Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Mt Penang Roads Upgrade
Baxter Track and Parklands Road, Kariong

Prepared for
Hunter and Central Coast Development Corporation

Project 206464.00
September 2021

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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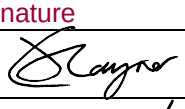
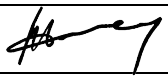
The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		14 September 2021
Reviewer		14 September 2021

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Report on Geotechnical Investigation
Proposed Mt Penang Roads Upgrade
Baxter Track and Parklands Road, Kariong

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed road upgrade at Mt Penang, Kariong. The investigation was commissioned by Hunter and Central Coast Development Corporation and was undertaken in accordance with DP proposal 206464.00.P.001.Rev0 dated 6 July 2021.

For the purpose if this assessment, DP was provided with Civil Engineering drawings prepared by Northrop Consulting Engineers Pty Ltd (ref. NL191249, dwg. CD-03-C1.00 to 21, rev. 2, dated 28 June 2021).

It is understood that Hunter & Central Coast Development Corporation proposes to upgrade the existing unsealed Baxter Track, and form an extension of Parklands Road to connect with Baxter Track. Based on the drawings provided, it is understood that works would include:

- A sealed at-grade upgrade to the western section of Baxter Track, extending from Kangoo Road to approximately CH260, with a culvert to be constructed at approximately CH190;
- Construction of a new at-grade extension of Parklands Road to the north from approximate CH260 to CH460 to connect with the Baxter Track upgrade;
- A new roundabout at the intersection of Parklands Road and McCabe Road at approximate CH460; and,
- A driveway upgrade to the remaining eastern section of the Baxter Track, with entrance from the new Baxter Track/Parklands Road upgrade to Frank Baxter Juvenile Justice Centre.

The aim of the investigation was to provide comment on the following:

- Subsurface conditions and observations on groundwater at test locations;
- California bearing ratio (CBR) values of anticipated subgrade material;
- Flexible pavement thickness designs for the following:
  - Baxter Track and Parklands Road;
  - Parklands Road roundabout; and
  - Baxter Track driveway.
- Subgrade preparation measures; and,
- Bearing capacity and foundation preparation measures for the proposed culvert.

The investigation included the drilling of nine boreholes, in situ testing and laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

2. Site Description

The existing Baxter Track is located off Kangoo Road and extends approximately 480 m south-east to Frank Baxter Juvenile Justice Centre and comprises an unsealed gravel surfaced flexible pavement. A drainage line falling to the south-west is located at approximate CH190 and a culvert extends under Baxter Track. Photographs showing site conditions along Baxter Track at the time of the investigation are presented in Figure 1 to Figure 3.

Figure 1: Photograph showing existing Baxter Track, taken from near intersection with Kangoo Road, looking south-west

Figure 2: Photograph showing existing drainage line and location of proposed culvert at approximate CH190

Figure 3: Photograph showing existing Baxter Track, taken from near proposed driveway entrance to Frank Baxter Juvenile Justice Centre, looking south-west

The proposed roundabout and extension of Parklands Road is located north of the existing intersection of Parklands Road and McCabe Road. Parklands Road and McCabe Road comprise sealed flexible pavements, whilst the proposed alignment to the north generally contains grass surfaced undeveloped rural land. A photograph showing the location of the proposed roundabout and extension of Parklands Road is shown in Figure 4.

Figure 4: Photograph showing existing intersection of Parklands Road and McCabe Road and location of proposed roundabout and road extension, looking north-east

With reference to local topographic information, surface levels rise from approximately 187 m AHD at the western end of Baxter Track to 194 m AHD at the eastern end. The surface level at the intersection of Parklands Road and McCabe Road is approximately 184 m AHD. Surface slopes typically rise in an easterly direction at approximately 2°.

3. Published Data

3.1 Regional Geology

Reference to regional geological mapping (GSNSW, 2019) indicates that the site is underlain by the Triassic aged Hawkesbury Sandstone Formation. The Hawkesbury Sandstone Formation typically comprises medium to coarse grained sandstone, with minor laminated mudstone and siltstone lenses, and residual soils derived from the weathering of these rocks.

3.2 Soil Landscape

Reference to the Gosford Lake Macquarie 1:100,000 scale Soil Landscape Series sheet indicates that the site is mapped as comprising residual soils of the Somersby landscape group. This landscape group typically includes gently undulating to rolling rises on deeply weathered Hawkesbury Sandstone.

4. Field Work

4.1 Field Work Methods

Field work for the investigation was undertaken on 3 August 2021 and included the drilling of nine boreholes (Bore 1 to Bore 9) to depths of 1.2 m. The boreholes were drilled using a 5 tonne excavator fitted with a 300 mm pendulum auger. Dynamic cone penetrometer tests (DCPs) were carried out adjacent to the boreholes to provide information on the relative strengths or densities of the subsurface soils.

Borehole locations were set out with reference to the site plan of the proposed development. The locations of the boreholes are shown on Drawing 1, included in Appendix B. The coordinates and surface elevations of the test locations were recorded to MGA94 using a differential GPS, which typically has an accuracy of ± 0.1 m, depending on satellite coverage.

Engineering logs of the subsurface conditions encountered in the boreholes were prepared by a geotechnical engineer who also collected representative samples for identification purposes and subsequent laboratory testing.

4.2 Field Work Results

Details of the conditions encountered in the boreholes are given in the log sheets which are presented in Appendix C. These logs should be read in conjunction with the explanatory notes, which define the descriptive terms and classification methods.

The subsurface conditions encountered during the investigation are typically summarised as follows:

- **Baxter Track - CH0 to CH260 (Bores 1, 2 and 4):** Typically sandy silt / silt topsoil to a depth between 0.25 m and 0.45 m, overlying medium dense to dense residual pale brown sand, with clay and gravel;
- **Baxter Track Culvert - CH190 (Bore 3):** Soft grey sandy silt to a depth of 0.3 m, overlying firm grey sandy silt to 0.8 m depth, then firm pale grey residual sandy clay;
- **Parklands Road Extension and Roundabout - CH260 to CH460 (Bores 5, 6 and 7):** Typically sandy silt topsoil to a depth between 0.1 m and 0.25 m, overlying medium dense to dense residual pale brown sand, with clay and gravel; and,
- **Baxter Track Driveway - CH0 to CH220 (Bores 8 and 9):**
  - Bore 8: Brown gravelly silty sand fill to a depth of 0.55 m, overlying pale grey silt topsoil to a depth of 0.75 m, then medium dense residual pale brown sand, with clay and gravel;
  - Bore 9: Pale grey silt topsoil to a depth of 0.15 m, overlying medium dense residual pale brown sand, with clay and gravel.

Standing groundwater was not observed during the investigation. Groundwater seepage was observed at 0.3 m depth in Bore 3. The boreholes were backfilled on completion of logging and sampling which precluded long term monitoring of groundwater levels. It should be noted that groundwater levels are variable and can be affected by factors such as soil permeability and recent climatic conditions, and can vary with time.

5. Laboratory Testing

California Bearing Ratio (CBR) and Standard Compaction testing was undertaken on a bulk sample of anticipated subgrade material collected from Bore 2. A laboratory test report is presented in Appendix D and results summarised in Table 1.

Table 1: Summary of CBR and Standard Compaction Testing

Sample Location	Sample Depth (m)	Description	Field Moisture Content (%)	Optimum Moisture Content (%)	Maximum Dry Density (t/m^3)	CBR (%)	CBR Swell (%)
Bore 2	0.4 - 0.6	SAND	8.3	10.0	2.11	35	-0.5

6. Proposed Development

It is understood that Hunter & Central Coast Development Corporation proposes to upgrade the existing unsealed Baxter Track, and form an extension of Parklands Road to connect with Baxter Track. Based on the drawings provided, it is understood that works would include:

- A sealed at-grade upgrade to the western section of Baxter Track, extending from Kangoo Road to approximately CH260, with a culvert to be constructed at approximately CH190;
- Construction of a new at-grade extension of Parklands Road to the north from approximate CH260 to CH460 to connect with the Baxter Track upgrade;
- A new roundabout at the intersection of Parklands Road and McCabe Road at approximate CH460; and,
- A driveway upgrade to the remaining eastern section of the Baxter Track, with entrance from the new Baxter Track/Parklands Road upgrade to Frank Baxter Juvenile Justice Centre.

A plan of the proposed roads upgrade is shown in Figure 5.

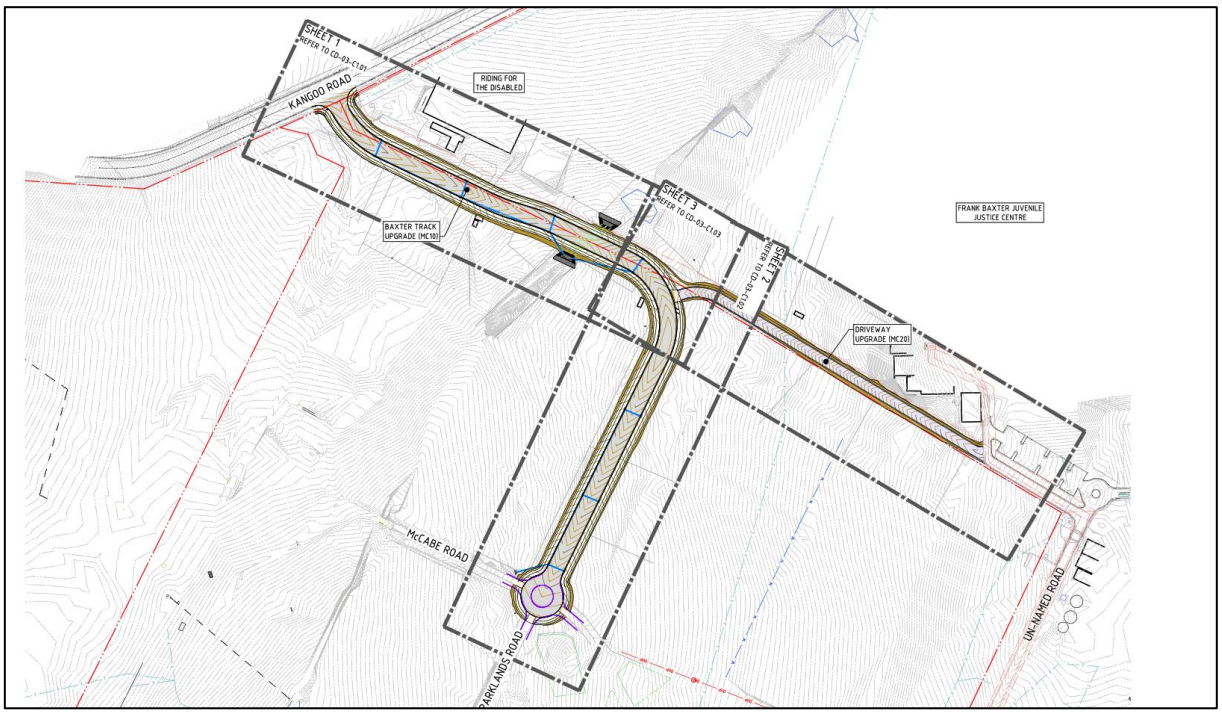

Figure 5: Plan of the proposed roads upgrade

(adapted from Northrop Consulting Engineers Pty Ltd drawing, ref. NL191249, dwg. CD-03-C1.00 to 21, rev. 2, dated 28 June 2021)

7. Comments

7.1 Pavement Thickness Design

7.1.1 Design Traffic Loading

Based on advice provided by Hunter & Central Coast Development Corporation, it is understood that the proposed Baxter Track and Parklands Road upgrade is to be designed as a "collector/distributor road" in accordance with CCC (2020a). As per Table 6.1 of CCC (2020a), collector/distributor roads have a traffic loading of 8×10^6 Equivalent Standard Axle Repetitions (ESA) over a 40 year design period.

No information was provided regarding the traffic loading for the propsoed Baxter Track Driveway, however, it is assumed that the road would be classed as an "access road" in accordance with CCC (2020a). As per Table 6.1 of CCC (2020a), access roads have a traffic loading of 5×10^5 Equivalent Standard Axle Repetitions (ESA) over a 40 year design period.

Should the actual traffic loadings differ to the above, then the pavement thickness designs will need to be revised by DP.

7.1.2 Design Subgrade CBR

The results of the investigation indicate that the subgrade in the area of the proposed road upgrades will comprise pale brown medium dense to dense residual sand, with clay and gravel. It is noted that some areas may contain silty topsoil material at design subgrade level, and there may be a need for some over-excavation and provision of a select layer.

Based on the results of the boreholes, laboratory testing, DCPs and experience with similar soils in the local area, a design subgrade CBR value of 8% has been adopted for pavement thickness design.

Subgrade preparation should be undertaken in accordance with the methodology given in Section 7.1.5.

7.1.3 Pavement Thickness Design for Baxter Track/Parklands Road and Baxter Track Driveway

The minimum layer thicknesses for the proposed Baxter Track/Parklands Road upgrade and Baxter Track driveway are presented in Table 2. The designs are based on procedures contained in CCC(2020a) and Austroads (2017). It also requires that subgrade preparation will be carried out in accordance with Section 7.1.5 of this report.

Table 2: Flexible Pavement Design Summary for Baxter Track/Parklands Road and Baxter Track Driveway

Pavement	Design Traffic Load (ESA)	Subgrade Material	Design Subgrade CBR (%)	Total Pavement Thickness (mm) (1,2)	Layer Component		
					Wearing Course (mm) (1)	Base Course (mm)	Subbase Course (mm)
Baxter Track / Parklands Road	8×10^6	Sand	8	360	30mm AC10 (C450 binder)	160	200
Baxter Track Driveway	5×10^5	Sand	8	300(3)	30mm AC10 (C450 binder)	150(4)	150(4)

Notes:

1 - A 10 mm prime / initial seal should be applied prior to the application of the asphaltic concrete wearing course but has not been included in the overall thickness design.

2 - As per CCC(2020a), the total pavement thickness does not include the thickness of the wearing course as asphalt surfacing less than or equal to 40mm is not considered to contribute to pavement thickness design.

3 - Minimum pavement thickness as per CCC(2020a).

4 - Placement and compaction of thin pavement layers may be difficult and hence the subbase layer may be omitted and replaced with an increased basecourse layer.

7.1.4 Pavement Thickness Design for Parklands Road/McCabe Road Roundabout

As per CCC (2020a), roundabout pavement design should comprise either a full depth asphalt pavement, heavily bound pavement, or rigid pavement. For the purpose of this assessment we have provided designs for both a full depth asphalt pavement and a heavily bound pavement.

Analysis was undertaken using the commercially available CIRCLY software and procedures contained in CCC (2020a) and Austroads (2017). The pavement material parameters adopted for the design of the roundabout pavement are outlined below. It is noted that the elastic modulus of the asphalt has been calculated based on a weighted mean annual pavement temperature (WMAPT) of 27°C:

- Asphaltic wearing surface (AC10, A15E binder, 10km/h) E = 1,100 MPa;
- Asphaltic base (AC20, C450 binder, 10km/h) E = 1,900 MPa;
- Heavily Bound Base Material E = 5,000 MPa;
- Select Material (CBR = 15%) E = 150 MPa; and
- Sand subgrade (CBR = 8%) E = 80 MPa.

The minimum layer thicknesses for the proposed Baxter Track/Parklands Road upgrade and Baxter Track driveway are presented in Table 2.

Table 3: Full Depth Asphalt and Heavily Bound Flexible Pavement Design Summary for Parklands Road/McCabe Road Roundabout

Pavement	Design Traffic Load (ESA)	Subgrade Material	Design Subgrade CBR (%)	Total Pavement Thickness (mm) [1,2]	Layer Component			
					Wearing Course (mm)	Asphalt Base Course (mm) [1]	Heavily Bound Base Course (mm)	Select Material (mm)
Option 1 - Full Depth Asphalt	8×10^6	Sand	8	350	45mm AC14 (A15E binder)	200 mm AC20 (C450 binder)	-	150
Option 2 - Heavily Bound	8×10^6	Sand	8	460	45mm AC14 (A15E binder)	60 mm AC20 (C450 binder)	250	150

Notes:

1 - A 10 mm prime / initial seal should be applied prior to the application of the asphaltic concrete base course but has not been included in the overall thickness design.

7.1.5 Subgrade Preparation Measures

Subgrade preparation for the proposed pavements should be carried out in general accordance with the following methodology:

- Where required, strip existing vegetation, fill, topsoils and other deleterious material. It is noted that in the location of Bore 8, gravelly silty sand fill and topsoil will need to be removed to a depth of approximately 0.75 m;
- Excavate to design level to expose the underlying medium dense to dense pale brown residual sand. It should be noted that some areas may contain silty topsoil material at design subgrade level, and there may be a need for some over-excavation and provision of a select layer;
- Proof roll the exposed surface accompanied by careful visual inspection by an experienced geotechnical consultant to allow detection and treatment of any soft or compressible zones. Unsuitable materials should be over-excavated and replaced with suitable fill;
- Subgrade materials should be compacted to at least 100% Standard compaction or 80% Density Index, with moisture contents within -3% and +1% of the optimum moisture content (OMC);
- Select material should comprise material having a soaked CBR value of at least 15%. The fill should be well graded and have a maximum particle size of not greater than 75 mm and conform to other material properties as listed in CCC (2020b). The material should be placed in layers not exceeding 250 mm loose thickness;
- Protect the area after subgrade preparation to maintain moisture content close to the equilibrium as far as practicable and prevent further disturbance. The placement of subbase gravel would normally provide adequate protection; and
- Place subsequent layers of suitable pavement materials in layers not thicker than 300 mm loose thickness and compact in accordance with details given in Section 7.1.6 of this report.

In accordance with CCC requirements, individual pavement layers (subgrade, select, subbase and basecourse) must be presented for testing immediately after placement and compaction. The results of such testing would need to be reported to CCC for final approval.

Earthworks testing and inspections should be carried out to Level 2 conditions, as defined in AS 3798 (2007).

7.1.6 Material Properties

The material quality and compaction requirements for pavement layers are presented in Table 4, as per CCC (2020b).

Table 4: Material Quality and Compaction Requirements

Layer	Material Quality	Compaction
Wearing Course	Conform to TfNSW Spec R116	TfNSW Spec R116
Asphalt Base Course	Conform to TfNSW Spec R116	TfNSW Spec R116
Heavily Bound Base Course	Conform to TfNSW Spec. 3051, Traffic Category B, or IPWEA Spec. Class R1	TfNSW Spec R73, Minimum 102% Standard Compaction
Unbound Base Course	Conform to TfNSW Spec. 3051, Traffic Category B, or IPWEA Spec. Class R1	TfNSW Spec R71, Minimum 102% Standard Compaction
Unbound Subbase Course	Conform to TfNSW Spec. 3051, Traffic Category B, or IPWEA Spec. Class R1	TfNSW Spec R71, Minimum 100% Standard Compaction
Select Fill	Minimum CBR 15%, conform to CCC (2020b)	TfNSW Spec R44, Minimum 102% Standard Compaction
Subgrade	Minimum CBR 8%	TfNSW Spec R44, Minimum 100% Standard Compaction or 80% Density Index

It is noted that CCC (2020b) states that a minimum relative compaction of 95% Standard compaction is required for subgrade material. However, the pavement thickness design presented in this report is based on the subgrade being compacted to at least 100% Standard compaction. If relative compaction on subgrade material of less than 100% Standard compaction is achieved during construction then this would result in a lower design subgrade CBR value and, therefore, a thicker pavement. In this case, further advice regarding pavement thickness would be required by a geotechnical engineer. It is DP's recommendation that the subgrade should be compacted to at least 100% Standard compaction.

7.1.7 Drainage

The vehicular pavement thickness designs provided above depends on the provision of adequate surface and subsoil drainage to maintain the subgrade as close to the optimum moisture content as possible and to ensure that the pavement layers do not become saturated.

Preparation of subgrade surfaces should normally be such that adequate crossfalls for surface drainage are achieved across the final pavement. Pavement subsoil drains should be keyed it to existing pavement drains where practicable or installed at least 0.3 m below subgrade level adjacent to pavements.

7.2 Culvert at CH190

Based on the results of the investigation, the conditions encountered at the proposed culvert location comprise soft grey sandy silt to a depth of 0.3 m, overlying firm grey sandy silt to 0.8 m depth, then firm pale grey residual sandy clay.

It is recommended that the culvert be supported within the firm pale grey residual sandy clay as identified below 0.8 m depth in Bore 3.

Footings designed to be supported within the firm pale grey sandy clay could be proportioned for a maximum allowable bearing pressure of 50 kPa.

Site preparation for the proposed culvert foundation should be undertaken in general accordance with the following methodology:

- Strip existing vegetation, topsoils and other deleterious material;
- Excavate to design foundation level to expose the underlying firm pale grey residual sandy clay. It should be noted that some over excavation of soft to firm sandy silt material may be required below the culvert foundation level;
- Where over excavation of unsuitable material is required below the culvert foundation level, then coarse free draining granular material should be placed back up to the foundation level. A layer of geotextile should also be placed at the base of the excavation and wrapped up the side walls of the excavation; and
- Protect the area after preparation to prevent further disturbance. The placement of a blinding layer of base slab would normally provide adequate protection.

A geotechnical engineer should be present during construction to check that the foundation materials are suitable for the design bearing pressures adopted and also to check that the site preparation measures detailed above are appropriate.

8. References

AS 3798. (2007). *Guidelines on Earthworks for Commercial and Residential Developments.* Standards Australia.

Austroads. (2017). *Guide to Pavement Technology Part 2: Pavement Structural Design.* Publication No. AGPT02-17: Austroads Ltd.

CCC. (2020a). *Civil Works Specification, Design Guideline 2020.* Revison date July 2020: Central Coast Council.

CCC. (2020b). *Civil Works Specification, Construction Specification 2020.* Revision date July 2020: Central Coast Council.

GSNSW. (2019). *NSW Seamless Geology.* Geological Survey NSW Web Map Service.

IPWEA NSW. (2010). *Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage.* Department of Environment, Climate Change and Water (DECCW) in conjunction with Institute of Public Works Engineering Australia (NSW) .

TfNSW 3051. (2020). *QA Specification 3051, Granular Pavement Base and Subbase Materials.* Edition 7 / Revision 1: Transport for NSW (formerly RMS).

TfNSW R116. (2020). *QA Specification R116 Heavy Duty Dense Graded Asphalt.* Edition 9 / Revision 1: Transport for NSW (formerly RMS).

TfNSW R44. (2020). *QA Specification R44, Earthworks.* Edition 5 / Revision 1: Transport for NSW (formerly RMS).

TfNSW R71. (2020). *QA Specification R71, Construction of Unbound and Modified Pavement Course.* Edition 5 / Revision 1: Transport for NSW (formerly RMS).

TfNSW R73. (2020). *QA Specification R73, Construction of Plant Mixed Heavily Bound Pavement Course.* Edition 3 / Revision 2: Transport for NSW (formerly RMS).

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Baxter Track and Parklands Road, Kariong in accordance with DP's proposal 206464.00.P.001.Rev0 dated 6 July 2021 and acceptance received from Hunter and Central Coast Development Corporation dated 15 July 2021. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Hunter and Central Coast Development Corporation 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. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

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.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

November 2020

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

continued next page

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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Appendix B

Drawing 1 - Test Location Plan

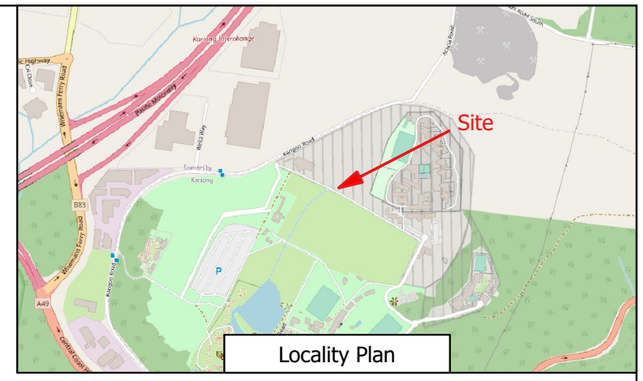
Legend

- Approximate Borehole Location
- Approximate DCP Location

Aerial Image Plan

Drawing adapted from Metromap Image, dated 6 April 2020

100 0 100 200 300 400 m



Locality Plan

Proposed Development Plan

FOR INFORMATIC

Drawing adapted from Northrop Consulting Engineers Pty Ltd drawing, ref. NL191249, dwg. CD-03-C1.00, rev. 2,

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Hunter & Central Coast Development Corporation		
OFFICE: Central Coast	DRAWN BY: JBR	
SCALE: 1:4,000 @ A3	DATE: 08.09.2021	

TITLE: **Test Location Plan**
Proposed Mt Penang Roads Upgrade
Baxter Track and Parklands Road, Kariong

N

PROJECT No:	206464.00
DRAWING No:	1
REVISION:	0

Appendix C

Sampling, Testing and Excavation Methodology
Soil Descriptions
Terminology, Symbols and Abbreviations
Borehole Logs

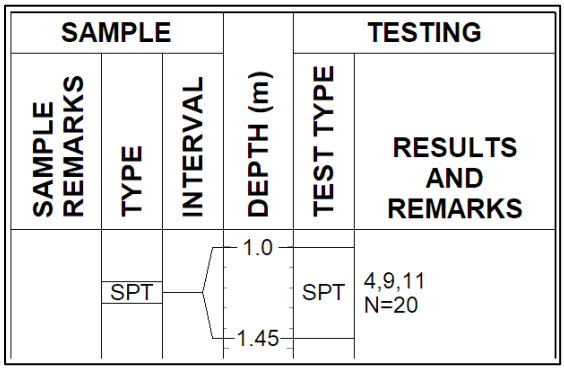
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

November 2020

Sampling and Testing

A record of samples retained and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Sample from SPT test	SPT
Environmental sample	E
Gas sample	G
Jar sample	J
Undisturbed tube sample	U[1]
Water sample	W
Piston sample	P
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =*x* blows for *y* mm penetration HB = hammer bouncing	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	Observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

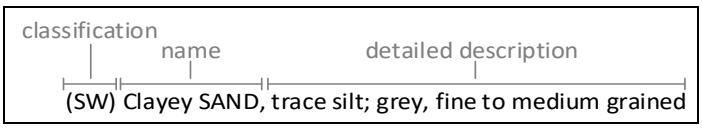
The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Excavator/backhoe bucket	B[1]
Toothed bucket	TB[1]
Mud/blade bucket	MB[1]
Ripping tyne/ripper	RT
Rock breaker/hydraulic hammer	RB
Hand auger	HA[1]
NMLC series coring	NMLC
HMLC series coring	HMLC
NQ coring	NQ
HQ coring	HQ
PQ coring	PQ
Push tube	PT [1]
Rock roller	RR[1]
Solid flight auger. Suffixes: (TC) = tungsten carbide tip, (V) = v-shaped tip	SFA[1]
Sonic drilling	SON[1]
Vibrocore	VC[1]
Wash bore (unspecified bit type)	WB[1]
Existing exposure	X
Hand tools (unspecified)	HT
Predrilled	PD
Specialised bit (refer report)	SPEC[1]
Diatube	DT[1]
Hollow flight auger	HFA[1]
Vacuum excavation	VE

[1] – numeric suffixes indicate tool diameter/width in mm

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:



The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence it's behaviour. The detailed description presents more information about the soil's composition, condition, structure, and origin.

Classification, naming and description of soils requires the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Fraction	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soils behaviour.

Component Proportion Designation	Definition[1]	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to it's engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub categories. Refer "identification of minor components" below

Composite Materials

In certain situations a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example "INTERBEDDED Silty CLAY AND SAND".

Classification

The soil classification comprises a two character group symbol. The first symbol identifies the primary component. The second symbol identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component[1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters `(?)`, with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description.

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterize due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular particle size with the range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

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Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	<PL
	Near plastic limit	Can be moulded	≈PL
	Wet of plastic limit	Water residue remains on hands when handling	>PL
	Near liquid limit	"oozes" when agitated	≈LL
	Wet of liquid limit	"oozes"	>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Rock

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered rock origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description

Quantitative engineering performance of these materials may be determined by laboratory testing, or estimated by correlated field tests (for example penetration or shear vane testing). In some cases performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	ST
Very stiff	Indented by thumbnail	>100 - ≤200	VST
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	FR

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15-≤35	L
Medium dense	>35-≤65	MD
Dense	>65-≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MCE
Weakly cemented	WKCE
Cemented	CE
Strongly bound	SB
Weakly bound	WB
Unbound	UB

Extremely Weathered Rock

AS1726-2017 considers weathered rock material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. very low strength rock). These materials may be identified as "extremely weathered rock" in reports and by the abbreviation code XWR on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RES
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LCS
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or sea shore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

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Terminology, Symbols and Abbreviations

November 2020

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style `XW`. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	`KL`
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	`UK`
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	`ND`
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	`NA`

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 188.8 AHD
COORDINATE E:341582.9 **N:** 6300599.5
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 1
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.0	FILL/ Sandy GRAVEL; grey; gravel fraction fine to coarse, sub-angular; sand fraction fine to coarse		FILL		M to D						
	0.12	TOPSOIL/ (ML) SILT; pale grey; low plasticity; trace rootlets		TOP	NA	<PL						
	0.45	(SP) SAND, with clay, with gravel; pale brown; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone		RES	D	M		D		0.6	DCP/150	16/100mm
	188	1.1m: white mottled red										
	1									1		
	1.2	Borehole discontinued at 1.20m depth - limit of investigation										
	187											
	2									2		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:47. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 188.1 AHD
COORDINATE E:341658.9 **N:** 6300565.4
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 2
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	188 / 0.0	TOPSOIL/ (ML) SILT; pale grey; low plasticity; trace rootlets		TOP	NA	<PL					DCP/150	5 10 15
	0.35	(SP) SAND, with clay, with gravel; pale brown; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone		RES	D	M		B		0.4 / 0.6		
	1 / 187	1.0m: white mottled red								1		25
	1.2	Borehole discontinued at 1.20m depth - limit of investigation										
	2 / 186									2		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:47. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 186.5 AHD
COORDINATE E:341741.8 **N:** 6300537.5
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 3
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
seepage	186 / 0.0	(ML) Sandy SILT; grey; silt fraction low plasticity; sand fraction fine to medium; with rootlets		ALV	S	=PL		D		0.6	DCP/150	5 10 15
	0.8	(CH) Sandy CLAY; pale grey; clay fraction high plasticity; sand fraction fine to medium		RES	F	>PL		D		1.0		
	185 / 1.2	Borehole discontinued at 1.20m depth - limit of investigation								2		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:47. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 188.6 AHD
COORDINATE E:341796.1 **N:** 6300492.5
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 4
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.0 / 188	TOPSOIL/ (ML) Sandy SILT; dark grey; silt fraction low plasticity; sand fraction fine to medium; with rootlets		TOP	NA	>PL					DCP/150	5 10 15
	0.25	(SP) SAND, with clay, with gravel; pale brown; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone		RES	MD	M						
	1									1		
	1.2 / 187	Borehole discontinued at 1.20m depth - limit of investigation										
	2									2		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:48. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 188.7 AHD
COORDINATE **E:**341796.2 **N:** 6300451.2
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 5
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE		REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	188 / 0.0	TOPSOIL/ (ML) Sandy SILT; dark grey; silt fraction low plasticity; sand fraction fine to medium; with rootlets		TOP	NA	>PL						DCP/150	5 10 15
	0.1	(SP) SAND, with clay, with gravel; pale brown; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone		RES	MD	M							
					L TO MD	M to W							
	1				MD						1		
	1.2	Borehole discontinued at 1.20m depth - limit of investigation											
	187												
	2										2		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:48. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 187.4 AHD
COORDINATE E:341755.1 **N:** 6300392.2
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 6
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.0 / 187	TOPSOIL/ (ML) Sandy SILT; dark grey; silt fraction low plasticity; sand fraction fine to medium; with rootlets		TOP	NA	>PL				1	DCP/150	5 10 15
	0.25	(SP) SAND, with clay, with gravel; pale brown; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone		RES	MD	M						
	1 / 186					M to W						
	1.2	Borehole discontinued at 1.20m depth - limit of investigation								2		
	2 / 185											

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:48. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 185.6 AHD
COORDINATE **E:**341716.2 **N:** 6300292.7
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 7
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.0	TOPSOIL/ (ML) Sandy SILT; dark grey; silt fraction low plasticity; sand fraction fine to medium; with rootlets		TOP	NA	>PL						
	0.15	(SP) SAND, with clay, with gravel; pale brown; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone		RES	MD	M		D		0.8	DCP/150	5 10 15
	185											
	1									1		
	1.2	Borehole discontinued at 1.20m depth - limit of investigation										
	184											
	2									2		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD: 75mm diameter hand auger
REMARKS:

OPERATOR: MVB
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:48. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 191.4 AHD
COORDINATE E:341884.9 **N:** 6300457.3
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 8
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	191 0.0	FILL/ Gravelly Silty SAND; brown; sand fraction fine to coarse; gravel fraction fine to coarse; trace concrete fragments		FILL	NA	M						
	0.55	TOPSOIL/ (ML) SILT; pale grey; low plasticity; trace rootlets		TOP		>PL						
	0.75	(SC) SAND, with gravel; pale brown mottled pale orange; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone		RES	MD	M		D		0.8	DCP/150	refusal on gravel
	1									1		
	1.2	Borehole discontinued at 1.20m depth - limit of investigation										
	190											
	2									2		
	189											

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:48. TEMPLATE ID: DP_101.02.00_SOILLOG

BOREHOLE LOG

CLIENT: Hunter and Central Coast Development Corporation
PROJECT: Proposed Mt Penang Raods Upgrade
LOCATION: Baxter Track and Parklands Road, Kariong

SURFACE LEVEL: 194.4 AHD
COORDINATE **E:**341959.2 **N:** 6300403.1
DATUM/GRID: MGA94 Zone 56 H
DIP/AZIMUTH: 90°/---

LOCATION ID: 9
PROJECT No: 206464.00
DATE: 03/08/21
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.0	TOPSOIL/ (ML) SILT; pale grey; low plasticity; trace rootlets		TOP	NA	<PL						
	0.15	(SP) SAND, with clay, with gravel; pale brown; sand fraction fine to medium; gravel fraction fine to coarse, sub-rounded to sub-angular ironstone; trace tree roots		RES	MD	M					DCP/150	5 10 15
	194											
	1									1		
	1.2	Borehole discontinued at 1.20m depth - limit of investigation										
	193											
	2									2		
	192											

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: 5T Excavator
METHOD: 300mm diameter pendulum auger
REMARKS:

OPERATOR: F.Murphy
CASING:

LOGGED: MVB

EXPORTED 12/09/21 17:48. TEMPLATE ID: DP_101.02.00_SOILLOG

Appendix D

Laboratory Test Results

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Central Coast Laboratory
Unit 5/3 Teamster Close Tuggerah NSW 2259
Phone: (02) 4351 1422
Fax: (02) 4351 1422
Email: aden.greentree@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Aden Greentree
Technician
Laboratory Accreditation Number: 828

Report Number: **206464.00-1**
Issue Number: 1
Date Issued: 24/08/2021
Client: Hunter and Central Coast Development Corporation
Suite B/Level 5, Newcastle NSW 2300
Contact: Michelle Viola
Project Number: 206464.00
Project Name: Mt Penang - Baxter Track and Parklands Road Upgrade
Project Location: Mt Penang Parkland Gardens, Kariong NSW
Work Request: 4413
Sample Number: CC-4413A
Date Sampled: 04/08/2021
Dates Tested: 10/08/2021 - 17/08/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 2 , Depth: 0.4-0.6m**
Material: SAND: pale brown, with clay and ironstone gravel

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**35**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	2.11		
Optimum Moisture Content (%)	10.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	2.11		
Field Moisture Content (%)	8.3		
Moisture Content at Placement (%)	10.0		
Moisture Content Top 30mm (%)	9.8		
Moisture Content Rest of Sample (%)	9.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.7		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0