hill

1. Introduction

The report outlines the result of geotechnical assessment carried out for proposed road embankment remediation works at Memorial Drive, The Hill.

It is understood that the City of Newcastle (CN) identified early stages of batter slope instability along Memorial Drive between 2 Fenton Avenue and 32 Memorial Drive, The Hill and that options for remediation works are being considered to provide long term stability of the batter. The extent of the site is provided in Figure 1 below.

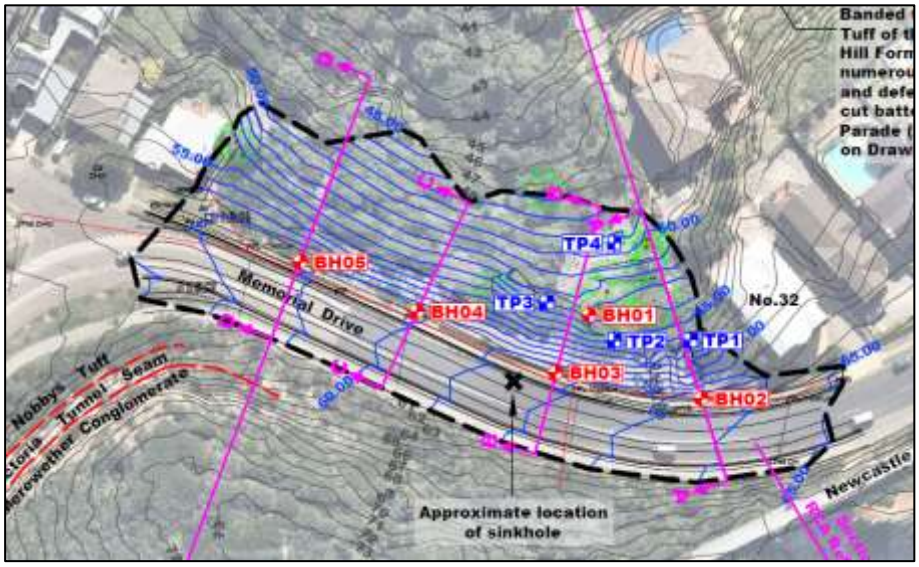


Figure 1: Site Extent (Extract from RCA Report Ref 14822-202/1, September 2021)

A geotechnical investigation has previously been carried out at the site by RCA in 2021 which included drilling of five bores, excavation of four test pits (refer Figure 1), geotechnical analysis and recommendations regarding options for remediation / stabilisation works.

BG&E have been engaged by CN to develop tender stage civil design documentation, building on the initial advice provided in (RCA , 2021) and further geotechnical assessment is required to support BG&E's design documentation. Based on discussions with CN and BG&E, the following options are being considered for the site:

- Option 1a – Soil Nails with earthworks: Reinstate footpath where damaged and carry out earthworks to re-grade the batter slope to a grade of 2(H):1(V). Install soil nails to re-graded batter slope;
- Option 1b –Soil Nails with minor regrade: Decommission footpath or "make good" with minimal works. Minimal earthworks to regrade/smooth out the batter slope to original grade (approx. 1 to 1.5H:1V) in area of failure only. Install soil nails to existing batter slope.
- Option 2a – Retaining wall with earthworks – Reinstate footpath and regrade the batter slope to 2H:1V and revegetate. Construct retaining wall approx. 1.5 m high to support the road and footpath;
- Option 2b – Retaining wall with minor regrade: Construct retaining wall approx. 1.5 m high to support road only. Reinstate footpath and road. Regrade/smooth out and revegetation of downslope batter to original grade (approx. 1 to 1.5H:1V) in the area of failure only;

Cross sections for the above options have been developed by BG&E and are attached.

The current geotechnical assessment includes site inspection, review of the previous investigation, and geotechnical analysis of the soil nail Option recommended in (RCA , 2021). The slope stability assessment was undertaken using SLOPE W in the location of the slip.

2. Adopted Geotechnical Model

2.1 Subsurface Conditions

The adopted geotechnical model for Revised Section B is shown Figure 2, with geological units summarised in Table 1. The location of Revised Section B is shown on Drawing 1 and is slightly to the east of Section B (RCA , 2021). Surface levels at the slip and Revised Section B have been modelled based on detailed survey data completed by CN, dated 7 April 2022.

Geological units at Revised Section B are based on the results of BH01, BH03, TP4 and groundwater measurements from piezometer installed at BH01 (RCA , 2021) which are attached. The following comments are provided in relation to the Unit 3 rock mass:

- The (RCA , 2021) investigation indicates the Unit 3 rock is predominantly massive and defects generally comprise clean/iron stained near horizonal bedding planes with some clean/ironstained joints dipping between 5 to 85 degrees;
- Coal seams were not encountered within the (RCA , 2021) bores drilled to depth between 3.2 m and 9.6 m.

On the basis of the above, the risk of slow deep-seated failures was considered to be very low, and this slope stability assessment considered failure surfaces penetrating through the soil units only.

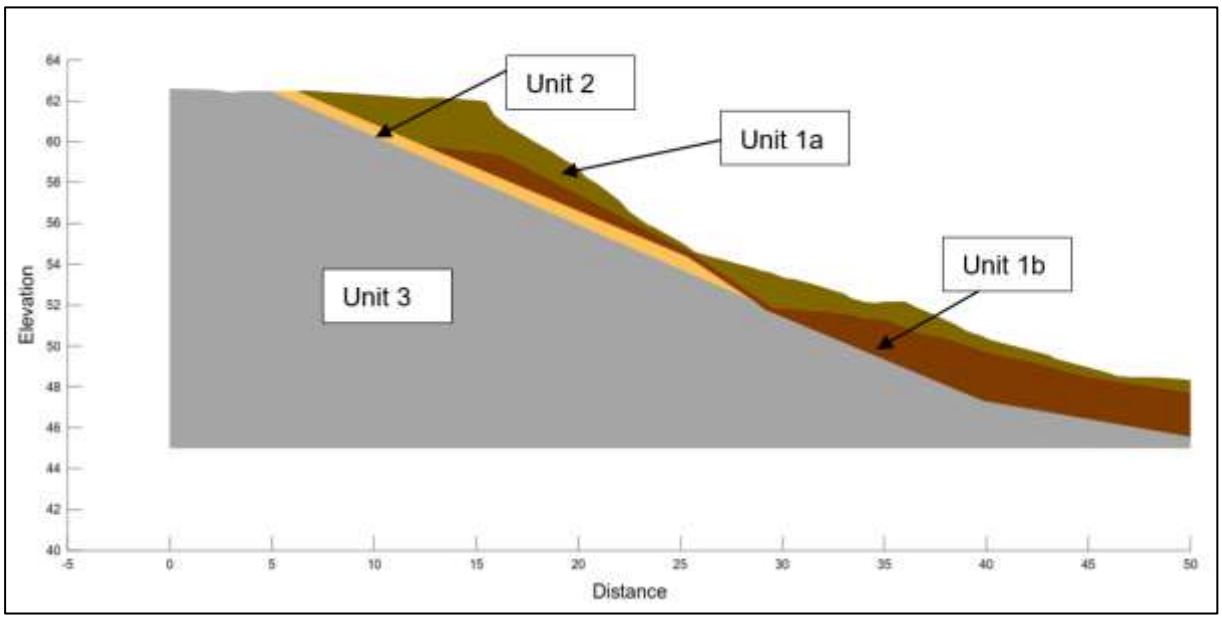


Figure 2: Revised Section B

Table 1: Geotechnical Model

Unit	Name	Description
1a	Fill: Poorly compacted	Generally comprising cohesive clay fill including Silty, Sandy and/or Gravelly Clay, with some minor granular fill comprising Gravelly Silty Sand and Silty Gravelly Sand
1b	Fill: apparently compacted	
2	Residual Clay	Generally in a stiff to very stiff condition
3	Bedrock: Very low strength	Sandstone and tuffaceous sandstone, underlain by Tuff with some chert bands.

The groundwater level at the piezometer at BH01 was measured on 30/7/2020 and 25/8/2021 and measured groundwater depth of between 8.5 m and 8.7 m within Unit 3. Groundwater was not encountered in BH01 during dry auger drilling through within soil units to a depth of 0.74 m. Seepage was noted in test pit TP4 at a depth of 1.8 m. It is noted fluctuations in groundwater conditions and levels may be expected due to variations in factors such as climatic and site conditions.

The analysis assumed adequate surface drainage will be provided to either divert/redirect water away from the crest of the slope or to the bottom of the slope.

Material parameters used in the geotechnical analysis are summarised below in Table 2. A target factor of safety value of 1.5 was adopted for the analysis.

Table 2: Preliminary Geotechnical Parameters for Slope Stability Analysis

Soil Unit	Unit weight γ (kN/m^3)	c' (kPa)	Friction Angle φ' (deg)
Unit 1a	18	2	27
Unit 1b	20	3	30
Unit 2	18	6	26
Unit 3	22	10	35

The geotechnical parameters for Unit 1a, 1b are for saturated soil conditions.

2.2 Soil Nails

The following properties for the soil nail system were incorporated in the slope stability analysis for Option 1b:

- An anchor spacing of between 1.5 m to 2.0 m;
- Soil Nails are 32 mm diameter 550 MPa Grade Threadbar Anchors with an assumed minimum tensile breaking load of 442 kN;
- Cored hole is 90 mm diameter;
- Soil nails are socketed at least 4 m into Unit 3 very low strength rock or stronger with an ultimate bond stress of 300 kPa;
- Bond strength is ignored within Unit 1 and Unit 2 soil layers;
- Facing system comprises steel mesh and an erosion control system (eg Geofabrics MACMAT-R or Geoweb or similar) that promotes soil stabilisation and vegetation growth). Soil nails are connected to steel mesh with a minimum square 300 x 300 mm steel plate.

It was assumed the soil nails would failure by the grout/ground interface before failure of the grout/bar interface and the soil nail bar reaches tensile failure (ie soil nail bars and grout assumed to behave elastically). It is noted grout/bar failure is seldom a problem for design bond lengths greater than 3 m. The structural capacity of the soil nails, grouting and the size/thickness of the soil nail head (bearing plate) will need to be checked by BG&E against soil nail loads reported in in Section 3 of this memo multiplied by a factor of 1.5. The soil nail anchor head should be properly secured to the steel mesh liner system using anchor heads.

3. Results of Geotechnical Analysis

Slope stability analysis of Option 1b was undertaken using slope stability software Geostudio SlopeW at one critical section (Revised Section B).

The analysis considered soil nail stabilisation of the existing slope only. The existing and proposed surface topography modelled was based on the latest survey by CN.

The following failure surfaces were considered in the analysis:

- Failure within the Unit 1a (Fill: Poorly compacted);
- Failure within Unit 1b fill (Fill: Apparently compacted);
- Failure within Unit 2 Residual Clay.

The slope stability analysis has considered the following sensitivity scenarios:

- Soil nails at 55 degree angle below horizontal;
- Rock level estimated based on available information at Revised Section B; and
- Lowering the top of rock level by about 1 m below depths encountered at test locations;

The slope stability analysis considered the following loading:

- 20 kPa general surcharge applied at top of piled embankment.

The results of the slope stability analysis are summarised in below in Table 3. Minimum soil nail length and design factored pull-out load values from the above described sensitivity analysis are provided below in Table 4.

Table 3: Results of stability analysis – Soil Nails inclined at 55 degrees below horizontal

Scenario			Factor of Safety Soil Nail Solution (Option 1b)
Run Number	Mode of Failure	Rock Level	
1	Failure through Unit 1a	Rock level as encountered	>1.5
2	Failure through Unit 1b		>1.5
3	Failure through Unit 2		>1.5
4	Failure through Unit 1a	Lower rock level by 1 m	>1.5
5	Failure through Unit 1b		>1.5
6	Failure through Unit 2		>1.5

Table 4: Soil Nail Configuration – Soil Nails Inclined 55 degrees below horizontal

Soil Nail Row Number	Minimum Soil Nail Length (m)	RL Soil Nail Head (m AHD)	Design Factored Pull-out Load of Soil Nail (kN)*
1	7	62.0	130
2	7	60.3	130
3	7	58.9	130
4	7	57.6	130
5	7	56.0	130
6	7	55.0	130

Notes to Table:

*Values to be multiplied by a factor of 1.5 to get ultimate pull-out load

In summary, the results of the stability analysis indicate that the proposed slope satisfies the targeted factors of safety of 1.5 in the long term.

An allowable pull-out resistance of 230 kN per soil nail is estimated where soil nails embedded a minimum 4 m into Unit 3 rock with an ultimate bond stress of 300 kPa (with factor of safety of 1.5 applied). The results of the slope/w analysis indicate the maximum credible pull-out force of 130 KN does not exceed the allowable pull-out resistance for soil nails embedded a minimum 4 m into Unit 3 rock.

4. Geotechnical Comments

4.1 Earthworks

4.1.1 Excavatability

Excavation for the project is expected to comprise cut and fill associated with construction of the retaining wall, flattening the existing fill batter and construction of drainage infrastructure.

Option 1

Where major earthworks are to achieve a 2(H):1(V) batter slope, excavation into rock may be required when keying in. At BH01 high strength tuff was encountered at a depth of 0.7 m. It should be noted that excavatability of the bedrock will be dependent not only on rock strength, but also on the presence, orientation and extent of discontinuities such as jointing and fracturing and other factors.

Excavation through medium to high strength rock will require heavy ripping, with assistance from hydraulic rock hammers or rock saws, or equivalent, particularly for detailed excavation and trimming.

Production rates, even with heavier ripping methods, could be slow however, this should be assessed by an appropriately qualified contractor.

Option 2

In the location of the proposed retaining wall, excavation of up to around 1.5 m is expected. Based on the results of BH03, excavation in this area is anticipated to be through fill (Units 1a and 1b). Excavation of site soils encountered in this area is expected to be readily achievable with conventional earthmoving equipment.

General

It is the contractor's responsibility to select appropriate excavation methods and equipment, taking into account the strength of rock, expected production rates, and the particle size distribution of excavated material if it will be intended for re-use as engineered fill. The contractor is also responsible for selecting excavation methods which result in vibrations that do not compromise the integrity of the nearby major utilities.

4.1.2 Re-use of Excavated Material

The excavated material is anticipated to comprise fill predominantly comprising sandy clay. A layer of sandy silt fill was encountered at TP4.

From a geotechnical perspective, site soils are anticipated to be suitable for bulk fill provided the soil is appropriately moisture conditioned. The use of hydrated lime could assist with reducing the moisture and also assist in increasing the relative strength of the soils. Excessively silty soil is not considered suitable.

Off-site re-use or disposal of excess soils generated must be carried out in accordance with the relevant EPA guidelines.

4.1.3 Engineered Filling

The following procedure is recommended for placement of engineered fill:

- Remove topsoil, uncontrolled fill and deleterious materials;
- Test roll the surface in order to determine any soft zones and assess moisture condition. Moisture contents should be in the range OMC -2% (dry) to OMC +1% (wet) where OMC is the optimum content at standard compaction;
- Compact the tyned natural surface to a dry density ratio of at least 100% Standard. The subgrade should be left exposed for a minimum of time prior to placement of fill layers;
- Suitable fill should be placed in horizontal layers not exceeding 300 mm loose thickness and compacted to a dry density ratio in the range 98% to 102% Standard. Moisture content should be in the range as stated above;
- Each layer of fill should be cut into the existing batter for a horizontal distance of at least 0.4 m to provide a 'key' into the existing fill batter;

- Each lift of fill should be placed beyond the proposed finished batter surface and trimmed back after adequate compaction has been achieved, in order to ensure adequate compaction right to the face of the finished batter surface.

Geotechnical inspections and testing should be performed during construction.

4.1.4 Batter Slopes

Permanent batter slopes in engineered filling (Option 1a and 2a) are recommended to be no steeper than 2:1 (H:V).

Slopes should not exceed 6 m in vertical height without incorporating intermediate benches. Benches should be a suitable width to allow access for equipment for future maintenance.

All batter slopes should be protected from erosion. Surface water should be diverted away from slopes by installation of a dish drain, or similar, behind the crest of slope.

4.2 Retaining Wall Design Parameters

For permanent retaining walls, where the wall will be free to deflect, design should be based on “active” (K_a) earth pressure coefficients, assuming a triangular earth pressure distribution. This would comprise any non-propped or laterally un-restrained walls (e.g. cantilever type walls) or gravity walls.

Where structures and/or services are near the crest, or if the retaining walls are laterally restrained by a structure and not free to deflect, retaining wall design should be based on “at-rest” (K_o) earth pressure coefficients. This would apply for Option 2a and 2b, where the retaining wall would be constructed adjacent to Memorial Drive.

The suggested long term (permanent) design soil parameters are shown in Table 5 below. The earth pressure coefficients are for level backfill. Any additional surcharge loads, including those imposed by inclined slopes behind the wall, during or after construction, should be accounted for in design.

Table 5: Geotechnical Parameters for Retaining Structures

Parameter	Symbol	Unit 1: Fill	Unit 2: Natural Clay and Engineered Fill	Unit3a: Bedrock – Very low strength	Unit 3b: Bedrock - - Low strength or stronger
Bulk Density (kN/m^3)	γ	18	19	22	22
Submerged (buoyant) unit weight (below water table)	γ_{sub}	8	9	12	12
Active Earth Pressure Coefficient – Cantilever or Gravity Design (free to deflect)	K_a	0.38	0.39	Not Applicable	
At-rest Earth Pressure Coefficient – Propped / Restrained Wall	K_o	0.55	0.56	0.40	0.28
Passive Earth Pressure Coefficient	K_p	2.66	2.56	400 kPa	2000 kPa

Retaining walls not designed for hydrostatic pressure should include free draining backfill. A lightweight drainage ash could be used for the backfill behind the retaining wall to act as a free draining material and to also provide subgrade support where the road and footpath is reinstated. Slotted drainage pipe should also at the base of the backfill (ref Figure 3 below). The pipes should discharge to the stormwater drainage system. The backfill drainage should be encapsulated within geotextile fabric. Alternatively, the wall should be designed for full hydrostatic water pressures.

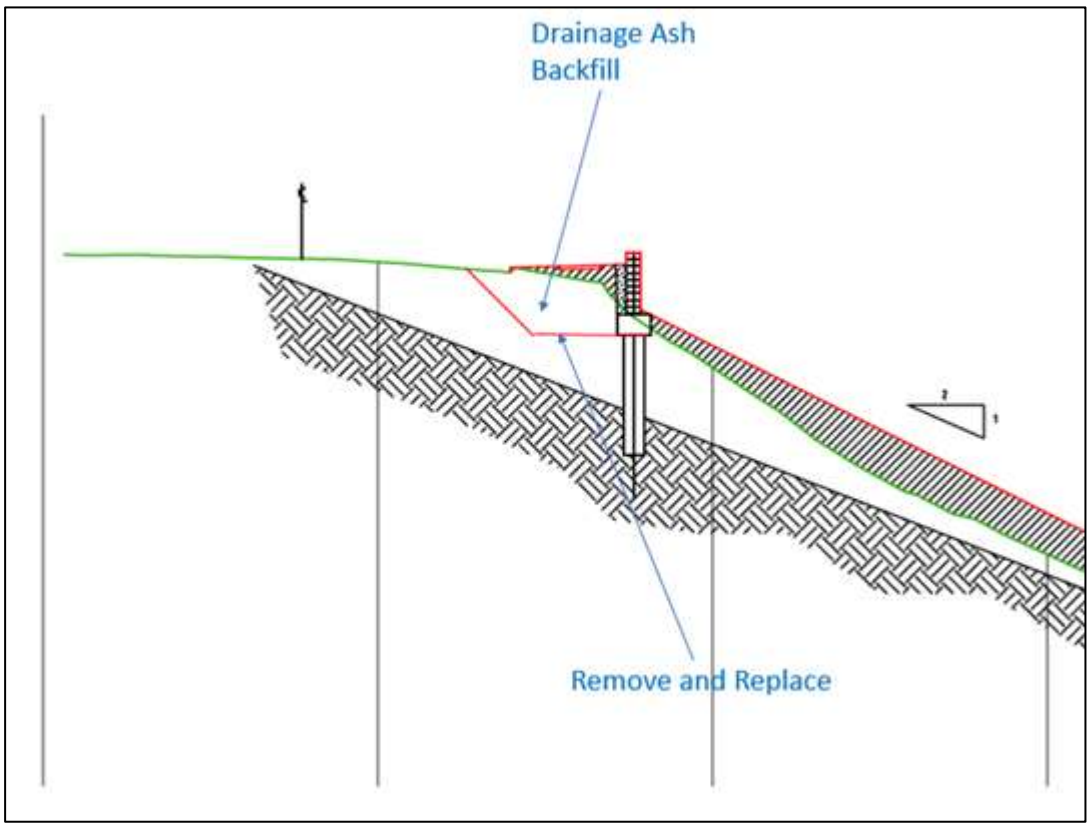


Figure 3: Backfilling requirement behind retaining wall

The retaining wall will need to be supported by piles founded in rock in order to provide adequate passive resistance.

It is assumed that pile loading will be predominately lateral and that vertical loads will be minor.

Traditional bored piles are considered a suitable option, although temporary casing may be required to prevent collapse of upper fill layers.

Table 6 shows the expected depth range for of suitable founding strata in the locations of proposed piles.

Table 6: Summary of Depths to Suitable Founding Strata

Bore	Approx Surface Level (AHD)	Approx depth Range Unit 2: Clay	Approx depth Range Unit 3a: Bedrock	Approx Depth to Top of Unit 3b: Bedrock
BH02*	63.4	1.9 – 3.1	3.1 – 3.5	3.5
BH03	61.6	3.3 – 3.9	3.9 – 4.1	4.1
BH04	59.8	2.2 – 2.9	2.9 – 3.4	3.4
BH05*	58.9	2.0 – 2.2	2.2 – 3.0	3.0

Notes to Table:

NE – Note Encountered

*auger bore

Based on the parameters given in Table 5 and adopted a factor of safety of 1.5 (for slope stability) for a 450 mm diameter pile, the pile depth (below lagging) was estimated using the Brinch Hanson Method to be in the order of 4 m (minimum 1.5 m socket into Unit 3 rock).

4.3 Geotechnical Risk and Opportunity

A summary of construction consideration, geotechnical risks and opportunities for the four options being considered by CN are provided in Table 7 below.

Table 7: Geotechnical Risk and Opportunity

Option	Construction Considerations	Risk	Opportunity
1a: Piled Retaining wall, 2H:1V gradient downslope	Excavator to have adequate reach to install piles. Bearing capacity and slope stability assessment for excavator to install piles. Major disruption to Memorial Drive to install piles and reinstate road/footpath after constructing retaining wall. Significant overfilling required to key into existing slope and place engineered fill at 2H:1V slope. Earthworks on steep slope will be difficult. Only small plant / machinery will be used.	Damage to existing road pavement during piling. Slope instability of excavator during piling. Erosion and short term stability of fill immediately after placement and requirement for temporary surface stabilisation. Compaction of fill downslope not achieved with small machinery. Encountering contamination in fill.	Stabilize road before further instability occurs downslope. Greater chance of revegetation with flatter slope. Achieve 50 year design life for structural solution
1b: Retaining wall and minor regrade downslope	Excavator to have adequate reach to install piles. Bearing capacity and slope stability assessment for excavator to install piles. Major disruption to Memorial Drive to install piles and reinstate road/footpath	No guarantee on future localised stability of soil downslope of retaining wall. No guarantee of achieving revegetation at current 'natural' 1.5H:1V slope.	Stabilize road before further instability occurs downslope. Localised earthworks behind retaining wall only. Achieve 50 year design life for structural solution.
2a: Soil nails (failed area only) and 2H:1V gradient downslope	Major disruption to Memorial Drive to allow soil nails to be installed from road level and allow road/footpath to be reinstated. Earthworks on steep slope will be difficult and only small machinery will be able to be used.	No guarantee on future stability of road and footpath. No guarantee of stability of existing slopes outside of current slip surface. Erosion and short term stability of fill immediately after placement and requirement for temporary surface stabilisation. Compaction of fill downslope not achieved with small machinery. Encountering contamination in fill.	Opportunity to install inclinometers to monitor lateral movement of fill below current road level and survey to monitor settlement of existing road. We note inclinometers may not pick up relatively fast moving slides such as a saturated slope under an extreme weather event. Monitoring will allow assessment of critical areas of instability and targeted areas where piled retaining wall solution would provide greatest benefit. Greater chance of revegetation with flatter slope.

		Maximum design life for soil nailed area to be in the order of 10 years	
2b – Soil nails (failed area only) installed in slope as-is (with minor regrade)	Minor disruption to Memorial Drive to allow soil nails to be installed from road level.	No guarantee on future stability of road. No guarantee of stability of existing slopes outside of current slip surface. No guarantee of revegetation of soil nail surface.	Opportunity to install inclinometers to monitor lateral movement of fill below current road level and survey to monitor settlement of existing road. Monitoring will allow assessment of critical areas of instability and targeted areas where piled retaining wall solution would provide greatest benefit.

5. References

AS 2159. (2009). *Piling - Design and Installation.* Standards Australia.

DP. (2022c). *Slope Stability Assessment, Proposed Retirement Village Development 12 Newcastle Street, Cardiff.* Report No. 205527.00.R.001.Rev0: Douglas Partners Pty Ltd.

Geoguide 1. (2000). *Guide to Retaining Wall Design.* The Government of Hong Kong: Geotechnical Engineering Office, Civil Engineering Department.

Leventhal, A., & Stone, P. (1995). Geotechnical Design Features - Deep Cuttings and High Embankments on the Western MArgin of the Newcastle Coal Measures (F3 - Sydney/Newcastle Freeway). *Engineering Geology of the Newcaslte-Gosford Region, Australian Geomechanics Society*, 292-302.

Northrop. (2021). *Civil Main Works Package Drawings (Issue for Tender).* Ref No. NL210183-01: Northrop Consulting Engineers Pty Ltd.

RCA . (2021). *Geotechnical Investigation, Road Embankment Batter Stability, Memorial Drive, The Hill.* 14822-202/1: RCA Australia.

6. Limitations

Douglas Partners (DP) has prepared this report for this project at Memorial Drive, The Hill, with reference to DP's proposal dated February 2022 and acceptance received from BG&E Pty Ltd. The work was carried out under City of Newcastle Terms of Engagement for Consultants (Edition 6, April 2020). This report is provided for the exclusive use of BG&E Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope of work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

[redacted]

Caitlyn Falla
Associate

[redacted]

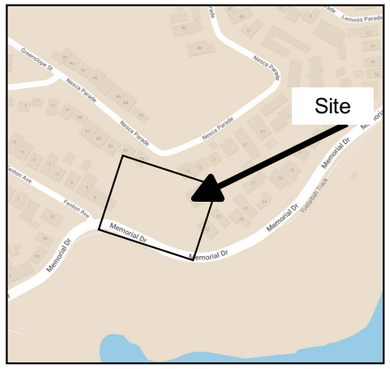
Daniel Barnes
Senior Geotechnical Engineer

[redacted]

Scott McFarlane
Principal

Attachments:

Drawing 1 – Slope Stability Section
Sketches by BG&E
Bore Logs adopted in Slope Stability Analysis



Site Location

Legend

- Revised Section
- Borehole Locations (RCA,2020)
- Test Pit Locations (RCA,2020)
- RCA Section

Drawing adapted from aerial imagery from MetroMap dated 9.10.2021.

RCA Test locations are approximate only sourced from RCA Report.

Contours sourced from ground surface supplied by BG & E (C4337 Memorial Drv 2022)

0 5 10 15 20 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	BG & E Pty Ltd		
OFFICE:	Newcastle	DRAWN BY:	CET
SCALE:	1:250 @A3	DATE:	03.May.2022

TITLE: **Slope Stability Section**
Geotechnical Investigation
Memorial Drive, The Hill, NSW

N

Project:	212449.00
DRAWING No:	1
REVISION:	0

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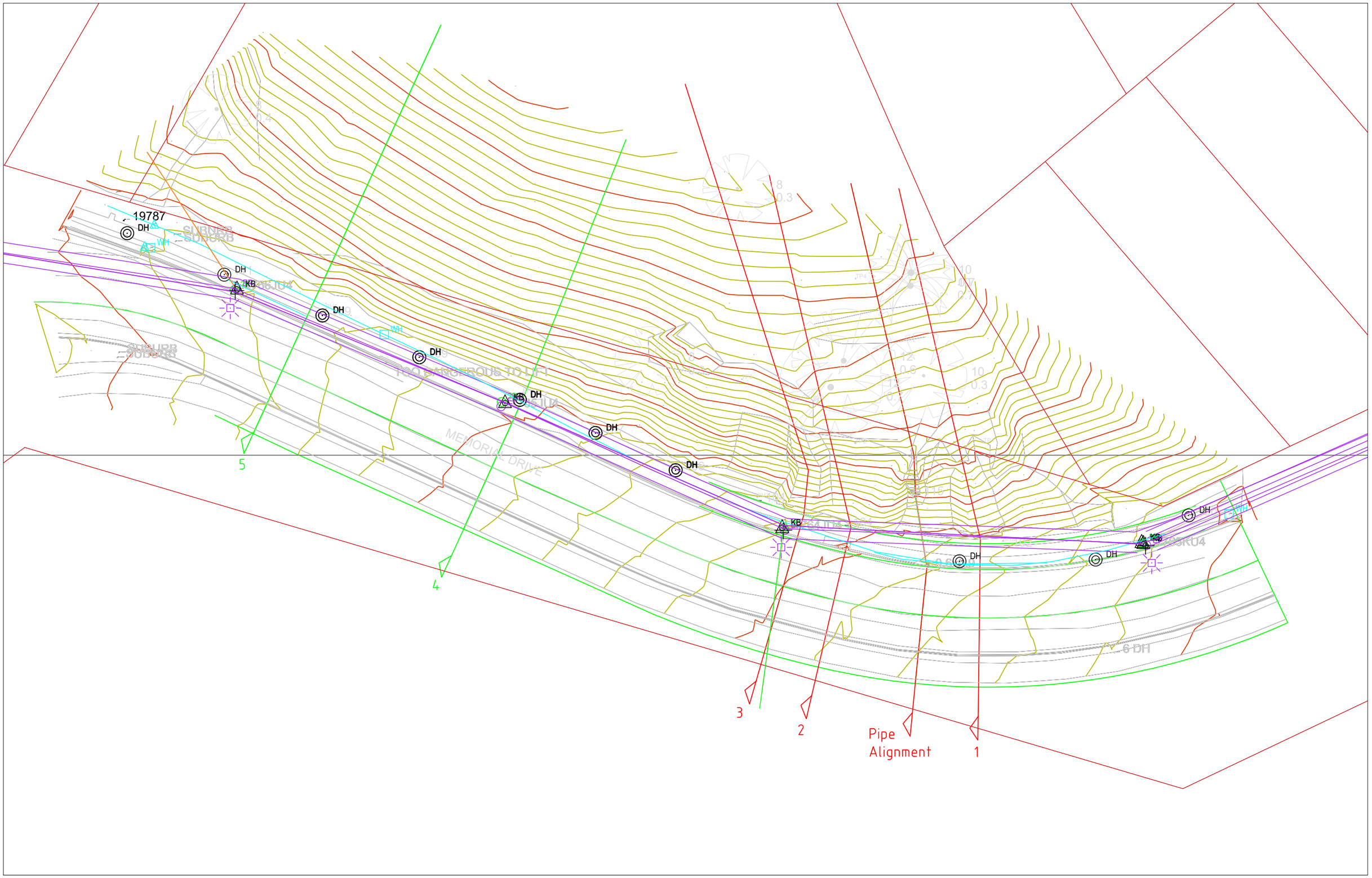
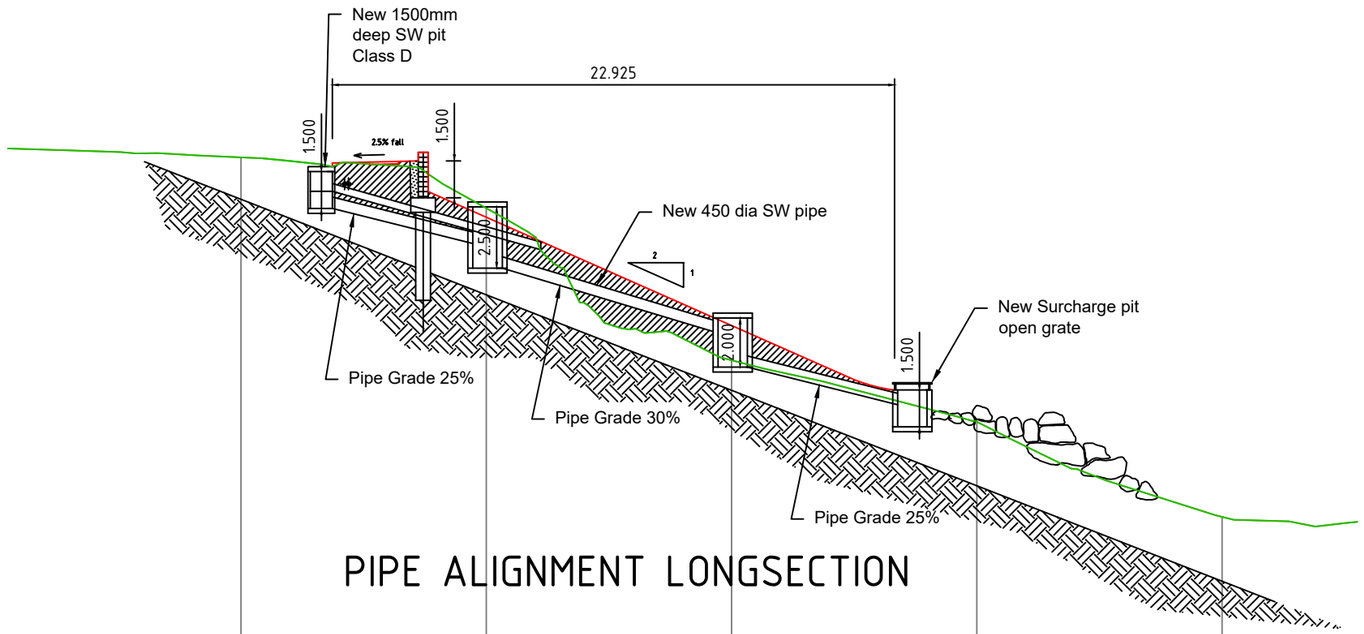
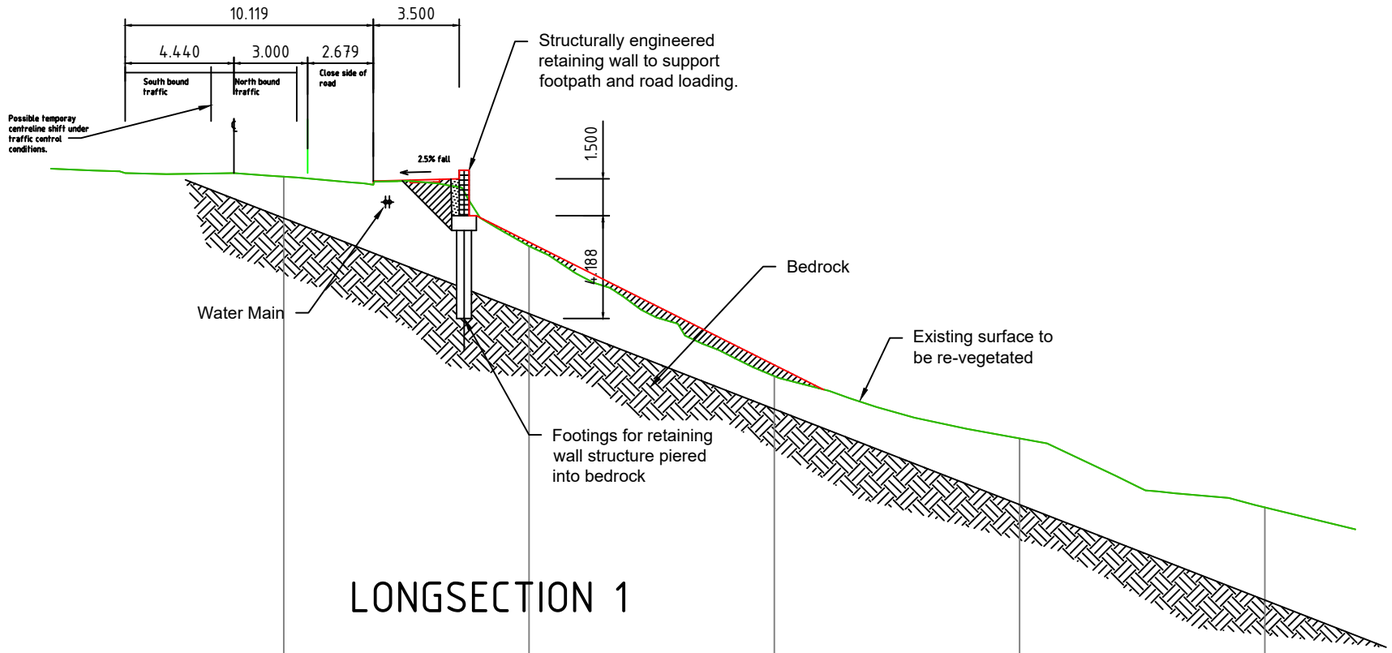




PIPE ALIGNMENT LONGSECTION



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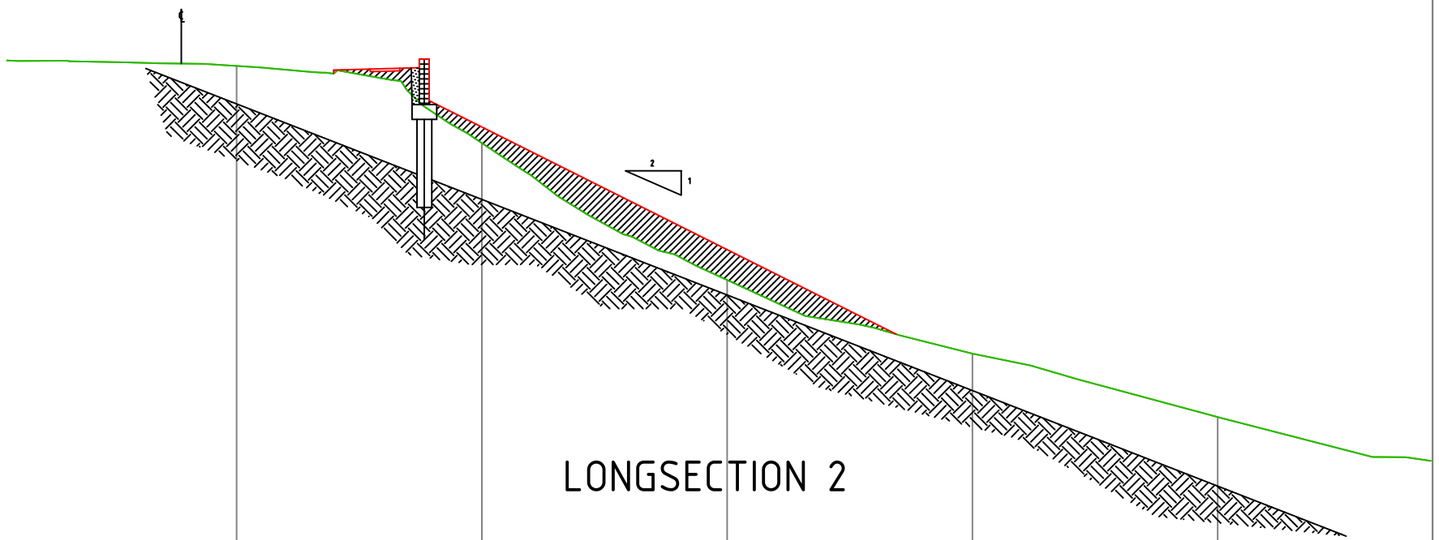

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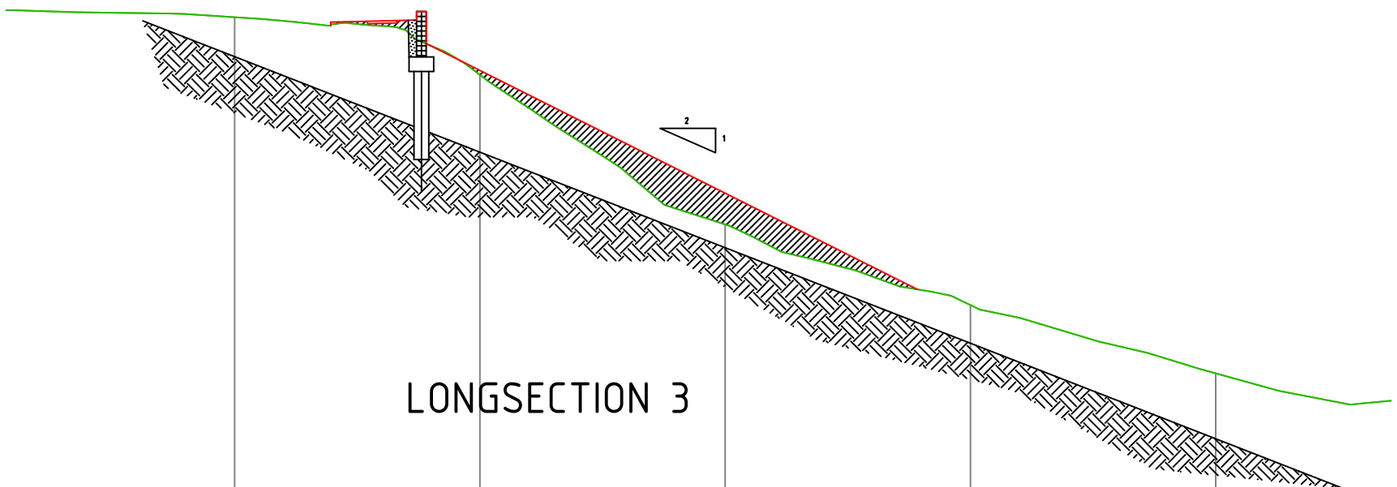

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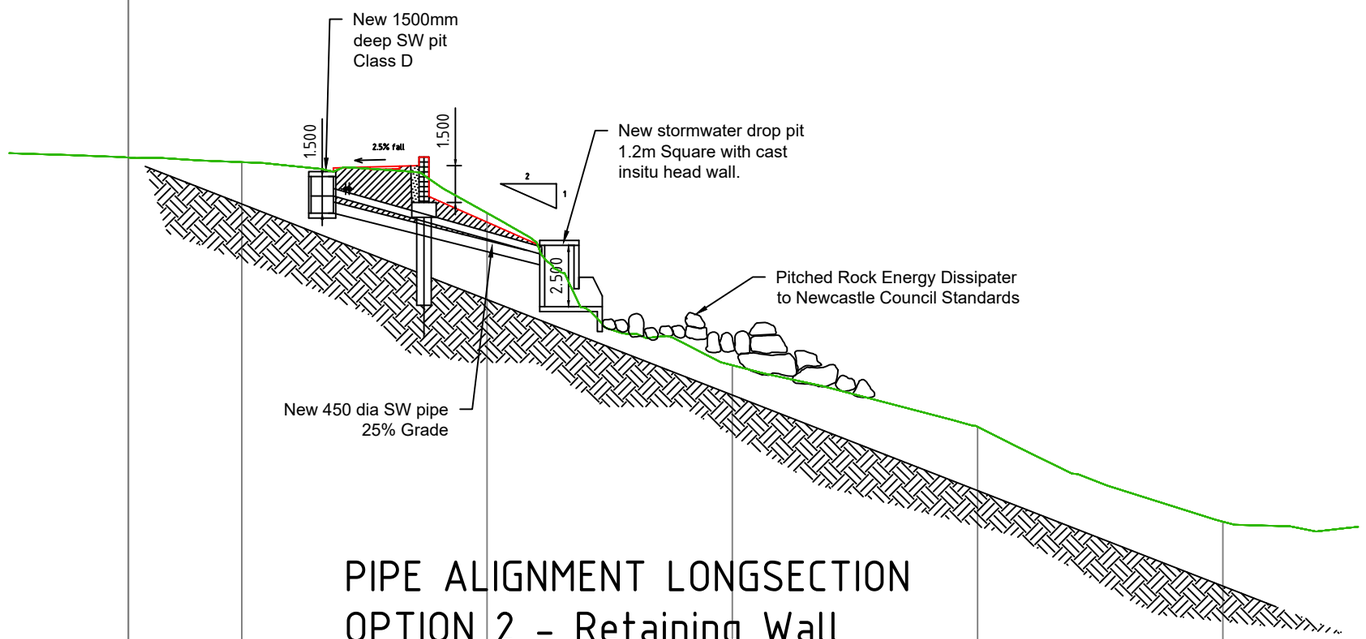
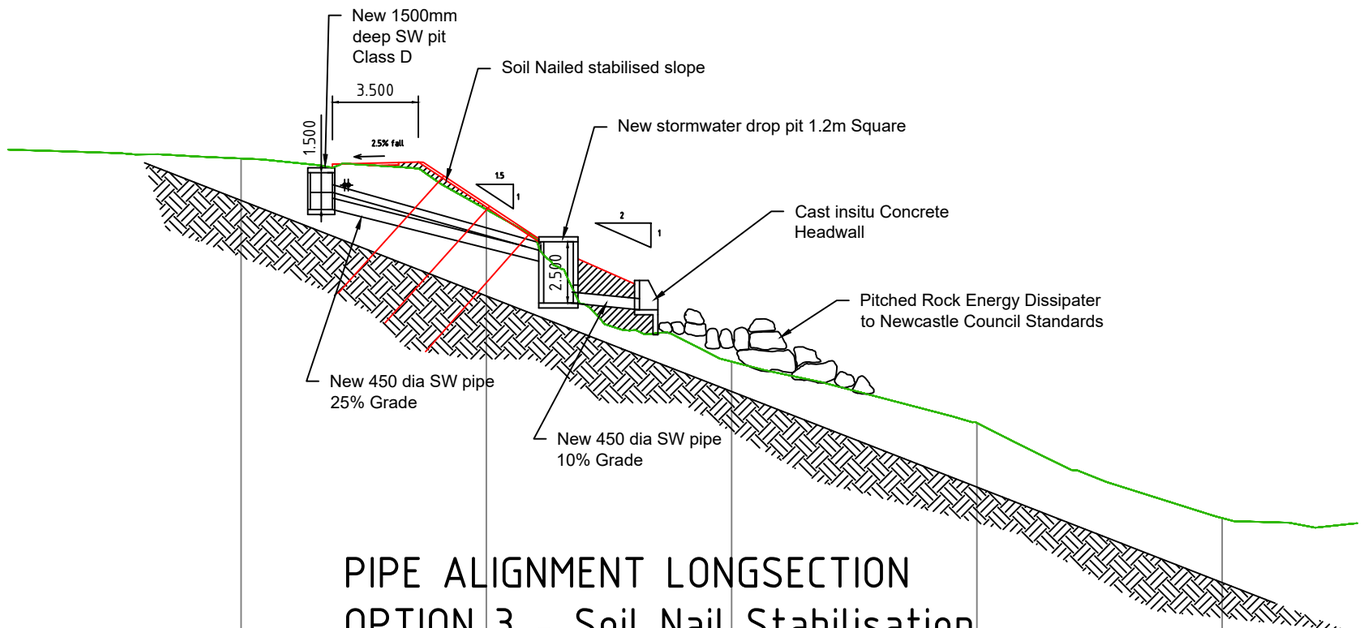
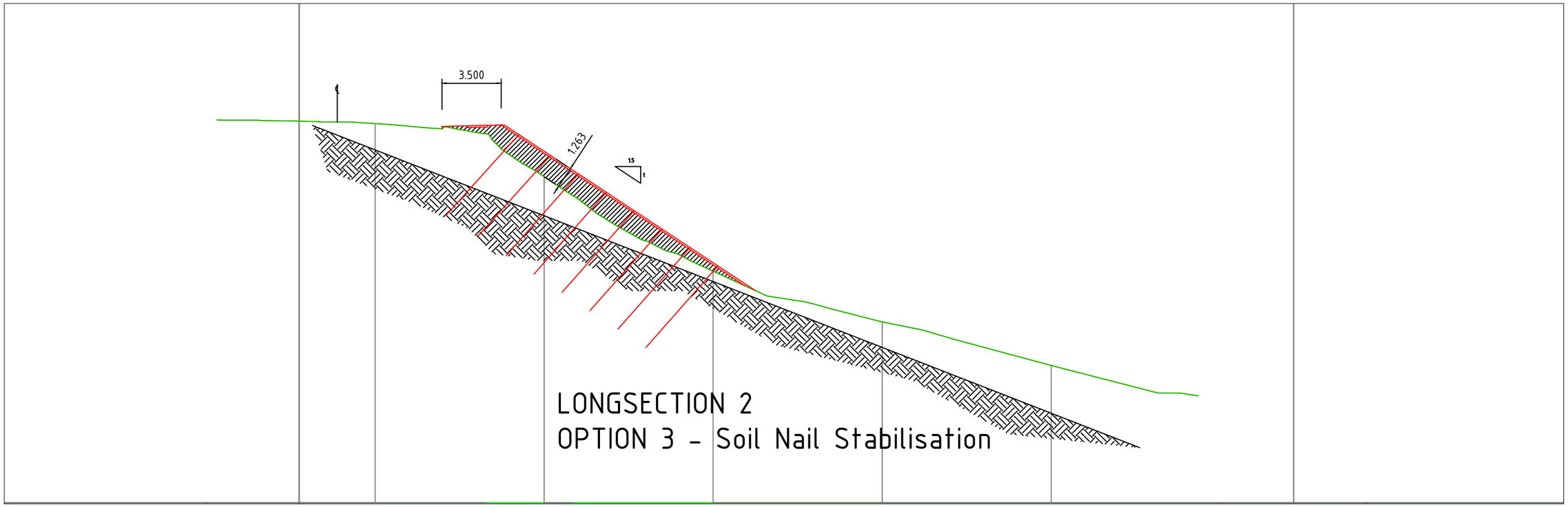


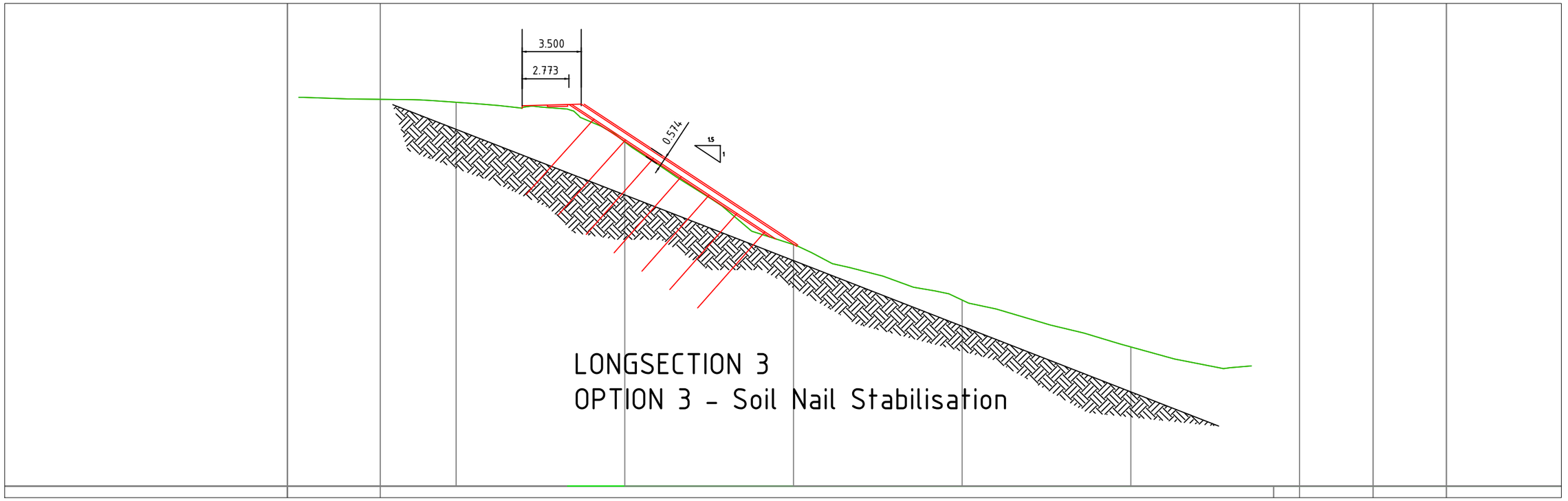
PIPE ALIGNMENT LONGSECTION
OPTION 2 - Retaining Wall



PIPE ALIGNMENT LONGSECTION
OPTION 3 - Soil Nail Stabilisation



LONGSECTION 2
OPTION 3 - Soil Nail Stabilisation



LONGSECTION 3
OPTION 3 - Soil Nail Stabilisation

GEOTECHNICAL TEST PIT LOG

TP4

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

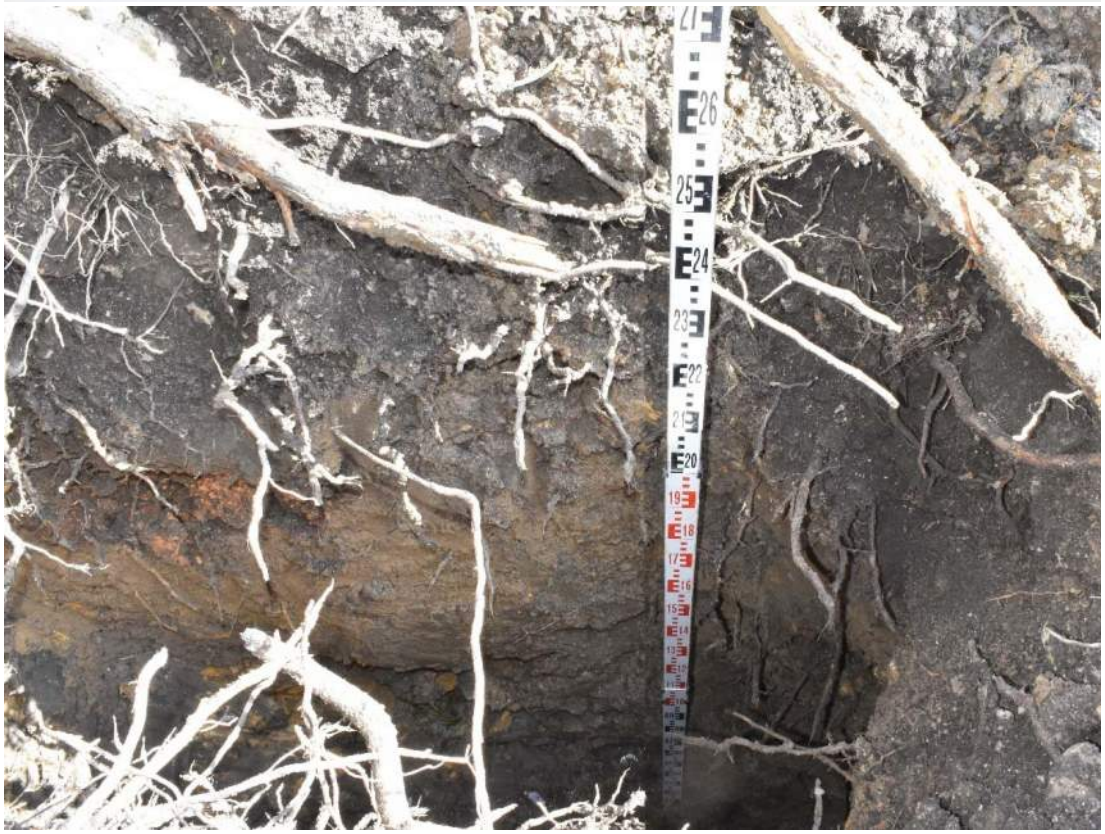
PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE: 07/07/2020
SURFACE RL: 49.40 m AHD
COORDS: 385427.78 m E 6354981.23 m N MGA94 56
EXCAVATION METHOD: 5.5t Excavator, 450mm wide bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
	0						ML	FILL, Sandy SILT, low plasticity, dark brown, with roots, sandstone cobbles and boulders, organics, and brick fragments	M		FILL
	3										
	7										
	1										
	3			49.0							
	5				0.5						
	6				0.55		CL-SC	FILL, Sandy CLAY/Clayey SAND, fine to coarse grained, low to medium plasticity, brown with some orange brick fragments	M		
	4										
	4		0.80m		0.80		CL-SC	FILL, Sandy CLAY/Clayey SAND, fine to coarse grained, low to medium plasticity, brown	M		
	11		D 1.00m	48.5	1.0						
	4										
	3										
	3				1.20		CI	FILL, Sandy CLAY, medium plasticity, brown, fine to coarse grained sand	w>PL		
	3		1.30m								
	2		D 1.50m	48.0	1.5						
	4										
	4										
Minor seepage	4										
	7							Becoming dark grey with sandstone boulders up to 600mm in diameter at 1.8m			
	4			47.5	2.0						
	9										
	8										
	8							Becoming with brick and terracotta fragments, and rock fragments up to 300mm in diameter at 2.2m			
	6										
	8			47.0	2.40			TEST PIT TP4 TERMINATED AT 2.40 m Excavator bucket refusal on unknown material			
	10				2.5						
	10										
	13										
				46.5							

LOGGED: TH | CHECKED: CJM | DATE: 08/07/2020

PROJECT No: 14822
PROJECT: The Hill
LOCATION: TP4
DEPTH: 0.0-2.4m
DATE: 7/07/2020



TEST PIT PHOTOGRAPH *Test Pit TP4*

Client:	City of Newcastle	**RCA Australia**
Project:	Geotechnical Investigation	
Location:	Memorial Drive, The Hill	**RCA ref:** 14822-202/1

GEOTECHNICAL BOREHOLE LOG

BH01

SHEET 1 OF 4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 09/07/2020
DATE COMPLETED: 10/07/2020
SURFACE RL: 53.12 m AHD
COORDS: 385422.87 m E 6354967.09 m N MGA94 56
DRILL MODEL: Hand Auger/Proline

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
				53.0	0.15		ML	FILL/TOPSOIL, Sandy Clayey SILT, low to medium plasticity, dark brown, with organics	w>PL		FILL / TOPSOIL
					0.30		CI-GC	FILL, Gravelly Silty CLAY/Clayey Silty GRAVEL, medium plasticity, grey and pale grey, fine to medium sub-angular to angular gravel	w>PL		FILL
HA	(Not encountered)				0.5		CI	FILL/SLOPEWASH, Sandy CLAY, medium plasticity, brown, fine to coarse grained sand Becoming with coarse angular gravel at 0.48m	w>PL		FILL / SLOPEWASH **Standpipe Piezometer Construction Detail** Standpipe piezometer comprises 50mm ID uPVC pressure pipe installed to 6.26m in 76mm diameter hole. Machine slotted and filter sock wrapped 3.0m screen from 6.26m to 3.26m. Clean 5mm gravel backfill from 6.26m to 2.90m. Bentonite seal from 2.90m to 0.00m.
				52.5	0.60		CI-CH	Sandy CLAY, medium to high plasticity, pale grey and orange, fine to medium grained sand Hand auger refusal at 0.74m	w>PL		RESIDUAL
				52.0	1.0			CONTINUED AS CORED BOREHOLE			
				51.5	1.5						
				51.0	2.0						
				50.5	2.5						

LOGGED: TH | CHECKED: CJM | DATE: 02/09/2021

RCA_LIB_08.1_RCA_STANDARD.GLB Log RCA NON CORED LOG 14822-LOGS.GPJ <<DrawingFile>> 02/09/2021 17:02 Produced by gINT Professional, Developed by Datgel

CORED BOREHOLE LOG
BH01

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 09/07/2020
DATE COMPLETED: 10/07/2020
SURFACE RL: 53.12 m AHD
COORDS: 385422.87 m E 6354967.09 m N MGA94 56
DRILL MODEL: Hand Auger/Proline

Borehole Information						Field Material Description				
METHOD	WATER LOSS	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				53.0							
					0.5						
				52.5			START CORING AT 0.74m				
					0.74						
NMLC	5% LOSS	100	20				TUFF, fine to medium grained, grey with orange-brown stained zones	SW - MW			BP 5° CN PR RF
				52.0	1.0						BP 5° CN PR RF JT 75° Clay VNR PR RF BP 5° CN PR RF FZ Clay seam BP 10° SN PR RF BP 5° Clay PR RF JT 65° SN PR RF
	5% LOSS	100	0	51.5	1.5						FZ BP 0° CN PR S BP 0° SN PR S JT 70° CN PR RF BP 5° CN PR RF BP 5° CN PR RF BP 0° SN PR S BP 0° SN PR S BP 0° SN PR RF BP 0° SN PR RF BP 0° SN PR RF BP 0° SN PR RF BP 0° SN PR RF BP 0° CN PR S BP 5° CN PR S JT 70° Fe SN PR RF JT 70° Fe SN PR RF BP 5° Fe SN PR RF BP 5° Fe SN PR RF BP 0° CN PR RF BP 0° CN PR S
	5% LOSS	100	76	51.0	2.0		Groundwater level measured in piezometer at depth of 2.3m on 30/07/2020				BP 5° CN PR RF
				50.5	2.5						BP 5° CN PR RF JT 85° SN PR RF
	5% LOSS	96	35				Cherty band from 2.69m to 2.74m				Clay seam
					2.74		CORE LOSS 0.02m (2.74-2.76)	SW - MW			
					2.76		TUFF, fine to medium grained, grey with orange-brown stained zones				BP 5° CN PR RF FZ

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CORED BOREHOLE LOG

BH01

SHEET 3 OF 4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 09/07/2020
DATE COMPLETED: 10/07/2020
SURFACE RL: 53.12 m AHD
COORDS: 385422.87 m E 6354967.09 m N MGA94 56
DRILL MODEL: Hand Auger/Proline

Borehole Information | Field Material Description

METHOD	WATER LOSS	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	5% LOSS	96	35	50.0			TUFF, fine to medium grained, grey with orange-brown stained zones	SW - MW			JT 10° Fe SN PR RF
					3.5			SW			
	5% LOSS	100	74	49.5				HW			DZ JT 40° SN U RF
								SW - MW			BP 5° SN PR S 5° 2 mm Clay seam
					4.0						JT 5° Clay VNR PR S JT 5° CN PR S
				49.0							
											JT 10° CN PR S JT 50° Fe SN PR RF JT 45° Fe SN PR RF BP 5° Fe SN PR RF
					4.5						
				48.5							BP 5° Fe SN PR RF JT 10° CN U RF
	5% LOSS	100	0								BP 5° SN PR RF BP 5° SN PR RF BP 5° SN PR RF FZ BP 5° Fe SN PR RF BP 5° Fe SN PR RF BP 0° Fe SN PR S FZ
					5.0						
	5% LOSS	100	0	48.0							JT 85° Clay CU RF 1 mm BP 5° SN PR RF BP 5° SN PR RF BP 5° SN PR RF
					5.32		CHERT, grey and orange-brown, numerous iron oxide stained fractures and annealed defects				BP 5° Fe SN PR RF JT 80° Fe SN PR RF JT 80° Fe SN PR RF JT 40° Fe SN PR RF
	5% LOSS	100	34		5.5						JT 60° Fe SN U RF
				47.5	5.61						
					5.64		CORE LOSS 0.03m (5.61-5.64)				
	5% LOSS	95	20				TUFF, fine to medium grained, grey with orange-brown stained zones	SW - MW			BP 5° CN PR RF BP 0° SN PR RF BP 0° CN PR RF BP 0° CN PR RF

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CORED BOREHOLE LOG
BH01

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 09/07/2020
DATE COMPLETED: 10/07/2020
SURFACE RL: 53.12 m AHD
COORDS: 385422.87 m E 6354967.09 m N MGA94 56
DRILL MODEL: Hand Auger/Proline

Borehole Information						Field Material Description					
METHOD	WATER LOSS	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	5% LOSS 5% LOSS	95 100	20 0	47.0		× × × × × × × × × × × ×	TUFF, fine to medium grained, grey with orange-brown stained zones	HW SW - MW			BP 0° CN PR S BP 0° CN PR S BP 0° CN PR S JT 10° Fe SN PR RF
				46.5	6.5		CORED BOREHOLE BH01 TERMINATED AT 6.26 m Refusal on silicious tuff				
				46.0	7.0						
				45.5	7.5						
				45.0	8.0						
				44.5	8.5						

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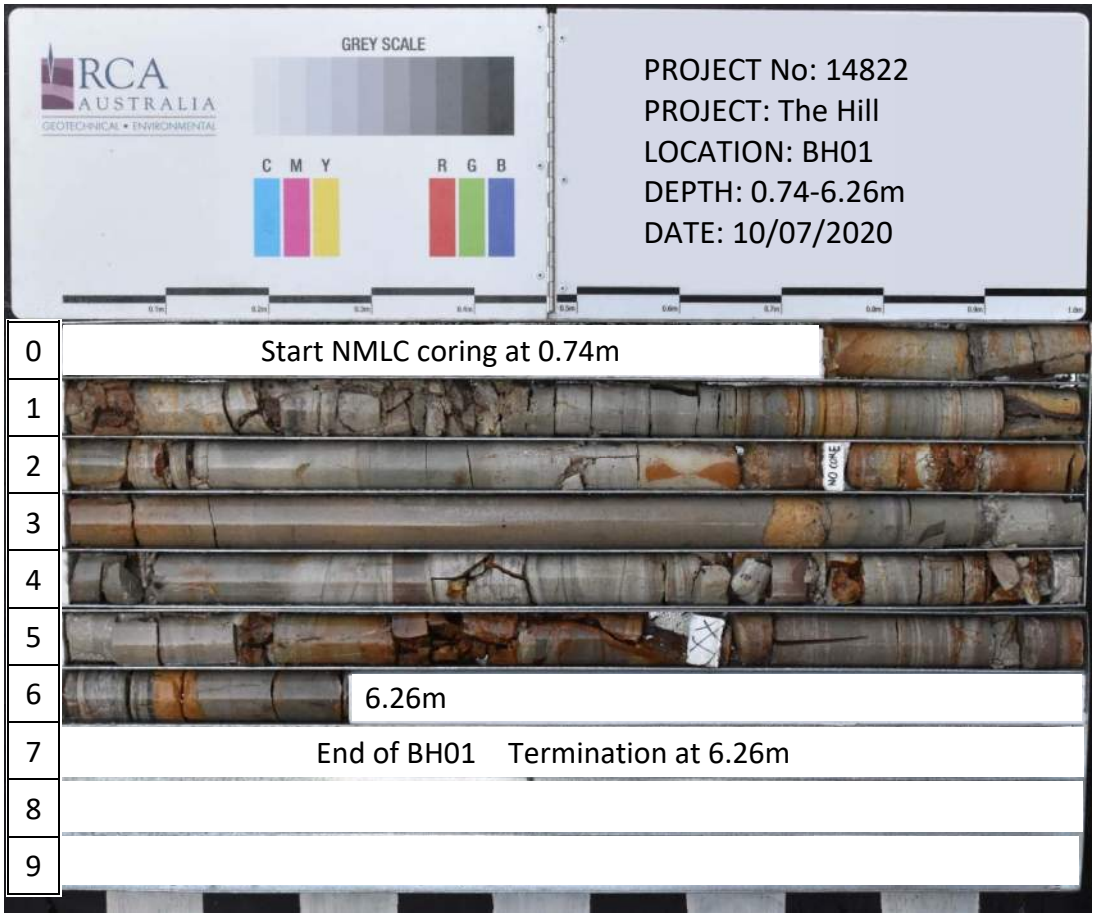

CORE PHOTOGRAPH *Borehole BH01, 0.74m to 6.26m*

Client:	City of Newcastle	**RCA Australia**
Project:	Geotechnical Investigation	
Location:	Memorial Drive, The Hill	**RCA ref:** 14822-202/1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

POINT LOAD STRENGTH TEST RESULTS

CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE: 14/07/2020
PROJECT No: 14822
CLIENT REF:

Bore	Depth (m)	Sample length (mm)	Sample diameter (mm)	Minimum cross-sectional area between platens (mm)	Platen Separation at failure (mm)	Orientation A = axial D = diametrical I = irregular	PIL-7 Gauge reading at failure (kPa)	Load at failure (kN)	Point load strength, I_s	Point load index, $I_{s(50)}$	Rock type and structure	Moisture content & storage history	Failure mechanism M = massive B = bedded J = jointed
BH01	0.86	130	52	2124	50	D	6660	6.3	2.5	2.5	Tuff	Moist, core box, 5 days	M/J
BH01	0.86	46	52	2080	40	A	12700	12.0	4.5	4.6	Tuff	"	M
BH01	1.84	100	52	2124	47	D	19500	18.5	8.4	8.1	Tuff	"	M
BH01	1.84	27	52	1196	23	A	8520	8.1	5.3	4.7	Tuff	"	M
BH01	2.16	100	52	2124	50	D	15460	14.7	5.9	5.9	Tuff	"	M
BH01	2.16	36	52	1352	26	A	18380	17.4	10	9.3	Tuff	"	M
BH01	3.17	70	52	2124	49	D	8020	7.6	3.2	3.1	Tuff	"	M
BH01	3.17	41	52	1924	37	A	10280	9.7	4.0	4.0	Tuff	"	M
BH01	4.48	130	52	2124	48	D	17200	16.3	7.1	6.9	Tuff	"	M
BH01	4.48	30	52	1092	21	A	15120	14.3	10	9.0	Tuff	"	M
BH01	5.86	90	52	2124	51	D	760	0.7	0.3	0.3	Tuff	"	J
BH01	5.86	31	52	1092	21	A	900	0.9	0.6	0.5	Tuff	"	J
BH01	6.23	60	52	2124	50	D	30620	29.0	12	12	Tuff	"	M

Test Methods: AS4133.4.1-2007 Cl 3.2 - Diametrical test
AS4133.4.1-2007 Cl 3.3 - Axial test
AS4133.4.1-2007 Cl 3.4 - Block and irregular lump test
AS4133.4.1-2007 Cl 3.5 - Anisometrical rock test

RCA Australia	**Calculated by: TH**	**Date: 14/07/20**
Office: Newcastle	**Checked by: CJM**	**Date: 14/07/20**

GEOTECHNICAL BOREHOLE LOG

BH03

SHEET 1 OF 5

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 22/07/2020
DATE COMPLETED: 22/07/2020
SURFACE RL: 61.59 m AHD
COORDS: 385416.42 m E 6354955.91 m N MGA94 56
DRILL MODEL: Limited access tracked drilling

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered)	0.50m	0.50m	61.5	0.5		CI	FILL, Sandy CLAY, medium plasticity, dark brown, fine to coarse grained sand, trace of fine sub-angular gravel	w>PL		FILL **Standpipe Piezometer Construction Detail** Standpipe piezometer comprises 50mm ID uPVC pressure pipe installed to 9.6m in 76mm diameter hole. Machine slotted and filter sock wrapped 3m screen from 9.6m to 6.6m. Clean 5mm gravel backfill from 9.6m to 5.9m. Bentonite seal from 5.9m to 0m.
		PP240 - 260kPa		61.0	0.60		SM	FILL, Gravelly Silty SAND, fine to medium grained, grey, with pale grey extremely weathered tuffaceous sandstone fragments	M		
		SPT 0, 0, 2 N=2	D								Tuffaceous Sandstone fragment blocked SPT at approximately 0.7m
		0.95m	0.95m								
			1.00m		1.00		CL-CI	FILL, Gravelly Sandy CLAY, low to medium plasticity, brown and orange-brown, fine to coarse grained sand, fine sub-rounded to sub-angular gravel	w~PL		
			U50	60.5							
		PP>400kPa	1.26m								
			1.50m		1.50		CL-CI	FILL, Sandy CLAY, low to medium plasticity, brown, fine to coarse grained sand, trace of to with some fine gravel	w>PL		
			U50	60.0							
		PP150 - 190kPa	1.82m								
		2.00m	2.00m		2.00		CI-CH	FILL, Silty CLAY, medium to high plasticity, grey, orange and brown, with some dark brown zones	w>PL		
		PP180 - 350kPa		59.5							
		SPT 1, 3, 4 N=7	D		2.30		CI	FILL, Sandy CLAY, medium plasticity, brown, fine to coarse grained sand, trace of fine to medium gravel including sandstone rock fragments	w>PL		
		2.45m	2.45m								
		2.50m	2.50m		2.5						
		PP180 - 340kPa		59.0							
		SPT 3, 5, 8 N=13	D					Becoming Sandy Gravelly CLAY with increased sand and gravel content at 2.8m			
		2.95m	2.95m								
		3.00m	3.00m								

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GEOTECHNICAL BOREHOLE LOG

BH03

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 22/07/2020
DATE COMPLETED: 22/07/2020
SURFACE RL: 61.59 m AHD
COORDS: 385416.42 m E 6354955.91 m N MGA94 56
DRILL MODEL: Limited access tracked drilling

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered)	PP120 - 170kPa PP>400kPa SPT 4, 4, 4 N=8 PP220 - 290kPa 3.45m 3.50m PP230 - 330kPa SPT 3, 8, 18 N=26 3.95m	D 3.45m 3.50m D 3.85m D 3.95m	58.5 58.0	3.30 3.5 3.85		CI	FILL, Sandy CLAY, medium plasticity, brown, fine to coarse grained sand, trace of fine to medium gravel including sandstone rock fragments Darker brown in colour from 3.1m to 3.3m	w>PL w<PL		
							CI-CH	Silty CLAY, medium to high plasticity, grey with brown and orange mottles, with some fine to medium grained sand	w~PL	VSt	RESIDUAL
								SANDSTONE, fine to medium grained, orange and grey	XW - HW	EL - VL	BEDROCK
				57.5 57.0 56.5 56.0	4.0 4.5 5.0 5.5			CONTINUED AS CORED BOREHOLE			

LOGGED: TH | CHECKED: | DATE: 02/09/2021

CORED BOREHOLE LOG
BH03

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 22/07/2020
DATE COMPLETED: 22/07/2020
SURFACE RL: 61.59 m AHD
COORDS: 385416.42 m E 6354955.91 m N MGA94 56
DRILL MODEL: Limited access tracked drilling

Borehole Information						Field Material Description					
METHOD	WATER LOSS	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				58.5							
					3.5						
				58.0							
					3.95		START CORING AT 3.95m				
NMLC	10% LOSS	100	59	57.5	4.0		Tuffaceous SANDSTONE, fine to medium grained, pale grey with orange-brown stained zones Decomposed and clayey from 3.95m to 4.08m	XW			DZ
								HW - MW			JT 15° SN PR RF BP 5° SN PR RF JT 10° SN CU RF BP 5° Fe SN PR RF FZ JT 5° Fe SN PR RF BP 5° Fe SN PR RF BP 5° Fe SN PR RF JT 85° Clay VNR PR RF BP 5° Fe SN PR RF JT 20° Fe SN PR RF JT 40° SN PR RF BP 0° SN PR RF
				57.0	4.5						
					5.0						JT 5° CN PR RF
				56.5							BP 10° Fe SN PR RF BP 15° Fe SN PR RF BP 15° Fe SN PR RF JT 5° Fe SN PR RF JT 15° SN PR RF
	15% LOSS	100	47		5.5						
				56.0							BP 5° CN PR RF BP 5° CN PR RF BP 5° CN PR RF
					5.65	× × × × × × × × × × × × × ×	TUFF, pale grey with some orange brown staining	MW			JT 30° Clay PR RF FZ JT 85° CN PR RF BP 5° CN PR RF BP 5° CN PR RF BP 5° CN PR RF

LOGGED: TH | CHECKED: | DATE: 02/09/2021

RCA_LIB_08.1_RCA_STANDARD.GLB Log RCA CORED BOREHOLE LOG 14822-LOGS.GPJ <<DrawingFile>> 02/09/2021 16:56 Produced by gINT Professional, Developed by Datgel

CORED BOREHOLE LOG
BH03

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 22/07/2020
DATE COMPLETED: 22/07/2020
SURFACE RL: 61.59 m AHD
COORDS: 385416.42 m E 6354955.91 m N MGA94 56
DRILL MODEL: Limited access tracked drilling

Borehole Information						Field Material Description				
METHOD	WATER LOSS	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	15% LOSS	100	47	55.5			TUFF, pale grey with some orange brown staining	MW			JT 20° Fe SN PR RF BP 5° Fe SN PR RF JT 20° Fe SN PR RF JT 20° SN PR RF
					6.5						JT 80° Fe SN U RF
				55.0							BP 5° SN PR RF
											FZ/SZ
					7.0						FZ
				54.5							JT 70° CN PR RF
											BP 10° CN PR RF
	20% LOSS	100	75		7.5						BP 5° CN PR RF JT 55° CN PR S JT 5° CN PR RF JT 40° Fe SN PR RF BP 5° CN PR RF
				54.0							JT 10° CN PR RF
					8.0						JT 25° Fe SN PR RF JT 80° Fe SN PR RF JT 5° SN PR RF
				53.5							JT 5° SN IR RF BP 5° CN PR RF JT 10° CN PR RF JT 5° CN PR RF
	20% LOSS				8.5		Groundwater level measured in piezometer at depth of 8.5m on 30/07/2020				BP 5° CN PR RF BP 5° CN PR RF
				53.0							JT 80° Fe SN CU RF
		100	60								BP 10° SN PR RF
	80% LOSS						Groundwater level measured in piezometer at depth of 8.7m on 25/08/2021				JT 30° CN PR RF JT 5° CN PR RF JT 5° Fe SN PR RF BP 10° Clay VNR PR RF

LOGGED: TH | CHECKED: | DATE: 02/09/2021

CORED BOREHOLE LOG
BH03

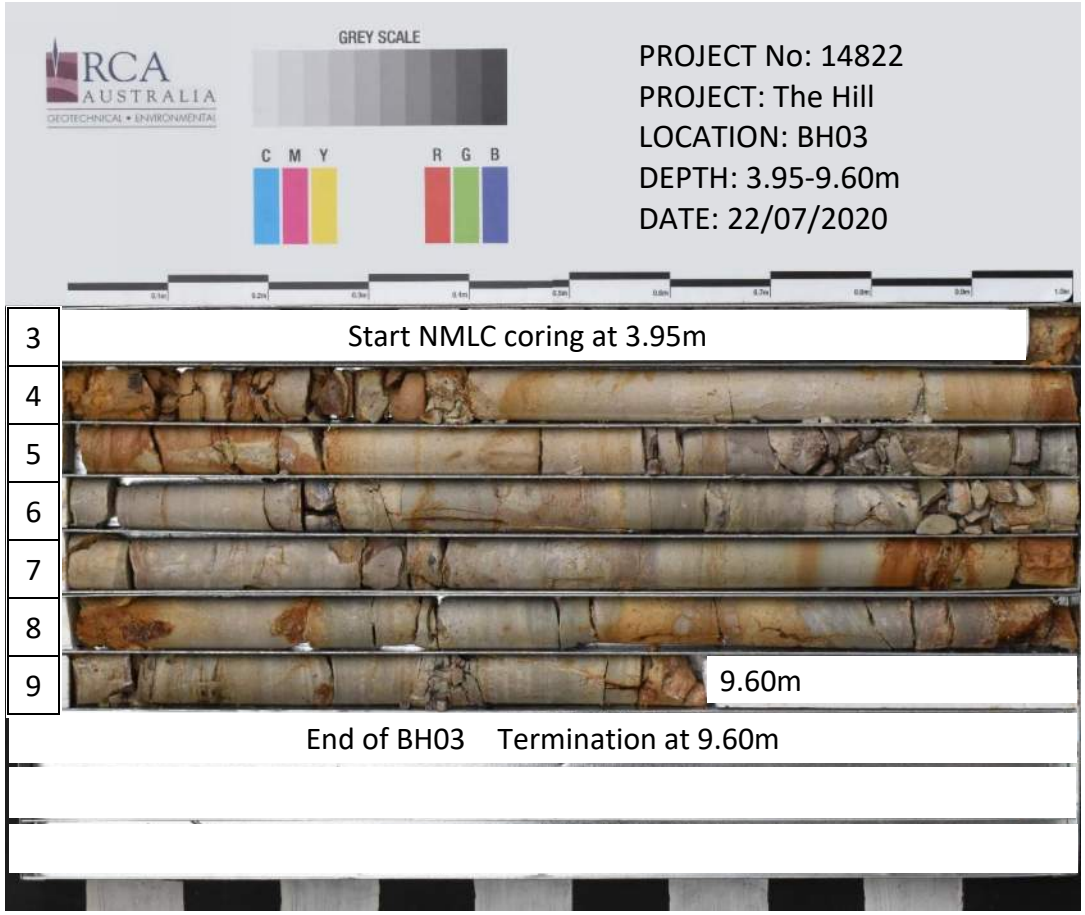
RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14822
CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE COMMENCED: 22/07/2020
DATE COMPLETED: 22/07/2020
SURFACE RL: 61.59 m AHD
COORDS: 385416.42 m E 6354955.91 m N MGA94 56
DRILL MODEL: Limited access tracked drilling

Borehole Information						Field Material Description				
METHOD	WATER LOSS	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	80% LOSS	100	60	52.5	9.5	× ×	TUFF, pale grey with some orange brown staining	MW			JT 50° SN PR RF BP 10° CN PR RF BP 10° CN PR RF
											BP 10° Fe SN PR RF
											FZ
											JT 70° Clay PR RF 2 mm
				52.0	9.60						BP 5° Fe SN PR RF BP 5° Fe SN PR RF
							CORED BOREHOLE BH03 TERMINATED AT 9.60 m				
				51.5	10.0						
				51.0	10.5						
				50.5	11.0						
				50.0	11.5						

LOGGED: TH | CHECKED: | DATE: 02/09/2021



CORE PHOTOGRAPH *Borehole BH03, 3.95m to 9.60m*

Client:	City of Newcastle	**RCA Australia**
Project:	Geotechnical Investigation	
Location:	Memorial Drive, The Hill	**RCA ref:** 14822-202/1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

POINT LOAD STRENGTH TEST RESULTS

CLIENT: City of Newcastle
PROJECT: Geotechnical Investigation
LOCATION: Memorial Drive, The Hill

DATE: 12/08/2020
PROJECT No: 14822
CLIENT REF:

Bore	Depth (m)	Sample length (mm)	Sample diameter (mm)	Minimum cross-sectional area between platens (mm)	Platen Separation at failure (mm)	Orientation A = axial D = diametrical I = irregular	PIL-7 Gauge reading at failure (kPa)	Load at failure (kN)	Point load strength, I_s	Point load index, $I_{s(50)}$	Rock type and structure	Moisture content & storage history	Failure mechanism M = massive B = bedded J = jointed
BH03	4.53	150	51	2043	49	D	600	0.6	0.2	0.2	Turraceous Sandstone	Moist, core box, 21 days	M
BH03	4.53	32	51	1530	30	A	340	0.3	0.2	0.2	Tuffaceous Sandstone	"	M
BH03	5.05	38	51	1836	36	A	3540	3.4	1.4	1.4	Tuffaceous Sandstone	"	M
BH03	5.68	100	51	2043	50	D	4040	3.8	1.5	1.5	Tuff	"	M
BH03	5.68	37	51	1428	28	A	5460	5.2	2.8	2.6	Tuff	"	M
BH03	6.80	160	51	2043	49	D	1380	1.3	0.5	0.5	Tuff	"	M
BH03	6.80	35	51	1377	27	A	1240	1.2	0.7	0.6	Tuff	"	M
BH03	7.54	90	51	2043	48	D	840	0.8	0.3	0.3	Tuff	"	M
BH03	7.54	40	51	1887	37	A	820	0.8	0.3	0.3	Tuff	"	M
BH03	7.80	300	51	2043	48	D	1700	1.6	0.7	0.7	Tuff	"	M
BH03	7.80	50	51	2142	42	A	1740	1.6	0.6	0.6	Tuff	"	M
BH03	8.18	230	51	2043	43	D	12860	12.2	6.6	6.2	Tuff	"	M
BH03	8.18	39	51	1785	35	A	8440	8.0	3.5	3.4	Tuff	"	M
BH03	8.44	110	51	2043	48	D	1820	1.7	0.7	0.7	Tuff	"	M
BH03	8.44	41	51	1785	35	A	740	0.7	0.3	0.3	Tuff	"	J
BH03	9.30	80	51	2043	48	D	1160	1.1	0.5	0.5	Tuff	"	M
BH03	9.30	35	51	1581	31	A	1300	1.2	0.6	0.6	Tuff	"	M

Test Methods: AS4133.4.1-2007 Cl 3.2 - Diametrical test
AS4133.4.1-2007 Cl 3.3 - Axial test
AS4133.4.1-2007 Cl 3.4 - Block and irregular lump test
AS4133.4.1-2007 Cl 3.5 - Anisometrical rock test

RCA Australia	**Calculated by: TH**	**Date: 12/08/20**
Office: Newcastle	**Checked by: CJM**	**Date: 12/08/20**