Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation and Preliminary Salinity Assessment

Proposed School
Lot 100, DP1261496, Maitland Street, Muswellbrook, NSW

Prepared for
Pacific Brook Christian School Ltd

Project 91601.03
July 2021

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	91601.03	Document No.	R.003.Rev2
Document title	Report on Geotechnical Investigation and Preliminary Salinity Assessment, Proposed School		
Site address	Lot 100, DP1261496, Maitland Street, Muswellbrook, NSW		
Report prepared for	Pacific Brook Christian School Ltd		
File name	91601.03.R.003.Rev2. Geotech		

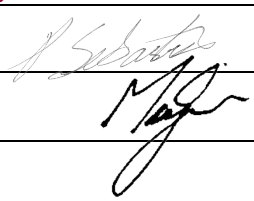
Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Caitlyn Falla	Michael Gawn	12 May 2020
Revision 1	Caitlyn Falla	Michael Gawn	25 August 2020
Revision 2	Caitlyn Falla/Paulo Sebastian	Michael Gawn	15 July 2021

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	Stephanie Ferguson, Pacific Brook Christian School Ltd
Revision 1	1	0	Stephanie Ferguson, Pacific Brook Christian School Ltd
Revision 2	1	0	Chris Baldry, Pacific Brook Christian School Ltd

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		15 July 2021
Reviewer		15 July 2021

bsi. ISO 9001 Quality Management
FS 604853

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

Douglas Partners
Geotechnics / Environment / Groundwater

Table of Contents

Page

Report on Geotechnical Investigation and Preliminary Salinity Assessment
Proposed School
Lot 100, DP1261496, Maitland Street, Muswellbrook, NSW

1. Introduction

This report presents the results of a geotechnical investigation and preliminary salinity assessment undertaken for a proposed school at Lot 100, DP1261496, Maitland Street, Muswellbrook, NSW. The investigation was commissioned by services order from Chis Baldry of Pacific Brook Christian School Ltd dated 3 April 2020 and was undertaken in consultation with NBRS Architecture (NBRS), project architects, with reference to Douglas Partners' (DP) proposal NCL200187 dated 27 March 2020.

For the purposes of the investigation, concept sketches dated 27 March 2020 were provided to DP by NBRS. Based on the concept plan, the development is located in the south-eastern potion of the site, and comprises several single and two-storey buildings as well as an at-grade carpark.

DP has had continuing involvement with the project, including a detailed site investigation for contamination (DP 2019). The current investigation was undertaken in conjunction with a supplementary investigation for contamination. The aim of the investigation was to assess the subsurface soil and groundwater conditions across the site in order to provide:

- Subsurface conditions;
- Comment on soil salinity;
- Site classification in accordance with AS2870-2011;
- Shallow footing design parameters;
- Design CBR and flexible pavement thickness design for the proposed carpark; and
- Excavation conditions and site preparation measures.

The investigation included a review of existing subsurface data, the excavation of seventeen (17) additional test pits 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 site is triangular in shape, with a northwest/southeast alignment and has an area of 2.432 ha (refer Figure 1). The site is bound by Muswellbrook Golf Course along the north-eastern boundary, Maitland Street along the south-western boundary and residential properties to the south-eastern boundary (see aerial image of site boundary below). The site address is 72-74 Maitland Street and is legally described as Lot 100 in Deposited Plan (DP) 1261496 (see Figure 2).

The site is generally level with a slight slope to a watercourse at the north-west boundary. This watercourse flows northeast into the adjoining golf course and on to Muscle Creek via a series of dams

on the golf course. Muscle Creek flows west into the Hunter River which at its closest is 1.3 km north-west of the site. Stormwater management on site is by overland flow.

72-74 Maitland Street was previously used for forestry plantation purposes and is mapped as Muswellbrook State Forest. The site is no longer used for this purpose and currently sits as an empty and underutilised site.

The main vehicular access to the site is from Maitland Street, as well as pedestrian access. Existing vehicular parking on site includes open air at grade parking spaces facing Maitland Street.

In terms of travel, Muswellbrook is approximately three (3) hours from Sydney, three hours (3) from Dubbo, two (2) hours from Tamworth and 90 minutes from Newcastle.

Figure 1: Aerial image of site boundary

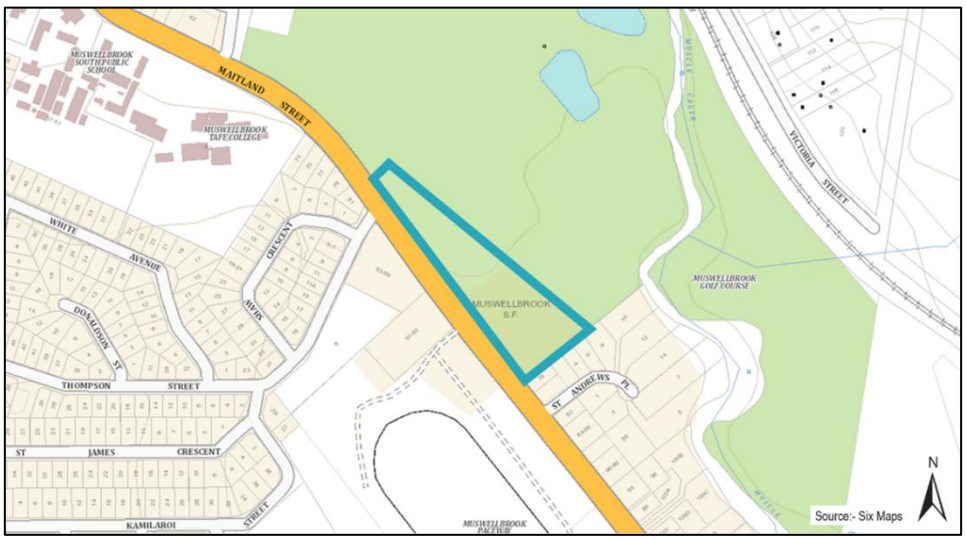


Figure 2: Site Context

At the time of the investigation (7 April 2020) the site was vacant and generally comprised several empty buildings/structures in connection with the previous site use (plant nursery), gravel and asphalt paths, gravel garden beds and grass covering. The south-eastern areas also comprised several mature trees along and adjacent to the site boundaries and internal gravel paths and gravel areas covered in weed matting presumably used as display beds when the previous nursery was in operation .

The north-western portion of the site was unfenced and appeared to be undeveloped comprising abundant mature trees and vegetated ground cover.

The site is relatively flat, sloping down gently to the north and east. Although some areas of the site are developed with hardstands (bitumen wearing course, concrete slabs) no formal surface or subsurface drainage was observed. Boggy areas due to recent rainfall were observed around Pits 410 and 503, however no salt crusting or vegetation die off was observed.

The site identified as Lot 100, DP1261496, Maitland Street, Muswellbrook, NSW, is also shown in Drawing 1, Appendix C.

3. Review of Mapping

3.1 Geology and Hydrogeology

Reference to the 1:100,000 Hunter Coalfields Geology Sheets indicates that the majority of the site is underlain by Quaternary alluvium deposits which typically comprise gravel, sand, silt and clay and the north-western portion is underlain by the Branxton Formation typically comprising conglomerate, sandstone, siltstone.

3.2 Soil Landscape and Acid Sulfate Soil Mapping

Reference to the 1:250,000 Singleton Soil Landscapes Sheet indicates that the site is underlain by alluvial soils of the Hunter soil landscape, and close to a boundary (at the north-western tip of the site) with an area underlain by residual soils of Roxburgh soil landscape.

Reference to the Acid Sulphate Soil Risk Map, prepared by the Department of Land and Water Conservation (DLWC) indicates the site is not mapped within an area known to comprise acid sulfate soils.

3.3 Hydrogeology

The regional groundwater flow regime is believed to the north and north-east towards Muscle Creek (located approximately 350 m north of the site). Groundwater has previously been encountered at a depth of around 6 m below the site (DP 2019). It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

3.4 Salinity Mapping

Reference to the NSW Central Resource for Sharing and Enabling Environmental Data (SEED) information system eSPADE indicates that soils in the surrounding area have shown no salting evident within available soil profiles.

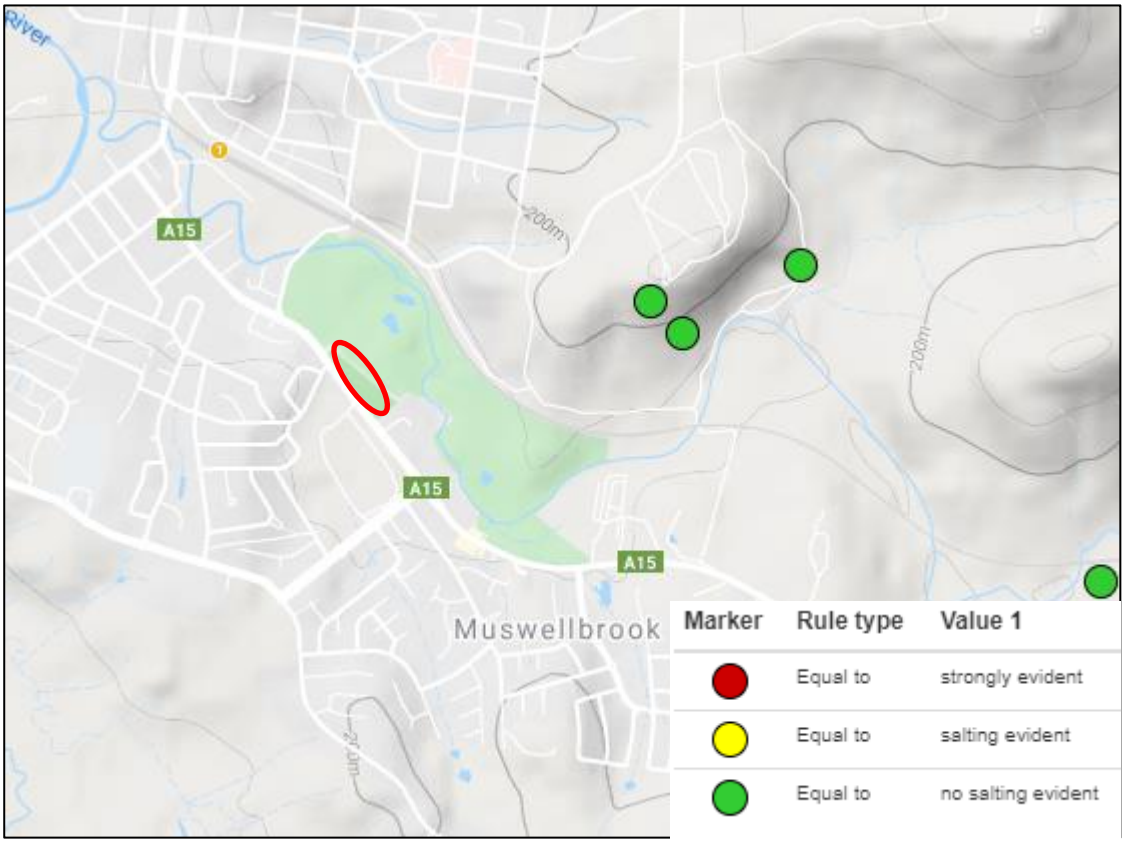


Figure 3: Soil profiles with salinity potential with approximate site location (red outline)

The following figures from eSPADE show modelled soil properties for soils from surface to 0.3 m (left) and 0.3 m to 1 m (right) for Cation exchange capacity (CEC), electrical conductivity (EC) and exchangeable sodium percentage (ESP).

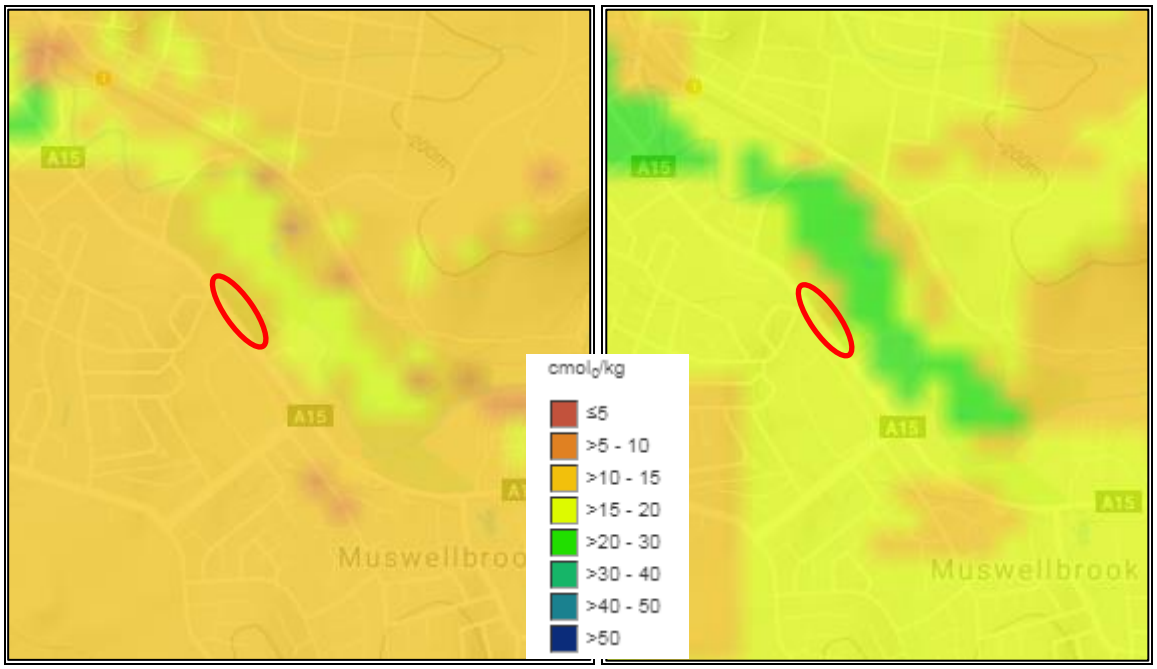


Figure 4: Modelled cation exchange capacity with approximate site location (red outline)

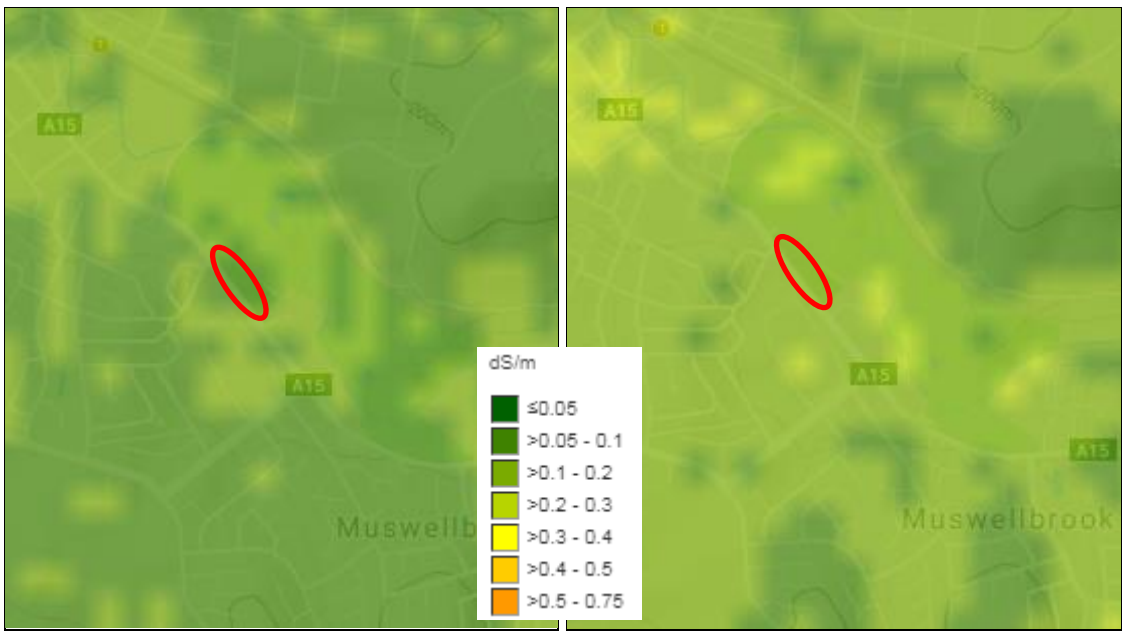


Figure 5: Modelled electrical conductivity with approximate site location (red outline)

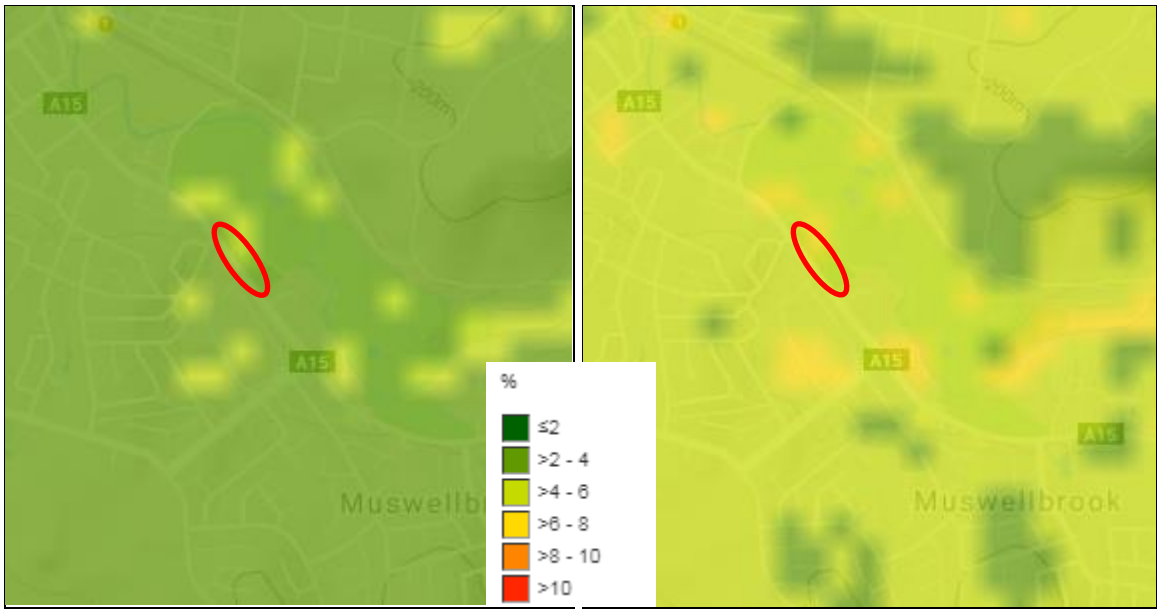


Figure 6: Modelled exchangeable sodium percentage with approximate site location (red outline)

4. Background

DP carried out a Detailed Site Investigation (for Contamination) in 2019 (DP 2019) which included excavation of 16 test pits (Pits 101 to 116) to depths of up to 1.5 m, drilling of two bores to depths of up to 10 m (Bores 201 and 202) and subsequent installation of groundwater monitoring wells. The test pit and bore logs are included in Appendix A.

The test pits encountered variable fill to depths of up to 0.5 m, underlain by silty clay and clayey silt to the termination depth of 1.5 m. Below this depth, the bores encountered a sand and gravel layer from 2.1 m to 6.6 m, underlain by clay to the termination depth.

Groundwater was encountered at depths of 6.3 m to 6.4 m in Bores 201 and 202 respectively. The pH was recorded at 7 pH units in both wells, while EC ranged from 2660 to 16100 µS/cm.

A preliminary contamination assessment was also carried out by J K Environmental in April 2019 (JK 2019) which comprised a site history review, drilling of 20 boreholes, sampling and laboratory testing. The results of the investigation were generally commensurate with DP (2019). The logs are included in Appendix A.

5. Field Work Methods

Field work was conducted on 7 April 2020 and comprised the following:

- Checking for underground services at proposed pit locations by a professional service locator prior to drilling;

- Excavation of 14 test pits (Pits 401 to 413 and 106A) to depths of 0.5 m to 2.85 m using a small excavator, for the primary purpose of contamination assessment (DP 2020);
- Excavation of three test pits (Pits 501 to 503) to depths ranging from 2.5 m to 3.0 m, targeting proposed structures, for the purposed of geotechnical investigation;
- Dynamic cone penetrometer (DCP) testing at Pits 112, 114, 405, 410 and 501 to 503 and Bores 201 to 202 to depths ranging from 0.6 m to 2.1 m. It is noted that Bores 201 and 202 were undertaken during DP, 2019;
- Logging of the soil profile at each location and collection of soil samples for geotechnical and contamination testing purposes.

The test locations were set out by an environmental engineer from DP who also logged the subsurface profile in the bores/pits and collected samples for identification and laboratory testing purposes. The test locations were surveyed using a hand-held GPS with a typical accuracy of ±10 m, depending on satellite coverage. Coordinates and RLs are recorded on the logs in Appendix A. The approximate locations of the tests are shown on Drawing 1, Appendix C.

6. Field Work Results

The subsurface conditions are presented in detail in the test pit logs, Appendix A. These should be read in conjunction with the general notes preceding them, which explain definitions of the classification methods and descriptive terms. Subsurface conditions encountered across the site have been summarised into geotechnical units and are presented in Table 1.

Table 1: Summary of Test Pit Results

Unit		Depth (m)		Stratum	Description
		From	To		
Unit 1	Unit 1.1	Surface (0.0)	0.03 / 0.1	WEARING COURSE	Bituminous spray seal typically 0.05 m thick at all pits with the exception of Pits 406,to 409 409, 501 to 503 and 106A.
	Unit 1.2	Surface (0.0)	0.1 / 0.4	FILL / TOPSOIL	Encountered in Pits 406 to 409, 106A and 502 to 503. Topsoil, or silty sand or sandy silty clay fill, with asphalt lenses in Pits 406 to 409.
	Unit 1.3	0.03 / 0.1	0.1 / 0.15	FILL - Roadbase	Encountered in Pits 402 to 405, 409, 411 to 413. Generally comprising gravelly sand roadbase.
	Unit 1.4	0.05 / 0.15	0.2 / 0.3	FILL – Ash and coal reject	Encountered in 401 to 405, 409 to 412 and 106A. Ash and coal reject gravel fill.
Unit 2	Unit 2.1	0.1 / 0.3	0.5 / 0.8 (LOI)	Silty Clay	Encountered in all pits with exception of Pits 410 and 501 to 502. Low to medium plasticity, pale brown, with some fine grained sand, typically in a firm to stiff condition.
	Unit 2.2	0.1	0.8	Sandy Clay	Encountered in Pits 501 and 502. Medium plasticity, pale brown, typically firm to stiff.
Unit 3		0.3 / 0.8	0.9 / 2.9 (LOI)	Silty Clay	Encountered in Pits 401, 405, 410 and 501 to 503. Medium to high plasticity, brown, typically in a very stiff the hard condition. Sandy bands encountered between 1.8 m and 2.6 m at Pit 501.

The subsurface conditions encountered were generally commensurate with those found in in DP 2019 and JK, 2019.

Groundwater was not encountered during excavation of the test pits. Groundwater was measured in Bores 201 and 202 during the previous investigation (DP, 2019) at depths of 5.9 m and 6.5 m below ground level respectively. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

7. Laboratory Testing

7.1 Geotechnical Testing

Laboratory testing comprised the following:

- Two shrink-swell tests;
- One Atterberg limits test; and
- Two Standard compaction / California bearing ratio (CBR) tests.

The detailed results are attached in Appendix B and are summarised in Table 2 and Table 3 below.

Table 2: Results of Laboratory Testing - CBR

Pit	Depth (m)	Description	FMC (%)	SOMC (%)	SMDD (t/m^3)	CBR (%)	Swell (%)
501	0.3 – 0.6	Sandy Clay	20.2	22.5	1.60	2.0	3.0
501	1.0 – 1.3	Silty Clay	18.0	22.5	1.61	4.5	1.5

Notes to Table 2:

FMC - Field moisture content SOMC - Standard optimum moisture content

SMDD - Standard maximum dry density CBR - California bearing ratio (4 day soaked)

Table 3: Laboratory Test Results - Shrink Swell and Atterberg Limits

Pit	Depth (m)	Description	FMC (%)	Pocket Penetrometer Reading (kPa)		Iss (%per ΔpF)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage
				Before Test	After Test					
410	0.3 – 0.75	Silty Clay	25.4	210	160	4.1	-	-	-	-
502	0.5 – 0.95	Sandy Clay	18.6	600	215	4.5	-	-	-	-
405	0.4 – 0.85	Silty Clay with Sand	22.0	-	-	-	56	19	37	16.5

Notes to Table 3:

FMC - Field moisture content Iss - Shrink/Swell Index

7.2 Chemical Testing

Laboratory testing for soil aggressivity and the preliminary assessment of potential salinity at the site was undertaken by Envirolab Services, a National Association of Testing Authorities, Australia (NATA) registered laboratory. Analytical Methods used are shown on the laboratory sheets in Appendix B.

A total of nine soils samples were selected for analysis of a combination of the following suite of analytes:

- pH;
- Electrical Conductivity (EC);
- Chloride (Cl);
- Sulphate (SO_4);
- Exchangeable Sodium Percentage (ESP).

The results of analysis undertaken on soils from the site are presented in the attached laboratory report sheets (Appendix B) and are summarised in Table 4 below.

Table 4: Summary of Chemical Laboratory Results

Pit	Sample Depth	Soil Description	Textural class	Soil pH	EC µS/cm	ESP (%)	SO_4 (mg/kg)	Cl (mg/kg)
402	0.4	Silty Clay – low to med plasticity	Light Clay	7.2	190	-	-	-
405	0.3	Silty Clay - low plasticity	Light Clay	8.3	39	-	-	-
405	1.5	Silty Clay - medium to high plasticity	Medium Clay	8.3	250	9	130	160
410	1.0	Silty clay – high plasticity	Medium Clay	9.1	380	-	-	-
410	2.5	Silty clay – high plasticity	Medium Clay	9.4	250	-	-	-
502	0.5	Sandy Clay – low to medium plasticity	Light Clay	6.4	560	-	-	-
502	1.0	Silty Clay – medium to high plasticity	Medium Clay	8.4	980	5	260	810
503	0.5	Silty Clay – low to med plasticity	Light Clay	8.7	150	-	-	-
503	1.0	Silty Clay –medium to high plasticity	Medium Clay	8.6	990	-	-	-

Notes to Table 4:
- Not Tested
ESP in % CEC in meq/100g
SO_4: Sulphates Cl: Chlorides

8. Proposed Development

Pacific Brook Christian School proposes the staged construction of a new school at 72-74 Maitland Street, Muswellbrook. This will involve site preparation work (including remediation), the removal of 88 trees, civil works, landscaping, and construction works in stages over the next 10 years.

The masterplan will support high-quality educational outcomes to meet the needs of students within the local community as follows:

- Administration building;
- Junior School facilities;
- Middle School facilities;
- Senior School facilities;
- Hope School (special needs) facilities;
- Multi-Purpose Hall;
- Maximum student capacity of 656;
- Maximum 65 staff;
- Agricultural facilities (including maintenance and bus area);
- On-site Parking (65 spaces, inclusive of 2 accessible);
- Tree removal;
- Landscaping;
- Internal infrastructure works;
- Acoustic and safety fence; and
- Vehicular access via Maitland Street.

Stage 1 is proposed together with the staged concept masterplan and consists of:

- Site remediation;
- Removal of 7 trees;
- Facilities for a maximum of 140 students and 16 staff, including:
    - One (1) administration and staff building;
    - One (1) staff and student amenities block; and
    - Six (6) General Learning Areas (GLAs);
- Landscaping;
- Internal infrastructure works; and
- Vehicular access via Maitland Street.

The overall proposed development includes several single and two storey structures over the south-east of the site, as well as a large, at-grade car park in the south-eastern corner.
It is understood that the site is subject to flooding, and as such, the buildings will be constructed on piers in order to minimise earthworks.

9. Comments

9.1 Site Classification

Site classification of foundation soil reactivity provides an indication of the propensity of the ground surface to move with seasonal variations in moisture. The site classification is based on procedures presented in AS 2870-2011 and the results of the geotechnical investigation. It should be noted that the standard footing designs presented in AS 2870 only apply to one and two storey residential structures. Similar principles in design for reactive soil movement, however, should be incorporated into design, construction and maintenance of the proposed development.

Based on the results of the field work and the procedures presented in AS 2870-2011, the site is Class P due to the presence of existing buildings, slabs and stockpiles in the areas of some of the proposed buildings. Abnormal moisture conditions can result in areas where trees and / or existing structures are to be removed. It is recommended that geotechnical inspection be undertaken following demolition of the existing buildings to assess foundation conditions and site classification.

If the structures are removed far enough in advance of house construction (i.e. at least 1 to 2 seasonal cycles), then the provisions for assessing site classification under normal moisture conditions will apply, and the site would be classified as Extremely Reactive – Deep (E-D).

As a guide for footing design, the characteristic surface movement (y_s) is estimated to be up to approximately 90 mm for footings founded in the natural stiff clay, under normal seasonal moisture fluctuations (i.e. not impacted by existing or recently demolished structures) without the influence of trees.

AS 2870-2011 provides guidance and a method to estimate potential surface movements due to tree induced suction change for existing and possible new trees (e.g. extreme drying effects).The estimated additional surface movement due to drying from trees remaining on site, within a distance of 0.5 times the height of the tree, from the buildings is estimated from Appendix H4(e) of AS 2870-2011. Based on DP's experience, it is expected that additional surface movements due to swelling because of removal of trees would be of similar magnitude to that for drying. The effect of additional surface movement from suction change due to the presence of the five trees within close proximity of the proposed buildings, (y_{tmax}), is estimated to be 40 mm. Footings should be designed for the surface movement from suction change due to the presence of trees (y_{tmax}), in addition to the estimated characteristic surface movement (y_s).

The classification is based on the information obtained from test pits, and on the results of laboratory testing, and have involved interpolation between data points. In the event that the conditions encountered during construction are different to those presented in this report, it is recommended that advice be sought from this office.

It should be noted that this classification is dependent on proper site maintenance, which should be carried out in accordance with the attached CSIRO Sheet BTF 18 and Appendix B of AS2870-2011.

9.2 Foundations

The anticipated loads of the proposed single and two-storey buildings should be supported by shallow pads or piles founded in natural clay soils. Footings should not be founded on uncontrolled fill. Shallow footings should be proportioned based on the design values given in Table 5.

Table 5: Design Parameters for Shallow Footings

Indicative Depth Range (m)		Description	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion[1] (kPa)
From	To			
0	0.1 – 0.4	Unit 1 - Fill	NA	NA
0.1 – 0.4	0.8	Unit 2 - Firm to Stiff Silty / Sandy Clay	NA	NA
0.8	2.5	Unit 3 - Very Stiff to Hard Silty Clay	150	20

Notes to Table 5:

1. For piles in tension / uplift. Shaft adhesion should be ignored to over the first 1.0 m of the soil profile

NA – not applicable

Footings proportioned for uplift loads should ignore the first 1.0 m of the soil profile to allow for the impacts of shrinkage around the footings during dry conditions.

Some sand / gravel layers were encountered in the eastern area of the site (Bores 201 and 202, DP 2019) however has not been encountered elsewhere. Groundwater has also been recorded well below the anticipated base of footings. As such, no collapsing soils are anticipated, and conventional bored piles are anticipated to be suitable for the project.

9.3 Soil Aggressiveness

The results of laboratory testing of soil samples collected during field work have been compared to the exposure classifications for steel and concrete as outlined in AS 2159:2009. The following table summarises the exposure classifications for each of the samples tested.

Table 6: Aggressivity Classification to AS2159

Test Location		Soil Type (A or B)	Classification for Concrete	Classification for Steel
Pit	Depth (m)			
405	1.5	B	Non-aggressive	Non-aggressive
502	1.0	B	Non-aggressive	Mildly aggressive

Notes to Table 6:

Soil Type A: High permeability soils (e.g. sands and gravels) which are in groundwater

Soil Type B: Low permeability soils (e.g. silts and clays) or all soils above groundwater

Reference should be made to Tables 6.4.3 of AS 2159:2009 to determine the minimum concrete cover to reinforcement required (for concrete piles), based on this exposure classification and the minimum concrete strength appropriate for the indicated site conditions.

9.4 Salinity

The results of the desktop assessment indicated the following with respect to potential soil salinity at the site:

- The NSW eSPADE website indicated the following:
  - Absence of mapped dryland or urban salinity indicators or salinity hazards across the site;
  - Low modelled cation exchange capacity <20 $cmol_0/kg$, which is indicative of non-sodic soils;
  - Low modelled electrical conductivity of <0.2 dS/m which is indicative of non-saline conditions (DLWC, 2002); and
  - Modelled exchangeable sodium percentage of between 2% and 8% which is indicative of non-sodic to slightly sodic soils.
- No obvious indicators of salinity (e.g. salt scalds, plant distress) were observed during previous site inspections.

The results of EC testing are summarised in Table 7, below, and are compared against the thresholds presented in DLWC (2002).

Table 7: Summary of Salinity Classification based on EC testing

Pit	Sample Depth	Soil Description	Ece (dS/m)	Soil Salinity Class
402	0.4	Silty Clay – low to med plasticity	1.6	Non-saline
405	0.3	Silty Clay - low plasticity	0.3	Non-Saline
405	1.5	Silty Clay - medium to high plasticity	1.8	Non-Saline
410	1.0	Silty clay – high plasticity	2.7	Slightly Saline
410	2.5	Silty clay – high plasticity	1.8	Non-Saline
502	0.5	Sandy Clay – medium plasticity	4.8	Moderately Saline
502	1.0	Silty Clay – medium to high plasticity	6.4	Moderately Saline
503	0.5	Silty Clay – low to med plasticity	1.3	Non-Saline
503	1.0	Silty Clay –medium to high plasticity	6.9	Moderately Saline

Notes to Table 7:

Saline Class (DLWC, 2002)
non-saline <2 dS/m
slightly saline 2-4 dS/m
Moderately saline 4-8 dS/m
very saline 8-16 dS/m
Highly saline >16 dS/m

A review of available mapping and soil property modelling indicates a low risk profile for salinity at the site, however based on the above laboratory test results, there is some risk of salinity, with four out of nine samples returning EC values in the slightly to moderately saline range. These results appear to be associated with high plasticity clay and sandy clay encountered in the western and southern areas of the proposed development.

Based on the results of laboratory testing, it is recommended that design and construction should be undertaken with respect to good practices as detailed in DLWC (2002) and the Building Code of Australia (BCA) to minimise the potential for saline impact to occur. Good practices are primarily based on reducing moisture ingress from rising/falling damp, condensation or inadequate site drainage. In this regard, the proposed construction methods (i.e. buildings on piers) will make these practices readily achievable. Typical construction practices include:

- Use of exposure class bricks and suitable mortars, with no raking;
- Select a higher strength or sulphate resistant concrete. Higher strength concretes are less permeable and therefore less susceptible to water ingress;
- Concrete cover should be suitable for exposure the classification (refer Section 9.3);
- Correctly installing a damp-proof course or equivalent within each building;
- Protect concrete from excessive water loss during curing;
- Providing adequate floor ventilation beneath buildings if they are constructed on bearers and joists;
- Maintaining the natural water balance and maintaining good drainage to prevent rises in ground water levels;
- Maintaining good drainage and minimising excessive infiltration;
- Ensuring that paths which are provided around buildings slope away from the building;
- Careful design of landscaping and landscape watering methods;
- Adequate drainage provided behind retaining walls; and
- Regular monitoring of pipes, etc. for leaks.

It is noted that most of the above features are consistent with the guidelines AS 2870 (2011) for standard non-saline sites.

9.5 Pavements

9.5.1 Subgrade

The results of laboratory testing on the expected silty / sandy clay subgrade indicate a soaked CBR in the range 2.0% to 4.5%. Samples were typically dry of optimum when subject to testing. It is noted that up to 3% swelling occurred in the samples during the soaking phase of testing. This is indicative of highly expansive subgrade conditions.

Given the presence of clay which is susceptible to softening when wet, the relatively low CBR test results and considering the expansive nature of the subgrade, it is suggested that a select subgrade layer is included in the pavement design.

Geotechnical inspections must be undertaken during excavation / construction to confirm subgrade conditions.

9.5.2 Design Traffic Loading

The proposed carpark pavement has been assessed / designed with reference to engineering guidelines presented in AUS-SPEC 0042 which have been adopted by Muswellbrook Shire Council.

Based on the recommended minimum design life of 25 years, and a capacity of 80 cars, a design traffic load of 4 x 10^5 Equivalent Standard Axels (ESA) has been adopted. It has been assumed that the roadway will not be used for kiss-and-drop.

In the event that a different design life / capacity is required, the pavement thickness designs presented in this report should be revised. Further the above traffic loadings should be reviewed as more detailed information on traffic loading becomes available. In particular, the likely number and types of trucks should be confirmed to assess the suitability of the suggested pavement thickness.

9.5.3 Pavement Thickness Design

The recommended flexible pavement thickness design is presented in Table 8 below and is based on AUS-SPEC 0042.

Given the relatively low results of CBR testing, and the susceptibility of the clay subgrades to weaken when exposed, a select subgrade of at least 250 mm is recommended. Where weak / wet heaving zones are encountered during pavement construction, a thicker layer of select material may be required.

Table 8: Pavement Thickness Design – Design Traffic = 4 x 10^5 ESA

Pavement Layer	Thickness (mm)
Wearing Course	Two coat spray seal or 30 mm AC (1)
Basecourse	150
Subbase	310(3)
Select Subgrade	250
Subgrade	CBR≥2.0%
Total (2)	460 + Select

Notes to Table 8:

1. A primer seal should be placed over the basecourse material prior to the AC wearing course.
2. Minimum total thickness, does not include wearing course or select subgrade.
3. Where an asphaltic wearing course is provided, the subbase can be reduced by the thickness of the AC up to a maximum of 25 mm.

The pavement thicknesses presented above are dependent on the provision and maintenance of adequate surface and subsurface drainage.

9.5.4 Material Quality and Compaction Requirements

Material quality and compaction requirements for the pavements are shown in Table 9 below.

Table 9: Material Quality and Compaction Requirements

Pavement Layer	Material Quality	Compaction Requirements
Basecourse	DGB20 or equivalent as per AUS-SPEC 1141, 2012)	Compact to at least 98% dry density ratio Modified AS1289.5.1.1.
Subbase	DGS20 or equivalent as per AUS-SPEC 1141, 2012)	Compact to at least 95% dry density ratio Modified AS1289.5.1.1.
Select Subgrade	Minimum soaked CBR≥15	Compact to at least 100% dry density ratio Standard AS1289.5.1.1
Subgrade	Minimum soaked CBR ≥2%	Compact to at least 100% dry density ratio Standard AS1289.5.1.1.

9.6 Site Preparation

The following general earthworks procedures are recommended for the preparation of pavement and building (where required) subgrades:

- Excavate to design subgrade level taking into account the need for a select material layer for pavements;
- Remove any fill (if encountered), organic topsoil, firm clay or other deleterious material;
- The stripped surface should be left exposed for a minimum of time prior to placement of fill and pavement. Poor trafficability will result if the stripped surface is exposed to wet weather due to the presence (in areas) of silty clay layers;
- Proof roll the surface using a medium sized smooth drum roller to assess the presence of any weak/wet areas. It is recommended that a geotechnical inspection be undertaken to assess the requirements and thickness of select material to be used at the base of the pavement to facilitate compaction of the overlying materials, if weak subgrade soils are encountered;
- Pavement select subgrade materials should be placed in layers not exceeding 250 mm loose thickness and compact to at least 100% dry density ratio Standard, at a moisture range from OMC -4% dry to OMC;
- Compact subgrade to:
  - Pavements - at least 100% dry density ratio Standard (AS 1289.5.1.1), at a moisture range from OMC -4% dry to OMC; and
  - Building areas – between 98% and 103% dry density ratio Standard (AS 1289.5.1.1) at a moisture range from OMC -2% dry to 2% to OMC;
- Engineered fill for general site filling should be placed in horizontal layers of not greater than 300 mm loose thickness and compacted to at least 95% Standard dry density ratio, at a moisture range of ±2% of OMC.

Subgrade preparation should be subject to geotechnical inspection and testing by DP as defined in AS 3798:2007.

10. References

AS 2870:2011, *Residential Slabs and Footings*, Standards Australia.

AS 3798:2007, *Guidelines on Earthworks for Commercial & Residential Development,* Standard Australia.

AS1289.5.1.1. (2003). *Australian Standard AS1289.5.1.1 "Methods of testing soils for engineering purposes".* Standards Australia.

AUS-SPEC 0042, *Development Design Specification, Pavement Design*, Rev 2 Muswellbrook Shire Council 2013.

Austroads (2017), *Guide to Pavement Technology, Part 2: Pavement Structural Design, AGPT02-17:2017*, Austroads.

CCAA (2008), *Technical Note 61, Articulated Walling*, Cement Concrete & Aggregates Australia.

DLWC (2002), *Site Investigations for Urban Salinity,* Local Government Salinity Initiative, Department of Land and Water Conservation, dated 2002.

DP (2019), *Detailed Site Investigation (Contamination), Lot 62 Maitland Street, Muswellbrook,* Report 91601.00.00.R.001.Rev0, dated July 2019, Douglas Partners Pty Ltd.

J K Environments (2019), *Preliminary Contamination Assessment, Lot 62, Maitland Street, Muswellbrook, NSW*, date 30 April 2019.

11. Limitations

Douglas Partners (DP) has prepared this report for this project at Lot 100, DP1261496, Maitland Street, Muswellbrook, NSW with reference to DP's proposal NCL200187 dated 27 March 2020 and acceptance received from Pacific Brook Christian School Ltd dated 3 April 2020. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Pacific Brook Christian School 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. 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.

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 for 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 filling 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 filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

CSIRO Sheet BTF 18
About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Borehole Logs (201 to 202)
Test Pit Logs (101 to 401 to 413, 501 to 503)
JK Borehole Logs (Bores 1 to 20)
Results of Dynamic Penetrometer Testing

Foundation Maintenance and Footing Performance: A Homeowner's Guide

PUBLISHING

BTF 18-2011
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

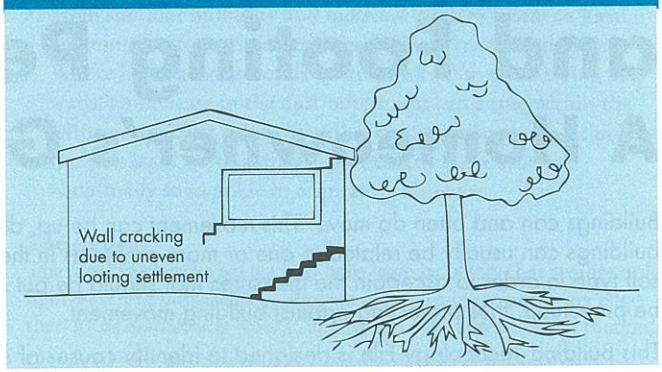
The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Trees can cause shrinkage and damage



Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

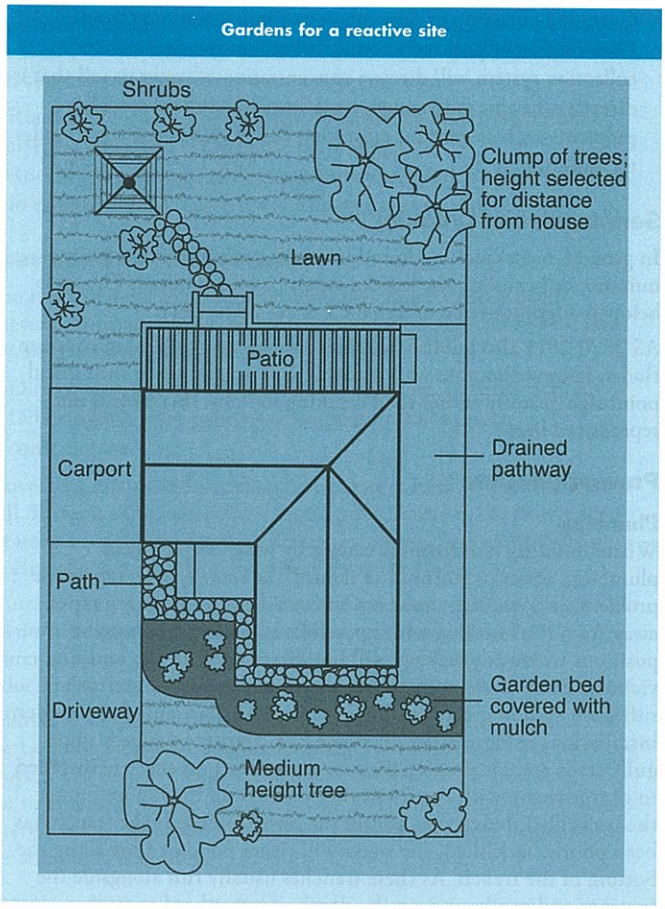
It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

Distributed by

CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au

About this Report

Douglas Partners

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.

About this Report

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.

Sampling Methods

Douglas Partners

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

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

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

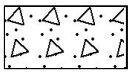
Symbols & Abbreviations

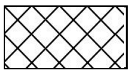
Graphic Symbols for Soil and Rock

General

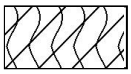

Asphalt

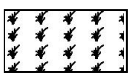

Road base

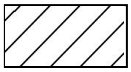

Concrete

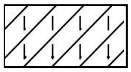

Filling

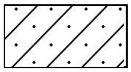
Soils


Topsoil

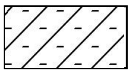

Peat

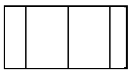

Clay

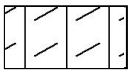

Silty clay

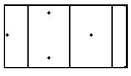

Sandy clay

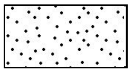

Gravelly clay

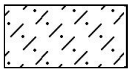

Shaly clay

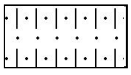

Silt


Clayey silt


Sandy silt

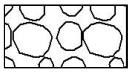

Sand

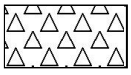

Clayey sand


Silty sand


Gravel

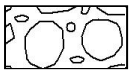

Sandy gravel


Cobbles, boulders

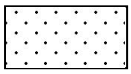

Talus

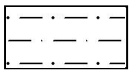
Sedimentary Rocks

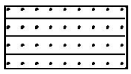

Boulder conglomerate

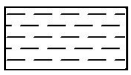

Conglomerate


Conglomeratic sandstone

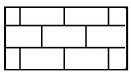

Sandstone


Siltstone

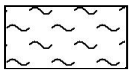

Laminite

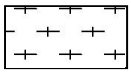

Mudstone, claystone, shale

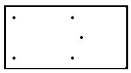

Coal


Limestone

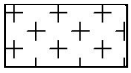
Metamorphic Rocks

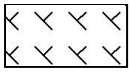

Slate, phyllite, schist

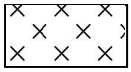

Gneiss

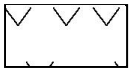

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301989
NORTHING: 6426905
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	TOPSOIL - Brown clayey silt topsoil with trace rootlets		D	0.2	E			Stickup = 1m From 0m to 0.1m, bentonite plug
	0.3	SILTY CLAY - Very stiff brown silty clay, M<Wp		D	0.5	E			
	1	At 0.9m some fine sized gravel From 1.0m dark brown		D	1.0	E			
				D	1.5	E			From 0.1m to 3m, backfill
	2			D	2.0	E			From 0m to 4m, 50mm diameter Class 18 PVC blank casing
	2.1	SANDY GRAVEL - (Loose) brown fine to medium grained sandy fine to coarse sized gravel, dry							
	2.3	CLAY - (Stiff) brown clay with trace fine grained sand, M<Wp		D	2.5	E			
	3			D	3.0	E			From 3m to 3.5m, bentonite plug
	3.4	CLAYEY SAND - (Medium dense) brown clayey fine grained sand, with trace fine sized gravel		D	3.5	E			
	4			D	4.0	E			
				D	4.5	E			
	5			D	5.0	E			From 3.5m to 7m, gravel From 4m to 7m, 50mm diameter Class 18 PVC machine slotted screen
				D	5.5	E			
	5.7	CLAY - (Stiff) pale grey mottled orange brown clay, M<Wp							
	6			D	6.0	E			
				D	6.5	E			
	7			D	7.0	E			End cap at 7m
	7.2	Bore discontinued at 7.2m, refusal							
	8								
	9								

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Lambert **CASING:** Nil
TYPE OF BORING: Push tube rig
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 302015
NORTHING: 6426934
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	TOPSOIL - Brown clayey silt topsoil with some rootlets		D	0.2	E			Stickup = 0.6m From 0m to 0.1m, bentonite plug
	0.3	SILTY CLAY - (Very stiff) brown silty clay, M<Wp		D	0.5	E			
	1			D	1.0	E			From 0.1m to 2.4m, backfill
				D	1.5	E			
	2			D	2.0	E			From 0m to 3.8m, 50mm diameter Class 18 PVC blank casing
		From 2.5m trace fine sized gravel		D	2.5	E			From 2.4m to 3m, bentonite plug
	2.9	SANDY GRAVEL - (Medium dense) fine to medium grained sandy fine to coarse sized gravel, moist		D	3.0	E			
	3			D	3.5	E			
	4			D	4.0	E			
				D	4.5	E			
	5			D	5.0	E			
				D	5.5	E			
	6			D	6.0	E			
	6.6	CLAY - (Stiff) ple grey mottled orange brown clay, with trace fine sized gravel, M<Wp		D	6.5	E			From 3m to 9.8m, 5mm washed sand
	7			D	7.0	E			From 3.8 to 9.8m, 50mm diameter Class 18 PVC machine slotted screen
		From 7.4m brown		D	7.5	E			
	8			D	8.0	E			
				D	8.5	E			
	9			D	9.0	E			
				D	9.5	E			End cap at 9.8m
	10.0			D	10.0	E			

Bore discontinued at 10.0m, limit of investigation

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Lambert **CASING:** Nil

TYPE OF BORING: Auger (TC)

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301973
NORTHING: 6426907

PIT No: 101
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.1	FILLING - Generally comprising pale brown sandy silty topsoil filling, trace rootlets and fine subangular gravel, dry							
		SILTY CLAY - Medium plasticity pale brown silty clay, trace fine gravel, w>PL		D	0.2	E	PID<1		
		From 0.4m red brown silty clay w>PL		D	0.6	E	PID<1		
1	1.0	Pit discontinued at 1.0m, limit of investigtion							1
2									2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301983
NORTHING: 6426951

PIT No: 102
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING - Generally comprising brown sandy silty filling, trace fine gravel and some rootlets, dry		D	0.05	E	PID<1		
		CLAYEY SILT - Medium to low plasticity pale grey and brown w<PL		D	0.3	E	PID<1		
	0.4	SILTY CLAY - Medium to high plastcity brown and red with rootlets, w>PL		D	0.7	E	PID<1		
	1.0	Pit discontinued at 1.0m, limit of investigtion							

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 302001
NORTHING: 6426950

PIT No: 103
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.1	FILLING - Generally comprising dark brown sandy silty topsoil filling with ash, and some rootlets, dry		D	0.05	E	PID<1		
		SILTY CLAY - Medium plasticity, pale brown, w<PL		D	0.3	E	PID<1		
		From 0.6m dark brown silty clay		D	0.7	E	PID<1		
1	1.0	Pit discontinued at 1.0m, limit of investigtion							1
2									2

RIG: 6.5 tonne excavator with 450mm bucket teeth
LOGGED: Sebastian
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 302021
NORTHING: 6426911

PIT No: 104
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING - Generally comprising brown sandy silty filling, trace fine gravel and some rootlets, dry		D	0.05	E	PID<1		
		CLAYEY SILT - Medium to low plasticity pale grey and brown w<PL		D	0.3	E	PID<1		
	0.5	SILTY CLAY - Medium plasticity brown silt trace rootlets, w>PL		D	1.0	E	PID<1		
	1.2	Pit discontinued at 1.2m, limit of investigtion							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1; 2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301999
NORTHING: 6426982

PIT No: 105
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising brown subrounded and subangular gravelly silty sand filling, dry		D	0.1	E	PID<1		
	0.2	CLAYEY SILT - Medium to low plasticity pale grey and brown w<PL		D	0.5	E	PID<1		
	0.6	SILTY CLAY - Medium to high plasticity brown and red with rootlets, w>PL		D	1.0	E	PID<1		1
	1								
	1.2	Pit discontinued at 1.2m, limit of investigtion							
	2								2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301930
NORTHING: 6426981

PIT No: 106
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising brown gravelly silty sand filling with clay, dry		D	0.1	E	PID<1		
		From 0.25m to 0.28m asphalt lens		D	0.26	E	PID<1		
		From 0.35m to 0.37m asphalt lens							
	0.4	CLAYEY SILT - Medium to low plasticity pale grey and brown w<PL		D	0.5	E	PID<1		
	0.6	SILTY CLAY - Medium plasticity, dark brown, w>PL							
	1								1
	1.2	Pit discontinued at 1.2m, limit of investigtion		D	1.2	E	PID<1		
	2								2

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301964
NORTHING: 6426981

PIT No: 107
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising silty sand sub base filling, trace coal, dry		D	0.1	E	PID<1		
		From 0.2m dark grey ash lens		D	0.22	E	PID<1		
	0.25	SILTY CLAY - Low plasticity, brown, w<PL							
		From 0.5m brown mottled red, w>PL		D	0.6	E	PID<1		
	1 1.0	Pit discontinued at 1.0m, limit of investigtion							1
	2								2

5 10 15 20

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301909
NORTHING: 6427013

PIT No: 108
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising brown fine to medium grained sand filling, trace fine gravel and silt, dry		D	0.3	E	PID<1		
	0.5	SILTY CLAY - Medium plasticity brown bottled red, w>PL		D	0.8	E	PID<1		
	1								1
	1.2	Pit discontinued at 1.2m, limit of investigtion							
	2								2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301926
NORTHING: 6427025

PIT No: 109
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising brown sandy silt filling with subrounded gravel, dry		D	0.3	E	PID<1		
	0.4	SILTY CLAY - Medium plasticity, brown, w>PL		D	1.0	E	PID<1		
				D	1.4	E	PID<1		
	1.5	Pit discontinued at 1.5m, limit of investigtion							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301901
NORTHING: 6426995

PIT No: 110
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Brown sandy silt filling with subrounded gravel, dry		D	0.1	E	PID<1		
	0.2	SILTY CLAY - Low plasticity, pale brown, w<PL		D	0.4	E	PID<1		
		From 0.6m dark brown silty clay, w>PL							
	1.0	Pit discontinued at 1.0m, limit of investigtion							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1; 2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301996
NORTHING: 6426991

PIT No: 111
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising sandy silty topsoil with, some general refuse and ACM fragments on surface, ash lens from 0.2m to 0.21m		D	0.0	E	PID<1		
	0.2	CLAYEY SILT - Low plasticity, pale brown and grey, w<PL			0.1				
	0.4	Pit discontinued at 0.4m, limit of investigtion							
	1								
	2								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301837
NORTHING: 6427065

PIT No: 112
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING - Generally comprising sandy silty topsoil filling, with subrounded to subangular gravel, rootlets, W<PL		D	0.05	E	PID<1		
		FILLING - Generally comprising brown silty fine grained gravel, dry		D	0.3	E	PID<1		
	0.5	SILTY CLAY - Medium plasticity, brown, w>PL		D	0.7	E	PID<1		
	0.8	Pit discontinued at 0.8m, limit of investigtion							
	1								1
	2								2

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301888
NORTHING: 6427052

PIT No: 113
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	SILTY TOPSOIL - Brown with rootlets, w<PL		D	0.05	E	PID<1		
		SILTY CLAY - Medium plasticity, brown, w>PL							
				D	0.4	E	PID<1		
	0.5	Pit discontinued at 0.5m, limit of investigtion							
	1								1
	2								2

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301827
NORTHING: 6427073

PIT No: 114
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.1	SANDY SILTY TOPSOIL - Brown with rootlets, W<PL		D	0.05	E	PID<1		
		CLAYEY SILT - Low plasticity, pale brown, w<PL		D	0.3	E	PID<1		
	0.4	SILTY CLAY - Medium plasticity, brown mottled red, w>PL							
	0.6	Pit discontinued at 0.6m, limit of investigtion							
	1								1
	2								2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301782
NORTHING: 6427121

PIT No: 115
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.1	SANDY SILTY TOPSOIL - Brown with rootlets, w<PL		D	0.05	E	PID<1		
		CLAYEY SILT - Low plasticity, pale brown, w<PL		D	0.3	E	PID<1		
	0.4	SILTY CLAY - Medium plasticity, brown mottled red, w>PL							
	0.5	Pit discontinued at 0.5m, limit of investigtion							
	1								1
	2								2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Detailed Site Investigation
LOCATION: Lot 100 DP 1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301777
NORTHING: 6427160

PIT No: 116
PROJECT No: 91601.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.1	FILLING - Generally comprising silty sandy clay, trace metal, w<PL		D	0.05	E	PID<1		
		SILTY CLAY - Medium plasticity, brown and red, w<PL		D	0.3	E	PID<1		
	0.4	Pit discontinued at 0.4m, limit of investigtion							
	1								1
	2								2

RIG: 6.5 tonne excavator with 450mm bucket teeth

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301967
NORTHING: 6426916.7

PIT No: 401
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.1	ASPHALT		D	0.05	E	PID<1		
	0.2	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist		D	0.15	E	PID<1		
		SILTY CLAY - Low plasticity pale brown, M<WP		D	0.25 0.3	B	pp = 350		
					0.4		PID<1		
		From 0.6m, medium plasticity and brown M>WP, very stiff			0.8		pp = 350-400		
	0.9	Pit discontinued at 0.9m, limit of investigation							
	1								1
	2								2
	3								3
	4								4

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301959.7
NORTHING: 6426923.2

PIT No: 402
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	ASPHALT		D	0.01	E	PID<1		
	0.15	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.17	E	PID<1		
	0.2	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist		D	0.4	E	PID<1		
		SILTY CLAY - Medium plasticity, pale brown, M>WP							
	0.8	Pit discontinued at 0.8m, limit of investigation							
	1								
	2								
	3								
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)
LOGGED: Sebastian
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301942
NORTHING: 6426943

PIT No: 403
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	ASPHALT		D	0.01	E	PID<1		
	0.1	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.2	E	PID<1		
	0.3	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist		D	0.4	E	PID<1		
	0.5	SILTY CLAY - Medium plasticity, pale brown, M>WP							
		Pit discontinued at 0.5m, limit of investigation							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

1
2
3
4

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301998
NORTHING: 6426955

PIT No: 404
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	ASPHALT							
	0.1	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.2	E	PID<1		
	0.25	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist							
		SILTY CLAY - Medium plasticity, pale brown with fine sand, M>WP							
	0.8	Pit discontinued at 0.8m, limit of investigation							
	1								
	2								
	3								
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)
LOGGED: Sebastian
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301984.2
NORTHING: 6426979.9

PIT No: 405
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.03	ASPHALT							
	0.15	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.2	E	PID<1		
	0.25			D	0.3				
		FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist			0.4		pp = 200		
		SILTY CLAY - Low plasticity, pale brown, some fine grained sand and rootlets		U					
	0.8	SILTY CLAY - Medium plasticity, brown, very stiff to hard M<WP			0.8 0.85		pp >400		
				D	1.5		pp >400		
		From 2.3m, with sandy clay and gravel		D	2.3				
				D	2.5				
	2.85	Pit discontinued at 2.85m, limit of investigation							

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301987.1
NORTHING: 6426982.7

PIT No: 406
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.3	FILL / SILTY SAND - Fine to medium grained, brown with gravel, clay and trace rootlets, moist							
	0.4	FILL - Dark grey, asphaltic lens		D	0.35	E	PID<1		
	0.7	SILTY CLAY - Pale brown, low plasticity, with some fine grained sand, M<WP							
	1	Pit discontinued at 0.7m, limit of investigation							
	2								
	3								
	4								

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301998.5
NORTHING: 6426958.9

PIT No: 407
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILL / SILTY SAND - Brown, fine to medium grained, brown with gravel, clay and trace rootlets, moist							
		From 0.25m to 0.3m, asphaltic lens, asphaltic lens only on northern pit wall		D	0.28	E	PID<1		
	0.37	SILTY CLAY - Pale brown, low plasticity, with some fine grained sand, M<WP							
	0.6	Pit discontinued at 0.6m, limit of investigation							
	1								1
	2								2
	3								3
	4								4

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)
LOGGED: Sebastian
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301986.1
NORTHING: 6426985.3

PIT No: 408
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL / SILTY SAND - fine to medium grained with gravel and clay, moist		D	0.21	E	PID<1		
		From 0.2m to 0.22m, trace asphaltic lens on south western corner of pit							
	0.3	SILTY CLAY - Pale brown, low plasticity, with some fine grained sand , M<WP							
	0.5	Pit discontinued at 0.5m, limit of investigation							
	1								
	2								
	3								
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)
LOGGED: Sebastian
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Little sample recovery in 0.21m sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301976.2
NORTHING: 6426996.7

PIT No: 409
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	FILL / SILTY SAND - FIne to coarse grained, brown, moist		D	0.08	E	PID<1		
	0.1								
	0.15	FILL - Dark grey, asphaltic lens		D	0.2	E	PID<1		
	0.3	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist							
	0.5	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist							
		SILTY CLAY - Pale brown, low plasticity, with some fine grained sand, M<WP							
	1	Pit discontinued at 0.5m, limit of investigation							
	2								
	3								
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301949
NORTHING: 6426978

PIT No: 410
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.05	ASPHALT							
	0.25	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist		D	0.2	E	PID<1		
		SILTY CLAY - Medium to high plasticity, brown, trace roots, M≥WP, firm to stiff			0.3		pp = 200		
				U					
		From 0.6m, very stiff			0.75				
	1			D	1.0	E	PID<1		
					1.8		pp = 200-300		
	2	From 2.0m, trace gravel							
				D	2.5	E	pp = 200-300 PID<1		
	2.7	Pit discontinued at 2.7m, limit of investigation							
	3								
	4								

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301416
NORTHING: 6426933

PIT No: 411
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	ASPHALT		D	0.01	E	PID<1		
	0.1	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.2	E	PID<1		
	0.3	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist							
	0.5	SILTY CLAY - Medium plasticity, pale brown, M>WP							
		Pit discontinued at 0.5m, limit of investigation							
	1								
	2								
	3								
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)
LOGGED: Sebastian
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301911
NORTHING: 6426984

PIT No: 412
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	ASPHALT		D	0.01	E	PID<1		
	0.1	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.15	E	PID<1		
	0.2	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist							
	0.5	SILTY CLAY - Medium plasticity, pale brown, M>WP							
		Pit discontinued at 0.5m, limit of investigation							
	1								
	2								
	3								
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)
LOGGED: Sebastian
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301884
NORTHING: 6427006

PIT No: 413
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.1	ASPHALT		D	0.08	E	PID<1		
	0.2	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.15	E	PID<1		
		SILTY CLAY - Medium plasticity, pale brown, M>WP							
	0.5	Pit discontinued at 0.5m, limit of investigation							
	1								1
	2								2
	3								3
	4								4

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301916.7
NORTHING: 6426947.5

PIT No: 501
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	SANDY SILT / TOPSOIL - Fine to medium grained, dark brown with rootlets and clay, moist, M<Wp							
		SANDY CLAY - Medium plasticity, fine to medium grained, pale brown, trace roots, stiff		D	0.3	B			
		From 0.5m, very stiff		D	0.5		pp = 200-250		
	0.8				0.6				
		SILTY CLAY - Medium to high plasticity, brown, M<Wp, hard		D	1.0	B	pp >400		
					1.3				
	1.8	SANDY CLAY - Low plasticity, fine to medium grained, brown, M<Wp, hard		D	2.0				
		From 2m, increased resistance							
		From 2.1m, increased sand content		D	2.5				
	2.6	SILTY CLAY - Medium plasticity, brown, M≫Wp, hard		D	2.9		pp >400		
	3.0	Pit discontinued at 3.0m, limit of investigation							

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth) and ripped

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301858
NORTHING: 6427039

PIT No: 502
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.1	SILTY SAND / TOPSOIL - Fine to medium grained, brown with oragnics and rootlets						
		SANDY CLAY - Medium plasticity, pale brown, fine to medium grained, with silt, M>WP, stiff		D	0.5		pp = 300	
		From 0.6m, very stiff		U50				
	0.8	SILTY CLAY - Medium to high plasticity, brown, trace sand, M≤WP, hard			0.9		pp >400	
	1			D	0.95 1.0			
	2			D	2.0		pp >400	
		From 2.2m, trace gravel						
				D	2.5			
	2.7	Pit discontinued at 2.7m, limit of investigation						
	3							
	4							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth) and ripped

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 310915
NORTHING: 6427021

PIT No: 503
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.0	SANDY SILTY CLAY - High plasticity, dark brown, M>WP (possible filling)							
	0.3	SILTY CLAY - Medium plasticity, pale brown, M ≥Wp, firm			0.5		pp = 100-200		
				U					
	0.9	From 0.9m, very stiff			0.9		pp = 300		
1		SILTY CLAY - High plasticity, brown, M≫Wp, very stiff			0.95				1
					1.0				
				U					
					1.45				
		From 1.5m, hard			1.5		pp >400		
		From 1.8m, trace gravel							
2					2.0		pp >400		2
		From 2.2m, increased resistance							
	2.5	Pit discontinued at 2.5m, limit of investigation			2.5				
3									3
4									4

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth) and ripped

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Pacific Brook Christian School Ltd
PROJECT: Preparation of SAQP, Proposed School
LOCATION: Lot 100 DP1261496, Maitland Street, Muswellbrook NSW

SURFACE LEVEL: --
EASTING: 301930
NORTHING: 6426981

PIT No: 106A
PROJECT No: 91601.03
DATE: 7/4/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.2	FILL / SILTY SAND - Fine to medium grained, brown, with gravel, clay and trace rootlets, moist							
	0.27	FILL - Dark grey, asphatic lens		D	0.25	E			
	0.3	FILL / GRAVELLY SAND - Generally comprising fine to medium grained brown, trace subrounded cobbles, moist		D	0.35	E			
	0.4			D	0.5	E			
	0.6	FILL / ASH - Fine to coarse grained, dark grey with fine gravel, and coal reject, moist							
		SILTY CLAY - Low plasticity, pale brown with fine grained sand, M<WP							
	1	Pit discontinued at 0.6m, limit of investigation							
	2								
	3								
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 6.5 Tonne Excavator with 450mm bucket (teeth)

LOGGED: Sebastian

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 1 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 26/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty sandy clay, low to medium plasticity, brown, with root fibres, trace of igneous gravel.	w<PL			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel.	w<PL			ALLUVIAL
							1							
							2			Silty CLAY: medium to high plasticity, dark grey, trace of fine grained sand, sub rounded igneous gravel, fine to medium grained sandstone gravel and ash.	w<PL			
							3		SC	Clayey SAND: medium to coarse grained, brown, trace of igneous gravel.	D			
										END OF BOREHOLE AT 3.8m				PUSHTUBE REFUSAL
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 2 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 26/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0			FILL: Sandy gravel, igneous, angular, dark grey, trace of ash.	M			
										Silty CLAY: medium to high plasticity, grey, trace of ash.	w≈PL			ALLUVIAL
							1			Silty CLAY: low to medium plasticity, brown, trace of fine grained sand and ash.				
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 3 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 26/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty gravel, igneous, angular, dark grey, with slag, trace of root fibres.	D			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, yellow brown, trace of ironstone gravel and ash.	w<PL			POSSIBLY NATURAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 4 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 26/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Sandy gravel, igneous, angular, dark grey, with asphalt fragments.	D			
									CL-CI	Silty CLAY: low to medium plasticity, brown, with fine grained sand, trace of igneous gravel and root fibres.	w<PL			
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of ironstone gravel, root fibres and ash.	w<PL			ALLUVIAL
							1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No. 5 1/1

Environmental logs are not to be used for geotechnical purposes

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 26/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	■		■				0		-	FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained sandstone gravel.	M			
	■									FILL: Sandy gravel, igneous, angular, dark grey, with slag.	M			INSUFFICIENT SAMPLE
▶									CI-CH	Silty CLAY: medium to high plasticity, grey, trace of fine to medium grained sandstone gravel and ash.				ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 6 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 26/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	■		■				0		-	FILL: Silty gravelly sand, fine to medium grained, yellow brown, with igneous gravel, trace of brick and tile fragments.	D			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, grey and brown, trace of fine to medium grained sandstone gravel and root fibres.	w<PL			ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 7 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty sand, fine to medium grained, brown, trace of igneous gravel and root fibres.	D			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of igneous gravel and root fibres.	w<PL			ALLUVIAL
	■		■				1							
	■									END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 8 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty sand, fine to medium grained, brown, with igneous gravel and root fibres, trace of ash.	D			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, brown, trace of ash.	w≈PL			ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 9 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Sandy gravel, igneous, angular, black, with slag, trace of root fibres.	D			GRASS COVER
										FILL: Silty gravelly sand, fine to medium grained, yellow brown, trace of igneous and shale gravel and root fibres.	D			
	■		■				1		CI-CH	Silty CLAY: medium to high plasticity, brown, trace of root fibres and ash.	w<PL			ALLUVIAL
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 10 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty clay, low to medium plasticity, dark brown, trace of root fibres and ash.	w<PL			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of igneous gravel, root fibres and ash.	w<PL			ALLUVIAL
	■		■				1							
	■		■							END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 11 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Clayey sand, fine to medium grained, brown, trace of root fibres.	M			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of root fibres and ash.	w<PL			ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.4m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 12 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Sandy clay, low to medium plasticity, dark brown, trace of igneous gravel and root fibres.	w≈PL			GRASS COVER
	■								CI-CH	Silty CLAY: medium to plasticity, light grey, trace of igneous gravel, root fibres and ash.	w<PL			ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No. 13 1/1

Environmental logs are not to be used for geotechnical purposes

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	■		■				0		CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel, root fibres and ash.	w<PL			ALLUVIAL
	■						1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 14 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty clay, low to medium plasticity, brown, trace of igneous gravel and root fibres.	w<PL			GRASS COVER
-									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel, root fibres and ash.	w<PL			ALLUVIAL
	■						1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 15 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■		■				0		- CI-CH	FILL: Gravelly sand, fine to medium grained, brown, with sub rounded igneous gravel, trace of root fibres. Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel and ash.	D			GRASS COVER ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 16 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION							0		-	FILL: Clayey silt, low to medium plasticity, dark brown, trace of root fibres.	w<PL			GRASS COVER
-									CI-CH	Silty CLAY: medium to high plasticity, trace of sub rounded igneous gravel, root fibres and ash.	w<PL			ALLUVIAL
							1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 17 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■		■				0		-	FILL: Clayey sand, fine grained, brown, with root fibres.	D			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel and ash.	w<PL			ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 18 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION							0		-	FILL: Clayey sand, fine grained, dark brown, trace of slag and root fibres.	M			GRASS COVER
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel.				ALLUVIAL
							1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. 19 **1/1**

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Peaty sand, fine to medium grained, dark brown, with organic material, trace of igneous gravel.	M			LEAF LITTER COVER
-									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel and root fibres.	w<PL			ALLUVIAL
	■		■				1							
										END OF BOREHOLE AT 1.5m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No. 20 1/1

Environmental logs are not to be used for geotechnical purposes

Client: PACIFIC GROUP OF SCHOOLS

Project: PROPOSED NEW SCHOOL

Location: LOT 62, MAITLAND STREET, MUSWELLBROOK, NSW

Job No.: E32307B **Method:** PUSHTUBE **R.L. Surface:**

Date: 27/3/19 **Datum:**

Plant Type: EZIPROBE **Logged/Checked by:** H.W./T.H.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0		-	FILL: Silty clayey sand, fine grained, brown, trace of root fibres.	M			LEAF LITTER COVER
									CI-CH	Silty CLAY: medium to high plasticity, light brown, trace of sub rounded igneous gravel fibres.	w<PL			ALLUVIAL
							1							
							2		CL-CI	Gravelly CLAY: low to medium plasticity, yellow brown, sub rounded igneous gravel.	w<PL			
							3		SM	Silty SAND: fine to medium grained, brown, with low to medium plasticity clay nodules.	M			
										END OF BOREHOLE AT 3.7m				
							4							
							5							
							6							
							7							

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

Results of Dynamic Penetrometer Tests

Dynamic Cone Penetrometer - DCP

Client

Project Preperation of SAQP

Location

Project No. 91601.03

Date 07/04/20

Page No. 1 of 1

Test Location	501	502	503	405	410	201	202	112	114	
RL of Test (AHD)										
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 - 0.15	2	4	2	11	4	1	1	2	9	
0.15 - 0.30	3	5	2	14	2	2	2	1	5	
0.30 - 0.45	3	4	4	9	3	2	4	3	5	
0.45 - 0.60	8	6	2	12	6	4	4	4	22	
0.60 - 0.75	20	15	4	12	11	7	5	5	>25/100	
0.75 - 0.90	19	20	3	11	19	7	20	6		
0.90 - 1.05	17	15	6	12	>25/100	15	>25/100	7		
1.05 - 1.20	18	16	11	11		15		11		
1.20 - 1.35	17	20	13	11		20		12		
1.35 - 1.50	14	25	14	16		27		13		
1.50 - 1.65	18	>25/100	13	18		>25/100		11		
1.65 - 1.80	15		13	20				25		
1.80 - 1.95	18		16	>25/100				>25/100		
1.95 - 2.10	19		25							
2.10 - 2.25										
2.25 - 2.40										
2.40 - 2.55										
2.55 - 2.70										
2.70 - 2.85										
2.85 - 3.00										
3.00 - 3.15										
3.15 - 3.30										
3.30 - 3.45										
3.45 - 3.60										

Test Method AS 1289.6.3.2, Cone Penetrometer (◉)

AS 1289.6.3.3, Sand Penetrometer (○)

Tested By JRK

Checked By

Remarks Ref = Refusal, 24/110 indicates 24 blows for 110 mm penetration

Appendix B

Laboratory Test Results

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Fax: (02) 4960 9601
Email: Peter.Gorseski@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

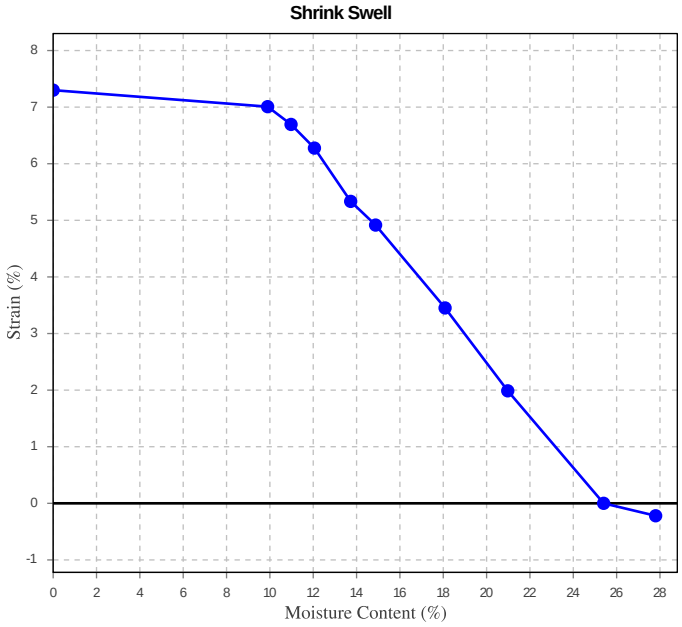
Approved Signatory: Peter Gorseski
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **91601.03-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Engineer - changed details*
Date Issued: 08/05/2020
Client:
3A Acacia Street, Tweed Heads South NSW 2486
Project Number: 91601.03
Project Name: Preparation of SAQP, Proposed School
Project Location: Maitland Street, Muswellbrook
Work Request: 4934
Sample Number: NC-4934A
Date Sampled: 07/04/2020
Dates Tested: 16/04/2020 - 20/04/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **410, Depth: 0.3-0.75m**
Material: Silty Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**4.1**
Visual Description	Silty Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**7.3**
Estimated % by volume of significant inert inclusions	0
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	25.4

Swell Test	
Initial Pocket Penetrometer (kPa)	210
Final Pocket Penetrometer (kPa)	160
Initial Moisture Content (%)	25.1
Final Moisture Content (%)	27.8
Swell (%)	**0.2**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Fax: (02) 4960 9601
Email: Peter.Gorseski@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

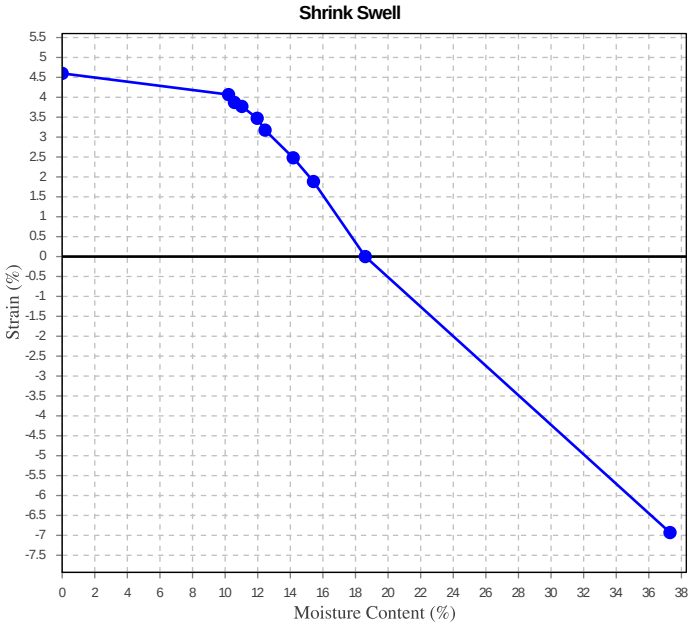
Approved Signatory: Peter Gorseski
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **91601.03-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Engineer - changed details*
Date Issued: 08/05/2020
Client:
3A Acacia Street, Tweed Heads South NSW 2486
Project Number: 91601.03
Project Name: Preparation of SAQP, Proposed School
Project Location: Maitland Street, Muswellbrook
Work Request: 4934
Sample Number: NC-4934B
Date Sampled: 07/04/2020
Dates Tested: 16/04/2020 - 20/04/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **502, Depth: 0.5-0.95m**
Material: Sandy Clay

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**4.5**
Visual Description	Sandy Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**4.6**
Estimated % by volume of significant inert inclusions	0
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	18.6

Swell Test	
Initial Pocket Penetrometer (kPa)	600
Final Pocket Penetrometer (kPa)	215
Initial Moisture Content (%)	17.9
Final Moisture Content (%)	37.3
Swell (%)	**6.9**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Fax: (02) 4960 9601
Email: Peter.Gorseski@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Peter Gorseski
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **91601.03-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Engineer - changed details*
Date Issued: 08/05/2020
Client:
3A Acacia Street, Tweed Heads South NSW 2486
Project Number: 91601.03
Project Name: Preparation of SAQP, Proposed School
Project Location: Maitland Street, Muswellbrook
Work Request: 4934
Sample Number: NC-4934C
Date Sampled: 07/04/2020
Dates Tested: 16/04/2020 - 24/04/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **405, Depth: 0.4-0.85m**
Material: Silty Clay with Sand

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	22.0

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	56		
Plastic Limit (%)	19		
Plasticity Index (%)	**37**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	16.5		
Cracking Crumbling Curling	Curling		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Fax: (02) 4960 9601
Email: Peter.Gorseski@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

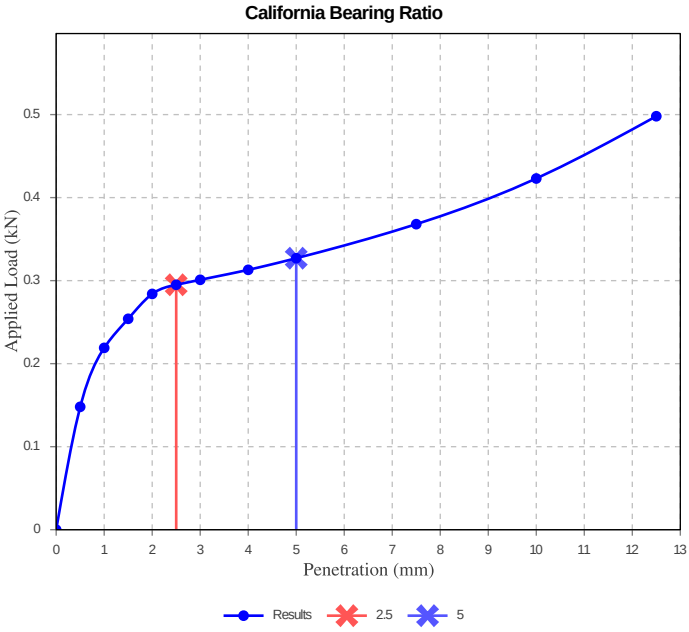
Approved Signatory: Peter Gorseski
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **91601.03-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Engineer - changed details*
Date Issued: 08/05/2020
Client:
3A Acacia Street, Tweed Heads South NSW 2486
Project Number: 91601.03
Project Name: Preparation of SAQP, Proposed School
Project Location: Maitland Street, Muswellbrook
Work Request: 4934
Sample Number: NC-4934D
Date Sampled: 07/04/2020
Dates Tested: 16/04/2020 - 23/04/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **501, Depth: 0.3 - 0.6m**
Material: Sandy Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	20.2

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
Maximum Dry Density (t/m^3)	1.60
Optimum Moisture Content (%)	22.5
Oversize Sieve (mm)	19
Oversize Material Wet (%)	0
Method used to Determine Plasticity	Visual Assessment
Curing Hours	122.3

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**2.0**		
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)	1.60		
Optimum Moisture Content (%)	22.5		
Laboratory Density Ratio (%)	99.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.54		
Field Moisture Content (%)	20.6		
Moisture Content at Placement (%)	22.5		
Moisture Content Top 30mm (%)	31.1		
Moisture Content Rest of Sample (%)	22.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	122.3		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Fax: (02) 4960 9601
Email: Peter.Gorseski@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

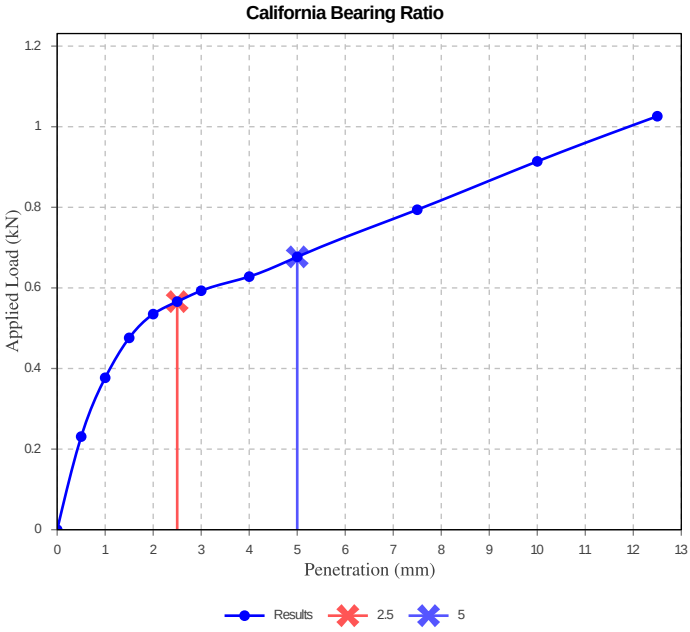
Approved Signatory: Peter Gorseski
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **91601.03-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Engineer - changed details*
Date Issued: 08/05/2020
Client:
3A Acacia Street, Tweed Heads South NSW 2486
Project Number: 91601.03
Project Name: Preparation of SAQP, Proposed School
Project Location: Maitland Street, Muswellbrook
Work Request: 4934
Sample Number: NC-4934E
Date Sampled: 07/04/2020
Dates Tested: 16/04/2020 - 23/04/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **501, Depth: 1.0-1.3m**
Material: Silty Clay

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.0

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
Maximum Dry Density (t/m^3)	1.61
Optimum Moisture Content (%)	22.5
Oversize Sieve (mm)	19
Oversize Material Wet (%)	0
Method used to Determine Plasticity	Visual Assessment
Curing Hours	122.2

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**4.5**		
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)	1.61		
Optimum Moisture Content (%)	22.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.58		
Field Moisture Content (%)	17.8		
Moisture Content at Placement (%)	22.3		
Moisture Content Top 30mm (%)	31.5		
Moisture Content Rest of Sample (%)	26.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	142.4		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 241051

Client Details

Client	Douglas Partners Newcastle
Attention	Caitlyn Falla
Address	Box 324 Hunter Region Mail Centre, Newcastle, NSW, 2310

Sample Details

Your Reference	**91601.03, Muswellbrook**
Number of Samples	4 Soil
Date samples received	17/04/2020
Date completed instructions received	17/04/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	22/04/2020
Date of Issue	27/04/2020
Reissue Details	This report replaces R00 created on 22/04/2020 due to: revised report with additional pH results.

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Jaimie Loa-Kum-Cheung, Metals Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil					
Our Reference		241051-1	241051-2	241051-3	241051-4
Your Reference	UNITS	405	405	502	502
Depth		0.3	1.5	0.5	1.0
Date Sampled		07/04/2020	07/04/2020	07/04/2020	07/04/2020
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	20/04/2020	20/04/2020	20/04/2020	20/04/2020
Date analysed	-	20/04/2020	20/04/2020	20/04/2020	20/04/2020
Electrical Conductivity 1:5 soil:water	µS/cm	39	250	560	980
pH 1:5 soil:water	pH Units	8.3	8.3	6.4	8.4

ESP/CEC			
Our Reference		241051-2	241051-4
Your Reference	UNITS	405	502
Depth		1.5	1.0
Date Sampled		07/04/2020	07/04/2020
Type of sample		Soil	Soil
Date prepared	-	21/04/2020	21/04/2020
Date analysed	-	21/04/2020	21/04/2020
Exchangeable Ca	meq/100g	10	31
Exchangeable K	meq/100g	0.8	0.5
Exchangeable Mg	meq/100g	12	19
Exchangeable Na	meq/100g	2.4	2.8
Cation Exchange Capacity	meq/100g	25	54
ESP	%	9	5

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			20/04/2020	[NT]	[NT]	[NT]	[NT]	20/04/2020	[NT]
Date analysed	-			20/04/2020	[NT]	[NT]	[NT]	[NT]	20/04/2020	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	99	[NT]

QUALITY CONTROL: ESP/CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			21/04/2020	[NT]	[NT]	[NT]	[NT]	21/04/2020	[NT]
Date analysed	-			21/04/2020	[NT]	[NT]	[NT]	[NT]	21/04/2020	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	113	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	120	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	113	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	124	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 241051-A

Client Details

Client	Douglas Partners Newcastle
Attention	Caitlyn Falla
Address	Box 324 Hunter Region Mail Centre, Newcastle, NSW, 2310

Sample Details

Your Reference	**91601.03, Muswellbrook**
Number of Samples	4 Soil
Date samples received	17/04/2020
Date completed instructions received	01/05/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

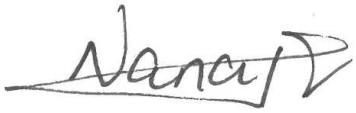
Date results requested by	11/05/2020
Date of Issue	11/05/2020

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Misc Inorg - Soil			
Our Reference		241051-A-2	241051-A-4
Your Reference	UNITS	405	502
Depth		1.5	1.0
Date Sampled		07/04/2020	07/04/2020
Type of sample		Soil	Soil
Date prepared	-	11/05/2020	11/05/2020
Date analysed	-	11/05/2020	11/05/2020
Chloride, Cl 1:5 soil:water	mg/kg	160	810
Sulphate, SO4 1:5 soil:water	mg/kg	130	260

Method ID	Methodology Summary
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			11/05/2020	[NT]	[NT]	[NT]	[NT]	11/05/2020	[NT]
Date analysed	-			11/05/2020	[NT]	[NT]	[NT]	[NT]	11/05/2020	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	98	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	100	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 241994

Client Details

Client	Douglas Partners Newcastle
Attention	Caitlyn Falla
Address	Box 324 Hunter Region Mail Centre, Newcastle, NSW, 2310

Sample Details

Your Reference	**91601.03, Muswellbrook**
Number of Samples	5 Soil
Date samples received	01/05/2020
Date completed instructions received	01/05/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

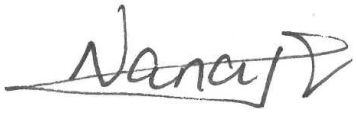
Date results requested by	08/05/2020
Date of Issue	05/05/2020

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		241994-1	241994-2	241994-3	241994-4	241994-5
Your Reference	UNITS	503	410	402	410	503
Depth		0.5	1.0	0.4	2.5	1.0
Date Sampled		07/04/2020	07/04/2020	07/04/2020	07/04/2020	07/04/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	04/05/2020	04/05/2020	04/05/2020	04/05/2020	04/05/2020
Date analysed	-	04/05/2020	04/05/2020	04/05/2020	04/05/2020	04/05/2020
pH 1:5 soil:water	pH Units	8.7	9.1	7.2	9.4	8.6
Electrical Conductivity 1:5 soil:water	µS/cm	150	380	190	250	990

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			04/05/2020	1	04/05/2020	04/05/2020		04/05/2020	[NT]
Date analysed	-			04/05/2020	1	04/05/2020	04/05/2020		04/05/2020	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	8.7	8.7	0	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	150	140	7	103	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

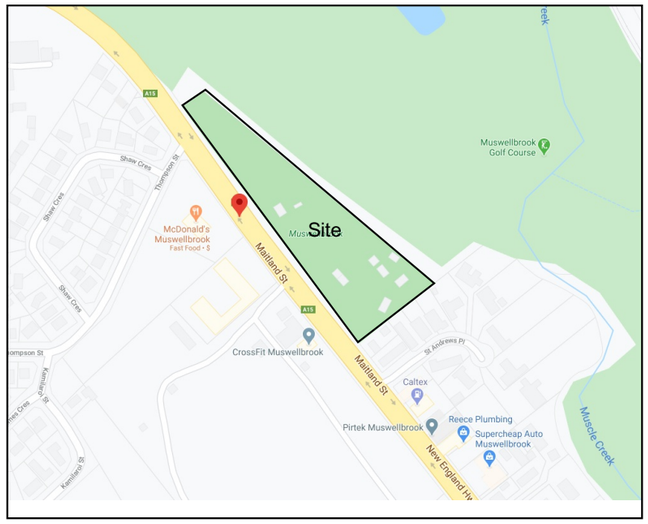
Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

pH/EC
Samples were out of the recommended holding time for these analysis.

Appendix C

Drawing 1 – Test Location Plan



Site Location

0 10 20 30 40 50 m

Drawing adapted from Nearmap Image dated 13.1.2019

Legend

- Approx Location of Test Pits (current investigation)
- Approx Location of Geotechnical Test Pits (current investigation)
- Approx Location of Test Pits (previous investigation-DP,2019)
- Approx Location of Previous Boreholes & Wells (previous investigation-DP,2019)
- Approx Location of Boreholes (JK Environment)
- Site Boundary
- Approx Location of Proposed Buildings
- Approx Location of Proposed Carpark

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Pacific Brook Christian School Ltd		
OFFICE: Newcastle	DRAWN BY: PLH	
SCALE: 1:1250 @ A3	DATE: 12.May.2020	

TITLE: **Test Location Plan**
Proposed School
Lot 100, DP1261496, Maitland Street, Muswellbrook NSW

N

PROJECT No:	91601.03
DRAWING No:	1
REVISION:	0