Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

New High School in Bungendore
Majara Street, Bungendore

Prepared for
NSW Department of Education - School Infrastructure
NSW

Project 202107.02
September 2021

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	202107.02	Document No.	R.001.Rev2
Document title	Report on Geotechnical Investigation New High School in Bungendore		
Site address	Majara Street, Bungendore		
Report prepared for	NSW Department of Education - School Infrastructure NSW		
File name	202107.02.R.001.Rev2		

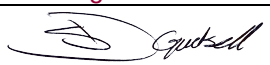
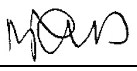
Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Shannon Goodsell	Michael Jones	30 July 2021
Revision 1	Shannon Goodsell	Michael Jones	5 August 2021
Revision 1	Shannon Goodsell	Michael Jones	7 September 2021

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	Doug MacPherson, NSW Department of Education - School Infrastructure NSW
Revision 1	1	0	Doug MacPherson, NSW Department of Education - School Infrastructure NSW
Revision 2	1	0	Doug MacPherson, NSW Department of Education - School Infrastructure NSW

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		Shannon Goodsell	7 September 2021
Reviewer		Michael Jones	7 September 2021

bsi. ISO 9001 Quality Management
FS 604853

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
Unit 2, 73 Sheppard Street
Hume ACT 2620
PO Box 1487
Fyshwick ACT 2609
Phone (02) 6260 2788

Douglas Partners
Geotechnics / Environment / Groundwater

Table of Contents

Report on Geotechnical Investigation
New High School in Bungendore
Majara Street, Bungendore

1. Introduction

This Geotechnical Investigation conducted by Douglas Partners Pty Ltd (DP) accompanies an Environmental Impact Statement (EIS) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) in support of an application for a State Significant Development (SSD No 14394209). The SSDA is for a new high school located at Bungendore.

This report addresses the Secretary's Environmental Assessment Requirements (SEARs), notably:

SEARs Requirement	Response
Geotechnical Report	Geotechnical assessment and recommendations for further site investigations

2. Proposed Development

The proposed development is for the construction of a new high school in Bungendore. The proposal has been designed as a stream 3 high school to initially provide for approximately 450 students with core 4 facilities aimed to future proof demand forecasted to 2036.

The site is located adjacent to the existing Bungendore Public School to the south enabling the creation of an education style precinct that will enable a cohesive connection between the two schools as well as the wider Bungendore community.

The proposal will include the demolition of the Bungendore Swimming Pool (to be relocated to Queanbeyan-Palerang Regional Council's proposed new Bungendore Sports Hub) and the Bungendore Community Centre; repurposing of existing council buildings; and the construction of new school buildings. New facilities for the high school will comprise of 24 general learning spaces; dedicated science and technology spaces; a gymnasium; library; canteen; outdoor learning and play areas that include two games courts.

A new agricultural plot is also proposed to the north of the main school site including a new agricultural building and scout storage shed, adjacent to the existing scout hall.

The proposal will also provide for shared administration and staff facilities between the high school and existing primary school and construction of a warm shell for community facilities including a community library, council shopfront and community health hub.

Additionally, miscellaneous off-site works, including upgrades to nearby road intersections and infrastructure, crossings, footpaths and the like will be provided to encourage active transport opportunities and respond to changing traffic conditions.

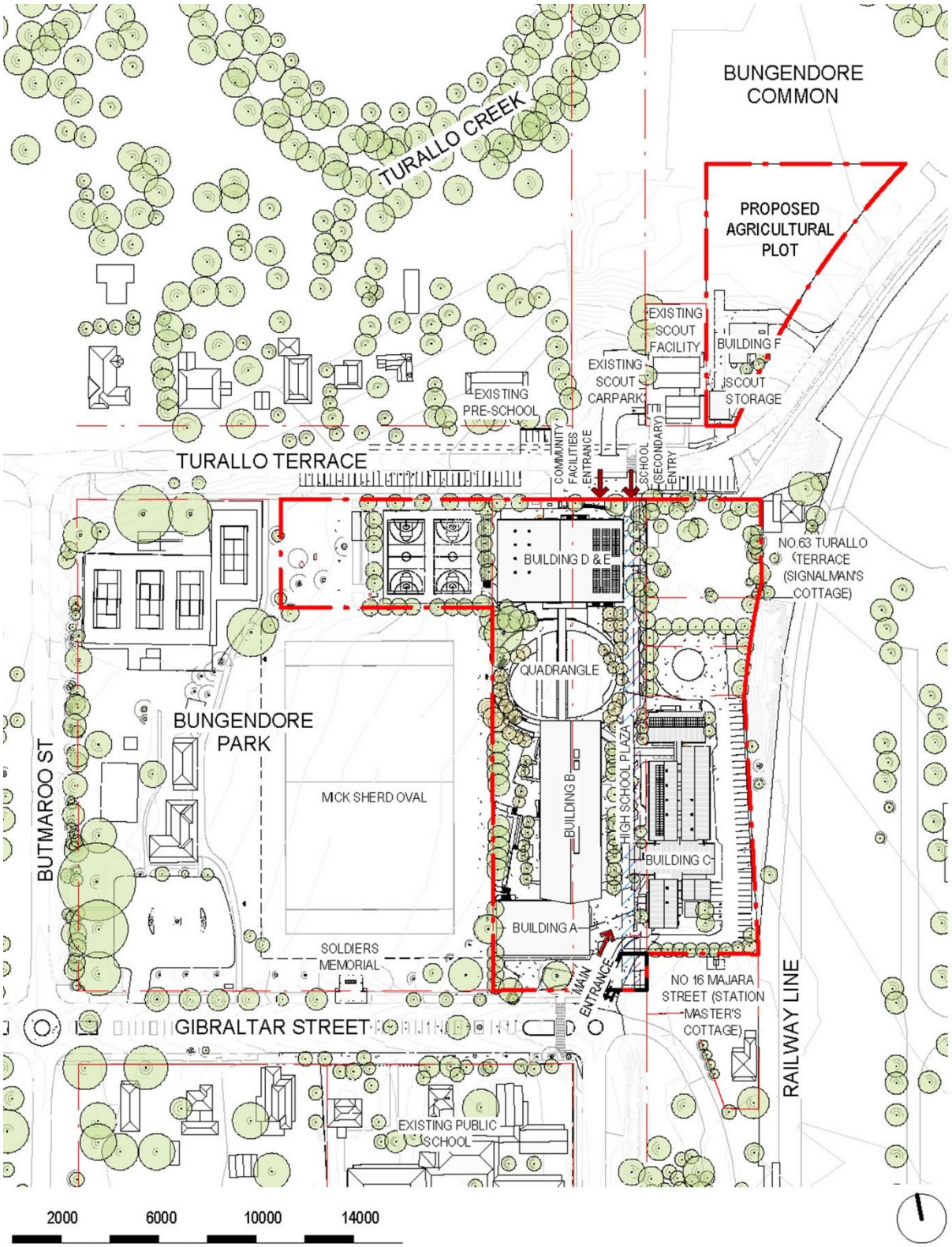


Figure 1: Proposed site plan
Source: TKD Architects

3. Site Description

The proposed development is located within the Bungendore Town Centre within the local government area of Queanbeyan-Palerang Regional Council. The proposal involves the use of land which includes Bungendore Park bounded by Gibraltar Street, Majara Street, Turallo Terrace and Butmaroo Street, the existing former Palerang Council site at 10 Majara Street, the Majara Street road reserve bounded by Turallo Terrace and Gibraltar Streets and Nos. 2, 4 and 6 Majara Street (Refer to Table 1 below).

The site is approximately 29,205 m^2 in area and consists of a relatively flat topography. It contains part of Bungendore Park, existing Council buildings and maintained public open space areas. The land is mostly cleared of vegetation with some mature trees intersperse throughout subject lots.

The surrounding area generally includes low density residential developments to the north and west, an existing rail line to the east and Bungendore Public School and the Bungendore train station to the south and south west respectively.

Table 1: New high school in Bungendore legal descriptions

Property Address	Lot Numbers
6-14 Butmaroo Street	Part Lot 701 DP1027107
2 Majara Street	Lot 12 DP1139067
4-6 Majara Street	Lot 13 DP1139067 Lot 14 DP1139067
10 Majara Street	Lot 3 DP830878
Butmaroo Street	Part Lot 701 DP96240
Portion of Majara Street (between Turallo Terrace and Gibraltar Street)	N/A

Figure 2: Site aerial depicting the land subject to the proposed High School.
Source: TKD Architects

4. General

DP has been engaged by TSA Management Pty Ltd (TSA) on behalf of NSW Department of Education - School Infrastructure NSW (SINSW) to provide a geotechnical investigation undertaken for the new high school in Bungendore to be located within a precinct centred on Majara Street, Bungendore (hereinafter referred to as 'the site'). It is understood that the development boundaries have been amended from those referred to in DP's previous reports (development boundary now includes an area

of land north of Turallo Terrace and the southern development boundary now borders Gibraltar Street). It should be noted that the client requires Pro-Forma paragraphs for the report (Sections 1 – 3 of the report) and DP has been required to reproduce these paragraphs in this report. . The report includes the observations made from a desktop assessment of the additional area in the north and observations and comments from DP's previous investigation and findings.

The investigation was undertaken in general accordance with DP's proposal 94188.03.P.002.Rev0 dated 16 July 2021. This report must be read in conjunction with all appendices including the notes provided in Appendix B and the site location, development boundaries and site features are shown on Drawing 1, Appendix A.

5. Background Information

Douglas Partners' (DP) previously completed a geotechnical investigation within the area between Turallo Terrace and Malbon Street/Kings Highway (DP, 2021).

The field work comprised the drilling of 26 boreholes using an EVH2100 drilling rig at the locations. It should be noted that only 12 of the 26 boreholes (BH01-T, BH02-T and BH01 – BH10) are located in the new site boundary of the site, shown on Drawing 1 (Appendix B). The boreholes were drilled through overburden soils and upper weathered rock (where encountered) with 110 mm diameter solid flight augers. BH01-T, BH02-T and BH04 – BH07 were augured to limit of investigation depths of 3 m, while Bores BH09 and BH10 were drilled to limit of investigation depths of 6.0 m. Bore BH03 refused in siltstone bedrock at a depth of 1.7 m. Bores BH01, BH02 and BH08 were cored drilled using an NMLC drilling bit through siltstone bedrock from depths of between 1.5 – 2.6 m to limit of investigation depths of between 6.0 m – 6.2 m.

Subsurface conditions encountered are given in the borehole logs in Appendix C, which should be read in conjunction with the notes defining classification methods and descriptive terms.

The succession of strata is broadly summarised below:

- **TOPSOIL FILL:** generally low to medium plasticity silty clay with a various mixture of sand and gravel in all boreholes to depths of between 0.2 m – 0.3 m; overlying

- **FILL:** generally low to high plasticity clayey soils and loose to dense sandy soils to depths of 0.3 – 0.7 m;

- **NATURAL SOILS:** generally low to high plasticity clayey and silty soils and dense to very dense sandy soils including extremely weathered rock to depths of 1.0 – 3.5 m. Bores BH01-T, BH02-T and BH07 were terminated in natural soils at 3.0 m depth.

- **BEDROCK:** variably very low to medium strength, extremely/highly weathered to moderately weathered siltstone in BH01 – BH06 and BH08 – BH10 to the limit of investigation or refusal depths of 1.7 m – 6.2 m.

No free groundwater was encountered during the drilling and coring of the boreholes. Groundwater wells were installed in Boreholes BH02, BH08 and BH09. However, groundwater conditions rarely

remain constant and can change seasonally due to variations in rainfall, temperature and soil permeability. For these reasons, it is noted that the moisture condition of the site soils may vary considerably from the time of the investigation compared to at the time of construction. It must be noted that due to the topography, sandy nature of the site soils in parts and fractured weathered rock, groundwater seepages must be expected following periods of rainfall.

The groundwater monitoring wells were measured on 4 May 2021. The following groundwater observations were made:

Table 2: Groundwater Recordings from Standpipe Piezometers.

Bore	Groundwater Depth and Estimated Reduced Level	
	4/5/2021	
	Depth (m)	RL (m)*
BH02	5.39	691.11
BH08	5.84	691.16
BH09	No Groundwater Observed	-

*Surface levels given in Table 2 are based on the survey data provided by Project Surveyors Pty Ltd

Laboratory testing was performed on selected samples of DP's previous investigation (DP, 2021) and comprised the following:

- 9 Atterberg limits and linear shrinkage tests (only six tests are now in the updated site boundaries);
- 3 shrink-swell tests (only one test is now in the updated site boundaries);
- 3 California bearing ratio (CBR) tests (only two tests are now in the updated site boundaries);
- 5 Uniaxial Compressive Strength (UCS) tests of rock core;
- 27 Point load index tests; and
- 6 pH, chloride and sulphate content (aggressivity) and salinity tests

The results of the laboratory testing from DP's previous investigation (DP, 2021) are provided in detail in the test report sheets in Appendix D. The results of plasticity testing, aggressivity tests, shrink-swell tests, CBR tests and UCS tests are summarised in Tables 3 – 7 below. The borehole locations are shown on Drawing 1 (Appendix B).

Table 3: Results of Atterberg Limits and linear shrinkage tests

Bore No.	Depth (m)	W_F (%)	W_L (%)	W_P (%)	PI (%)	LS (%)	Field Description
BH01-T	0.5	11.5	25	13	12	7.0	Fill/Silty Clay
BH02-T	1.0 – 1.4	13	38	29	9	4	Silty Clay
BH06	1.0 – 1.4	7.1	38	26	12	5.5	Silty Clay

BH07	1.0	9.7	30	21	9	3.0	Silty Clay
BH09	1.0	21.2	40	27	13	4.5	Silty Clay

Where W_F = Moisture content W_L = Liquid limit W_P = plastic limit
PI = Plasticity Index LS = Linear shrinkage

Table 4: Results of Shrink Swell Index tests

Bore No.	Depth (m)	Swell (%)	Iss (%)	SMCB (%)	SMCA (%)	Material
BH10	1.0 – 1.4	0.7	1.0	23.2	29.2	Silty Clay

Where Iss = Shrink Swell Index SMCB = Swell moisture content before
SMCA = Swell moisture content after

The Atterberg limits test results indicated that the clayey soils tested were of low to medium with some high plasticity (i.e. liquid limit greater than 50%). The clayey soils would be expected to be highly susceptible to shrinkage and swelling movements with changes in soil moisture content.

The shrink swell test results indicated that the clayey soils tested were of low to medium plasticity.

Table 5: Results of pH, Salinity, Chloride and Sulphate Testing

Bore No.	Depth (m)	pH	Electrical Conductivity * (µS/cm)	Chloride (mg/kg)	Sulphate, as SO_4 (mg/kg)	Estimated Salinity (mg/kg)	Resistivity (2) (ohm.cm)	Material
BH01	2.0	9.0	260	310	47	890	3800	Siltstone
BH04	2.0	8.4	640	840	72	2,200	1600	Siltstone
BH05	1.0	9.2	480	410	110	1,600	2100	Silty Clay
BH08	1.5	7.8	410	510	65	1,400	2400	Siltstone
Criteria for "Non-aggressive" Soil Conditions (low permeability soils or soils above the groundwater table) (1)		>5.5 (concrete) >5.0 (steel)	-	<5,000 (steel)	<5,000 (concrete)	See Figure 3	>5,000 (steel)	-

Notes:
(1) AS 2159:2009
(2) Resistivity (ohm.cm) is the inverse of Electrical Conductivity (S/cm)

The results of the aggressivity testing indicate that based on the low permeability soils above the water table the exposure classification for concrete is *Non-Aggressive* and for steel piles is moderately *Aggressive*.

Samples were also screened for salinity. The results indicate that all samples tested were non-saline.

Table 6: Results of UCS Testing

Bore No.	Depth (m)	UCS (MPa)
BH01	3.65 – 3.9	4.9
BH01	4.27 – 4.51	7.3
BH02	2.18 – 2.38	1.9
BH02	4.02 – 4.28	6.1
BH02	5.65 – 5.94	6.0

A total of 27 point load strength index tests were undertaken on samples of the rock core, 11 were undertaken in the axial direction and 16 in the diametral direction. The test results give $I_{S(50)}$ values ranging from 0.05 to 0.78 MPa, indicating rock strengths tested to be of very low and medium strength (point load results are located within the borehole logs). Based on the approximate relationship $q_u = 20 \times I_{s(50)}$, and the results of the UCS testing the estimated unconfined compressive strengths q_u range from 1.9 – 7.3 MPa (very low to medium strength). It is noted that during a number of axial tests and diametral tests, the rock failed along pre-existing planes of weakness (i.e. partially healed or insipient joints) and not through the rock fabric itself.

Table 7: Summary of Compaction & CBR Testing

Bore No.	Depth (m)	FMC (%)	OMC (%)	MDD (t/m^3)	CBR (%)	Swell (%)	Field Description
BH01-T	0.5 – 0.8	17	19	1.72	4.5	2.5	Silty Clay
BH06	0.5 – 0.8	15.5	16.5	1.73	0.5	9	Silty Clay

Where: FMC = Field moisture content; MDD = Maximum dry density (standard)
OMC = Optimum moisture content; CBR = California bearing ratio

The samples tested for CBR were compacted to about 100% standard dry density ratio at close to the optimum moisture content and soaked for four days under a surcharge loading of 4.5 kg.

Whilst the CBR test result is an accurate determination of a small remoulded laboratory sample, it is considered that the values obtained significantly over states the in-situ CBR strength and as such suggested to be downgraded for design purposes. This also allows for variability in the subgrade material across the site.

The compaction test results indicate that the soils tested from BH01-T and BH06 were up to 1 – 2 % dry of their standard optimum moisture contents, respectively. The clayey soils possess a high risk of low soaked CBR strength (BH06).

6. Walkover Inspection

A site walkover was undertaken by a geo-environmental scientist on 19 March and 22 July 2021. The general site topography was consistent with that described in Section 3. The following key site features pertinent to the investigation were observed:

- The site comprised mostly developed lots of land. The northern portion (north of Turallo Terrace) of the site comprised vacant land and was moderately grassed. Between Turallo Terrace and Gibraltar Street, a public swimming pool and associated structures, a community hall, the Queanbeyan-Palerang Regional Council offices and the Mick Sherd Oval were present. Some areas of vacant land were located between the infrastructure on site and comprised of grass coverage and some sporadic tree coverage;
- The northern portion of the site appeared to have been built up along the northern side of Turallo Terrace and sloped down towards a near-flat area, towards Turallo Creek;
- The northern portion of the site appeared to be within a floodplain
- The swimming pool area comprised of a 25 m swimming pool, several small buildings and several shade structures. Along the western boundary of the swimming pool, a mound of fill was present. Numerous small to large trees surrounded the swimming pool;
- The community centre comprised of one building and a playground with car parks to the north of the centre. Numerous small to large trees surrounded the community centre;
- The QPRC offices comprised of several buildings with car parks and landscaped areas around the offices;
- A small park/urban open space with numerous large trees was located to the south-east corner of the Mick Sherd Oval;
- The railway corridor along the eastern boundary of the site exposed siltstone bedrock;
- Surface fill/topsoil fill were noted across most areas of the site;
- Underground services were located across the entire site including stormwater, sewer, water mains, gas mains, electrical lines, communication lines and irrigation lines.

Figures 3 – 7 show the general conditions of the site at the time of the site walkover.

Figure 3: View of the fill mound alongside the western boundary of the swimming pool

Figure 4: General view of the northern area of the site, looking north. Swimming pool to the left, community centre to the right).

Figure 5: View of the Mick Sherd Oval, looking south west.

Figure 6: View of the Mick Sherd Oval, looking north.

Figure 7: View of the northern portion of the site (between Turallo Creek and Turallo Terrace

7. Regional Geology

7.1 Geology

Reference to the Canberra 1:100,000 Geological Sheet 8727 indicates that majority of the site (to the west of Majara Street) is underlain by Quaternary aged alluvium and part of the eastern side (between Majara Street and the existing railway) is underlain by colluvium, overlying middle to late Ordovician aged Birkenburn beds, which comprises interbedded sandstone, siltstone and shale. It is expected that the Birkenburn beds would underly the alluvium. An extract of the BMR map showing the indicated geological units is shown below in Figure 8.

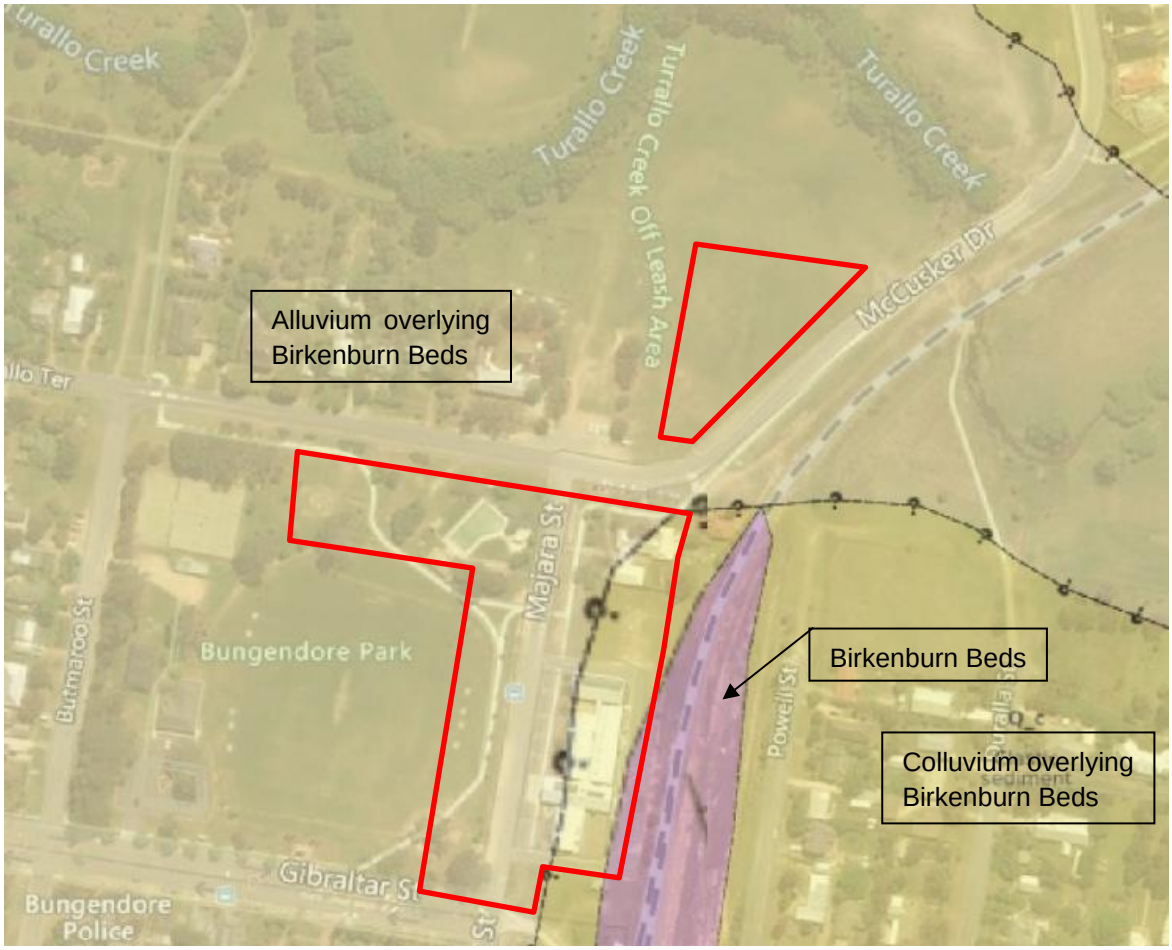


Figure 8: Extract from Geology Map

Source: Douglas Partners Pty Ltd

7.2 Acid Sulphate Soils

Reference to the CSIRO's Atlas of Australian Acid Sulfate Soils online mapping portal, (A S R I S - Atlas of Australian Acid Sulfate Soils (csiro.au)) indicates that the site has a low probability of acid sulfate soils to be present.

7.3 Hydrogeology

Anticipated groundwater flow direction is inferred to be towards the north/north-west to Turallo Creek and Halfway Creek.

A search of the publicly available registered groundwater bore database indicates that there are five registered groundwater bores within 500 m of the site to the south of the Turallo Creek as summarised in Table 6.

Table 6: Summary of Available Information from Nearby Registered Groundwater Bores

Bore ID Authorised Purpose Completion Year Status	Location Relative to Site	Final Depth (m)	Standing Water Level (m bgl)
GW020916 - 1952	496m W	21.9	N/A
GW402023 - 2002	273m SE	22.0	10.0
GW403783 - 2003	226m SE	50.0	28.0
GW403817 - 2007	490m W	39.0	6.0
GW404164 - 2004	455m NW	42.00	2.0
GW416600 – 2004	150 m E	5.1	4.35

8. Geotechnical Model

Based on the site observations, regional geology and previous investigation undertaken in the area, it is suggested that the subsurface profile for the additional northern area of the site will likely comprise the following:

- **TOPSOIL/TOPSOIL FILL:** low to medium plasticity silty clay and silty sand with a various amounts of rootlets and gravel up to depths of 0.2 m – 0.3; overlying;

- **FILL:** variable low to high plasticity clayey soils and loose to dense sandy soils, possibly greater than 1.5 m in some areas (closer to Turallo Terrace) and possibly shallower (equal to or less than 1.0 m) towards Turallo Creek overlying;

- **ALLUVIUM/RESIDUAL SOILS**: low to high plasticity clayey and silty soils and dense to very dense sandy soils (alluvium) and low to high plasticity silty clay (residual) varying in depths of up to 1.0 – 3.0 m deep and possibly even deeper towards Turallo Creek. Possible rocklike structure (extremely weathered sedimentary rocks) could also be expected at depths greater than 3.0 m. It should be noted that soils will be deeper at the western and northern part of the site where alluvial soils are mapped, likely with high plasticity soils; overlying;

- **WEATHERED ROCK:** likely initially very low strength, highly weathered sedimentary rock typically grading to stronger, less weathered rock with depths possibly up to 3.0 m or greater. Shallow rock may be encountered at the eastern end of the additional northern portion of the site, where Ordovician aged Birkenburn beds are mapped and were observed in the railway corridor.

The walkover indicated that an extensive amount of fill of unknown quality could be present within the northern portion of the site.

The actual ground conditions of the additional northern area could vary substantially from the interpreted geotechnical model and previous DP investigation (DP, 2021) and should be confirmed with intrusive geotechnical investigations at the site.

9. Preliminary Comments

The following comments are based on the results of DP's previous investigation (DP, 2021) and Douglas Partners (DP) experience with similar projects. It is likely that low rise school buildings, pavements and courts will be constructed. At this stage, it is not known whether there will be basement levels or significant retaining walls constructed at the site, though given the existing site levels excavation and fill is expected to create near-level construction platforms.

9.1 Site Classification

DP' previous investigation (DP, 2021) encountered various types of material including uncontrolled fill underlain by natural residual and alluvial soils and then weathered siltstone rock. The results of the previous investigation recommended the site classification below.

Site classification in accordance with AS 2870:2011 provides guidance on the patterns and magnitude of moisture related seasonal ground movements that must be considered in design. Due to the adverse moisture conditions arising from existing trees, and the presence of uncontrolled fill (including the general site fill within existing service trenches), the site is classified as Class P.

The main requirement for Class P sites is for design to be undertaken by a structural engineer using sound engineering principles.

The site classification based on soil reactivity alone following removal of topsoil and any existing fill, would likely be Class M rating but Class H1 to H2 may be possible, depending on the extent of highly reactive clay, the depth to rock and set back distances to trees.

It is recommended that the site be reclassified/reassessed after earthworks involving cut and fill work has been completed.

The additional northern portion of the site is expected to contain uncontrolled fill and alluvial soils. An intrusive investigation will be required to provide a site classification for this area.

9.2 Site Preparation

Topsoils, any underlying silty sandy soils and uncontrolled fill will need to be stripped from beneath areas proposed to support structures and pavements or where controlled fill to achieve design levels is required. This includes the backfill of any existing or redundant service trenches. The existing swimming pool at the corner of Turallo Terrace and Majara Street will need to be backfilled. Controlled fill should be placed in accordance with the following methodology:

- Strip topsoil, any silty/sandy soils, fill and root affected soils (to be expected to be up to 0.5 – 1.0 m deep adjacent to existing mature trees) from areas in which new engineered fill, structures and/or pavements are proposed. It should be noted that there is the potential for deeper fill within the additional northern area. It may be more cost effective to pier through the fill rather than stripping the fill in this area. Further intrusive investigations would be required to determine this;

- Moisture condition and compact the exposed surface and test-roll using a roller of minimum 12 tonne deadweight (or equivalent) in the presence of a geotechnical engineer. Any areas exhibiting unacceptable movements during the test-roll will require further remediation;
- Place fill in maximum 250 mm thick loose layers and compact to a minimum 98% standard maximum dry density, with moisture contents maintained within 2% of standard optimum moisture content;
- Poor trafficability should be expected across the site in periods of wet weather. A layer of granular product (e.g. road base, recycled crushed concrete, etc.) should be considered as the top layer of fill to improve trafficability on site;
- Earthworks should be undertaken in accordance with the requirements of AS 3798:2007 for Level 1 controlled fill.

9.3 Excavated Material Re-Use

From a geotechnical perspective, the topsoil and potential underlying silty sandy slopewash/colluvium would not be suitable for re-use. Some non-organic silty sand/sandy silt soils could potentially be blended with clay soils to improve its engineering properties and be used as controlled fill. Potential residual sandy clay, clayey sand and weathered rock on site would be considered suitable for re-use, provided any clays of high plasticity are used with caution. All re-used material will require careful control of the moisture content during compaction. To reduce potential for shrink/swell movements beneath structures, highly reactive clays should be excluded from controlled fill applications if possible, or else used at depth (> 1 m depth from foundation level) where possible. Similarly, soils with a high sand and silt content will be sensitive to changes in soil moisture content thus careful control on placement moisture contents and onsite drainage pathways will be critical (i.e.: stormwater flows must be diverted away from construction areas). As detailed above, the reuse of silty sandy soils is not recommended unless geotechnical guidance is obtained.

Excavated rock greater than low to medium strength would likely excavate as cobble and boulder sized fragments, which would need to be crushed using a mobile crushing plant to achieve a general maximum particle size of 75 mm prior to use within fill areas. It is likely that minimal fines would be created during the rock crushing process and that blending with the overlying soil may be required to create a suitable (well graded) fill material.

The suitability of re-using site-won fill and natural soil should also be considered from a contamination perspective.

If fill is imported to the site, then the engineering properties (e.g. plasticity, reactivity, CBR, etc.) should ideally be equivalent, or superior, to the existing suitable materials on site.

9.4 Excavation

Removal of the topsoil, fill, natural soils and up to low strength rock should be readily achievable using conventional earthmoving plant. Large excavators fitted with rock hammers, single tyne ripper and toothed buckets would be required should excavations encounter medium or higher strength rock, at

low production rates. Pending detailed geotechnical investigation results and excavation depths, some blasting may be warranted.

It should be noted that any off-site disposal of spoil will generally require assessment for re-use or classification in accordance with current *Waste Classification Guidelines* NSW EPA (2014). Further advice in relation to contamination will be provided separately.

9.5 Excavation Support

Vertical excavations within the soil and weathered rock will not be stable. For excavations up to 3 m in depth, maximum temporary batter slopes of 1H:1V (horizontal : vertical) are recommended. Permanent batter slopes should not be steeper than 3H:1V and should generally be flatter where vegetation maintenance is required. Erosion protection must be provided for all permanent batters. Further advice should be sought if deeper excavations are proposed.

Surcharge loads should not be placed closer to the crest of the batter than a distance equal to the vertical height of the batter, unless specific geotechnical stability analysis shows that the loads can be placed closer.

Retaining structures, if required, may be preliminarily designed using the parameters in Table 7. It is suggested that preliminary design for cantilevered or walls anchored with a single row of anchors be based on a triangular distribution with the lateral earth pressure being determined as a proportion of the vertical stress as given in the following formula:

$\sigma_z = K\ z\ \gamma$, where σ_z = Horizontal pressure at depth z (kPa)
K = Earth pressure coefficient
z = Depth (m)
γ = Unit weight of soil or rock (kN/m^3)

Table 7: Retaining Wall Design Parameters

Material	Unit Weight (kN/m^3)	Earth Pressure Coefficient		Ultimate Passive Earth Pressure (kPa)[1]
		Active (K_a)	At Rest (K_0)	
Controlled Fill	20	0.3	0.5	200
Very Stiff to Hard/ Medium Dense to Dense Natural Soil	20	0.3	0.5	250
Weathered Rock (very low strength and stronger)	22	0.25[2]	0.4[2]	400[2]

Notes: [1]Below a minimum of 0.5 m embedment below the base of the excavation;
[2]Provided that adverse jointing is not encountered in the rock.

The 'At Rest' coefficient (K_0) should be used where shoring walls are close to existing structures, to minimise ground (and wall) movements. Sections of the wall where small movements of the wall are acceptable can be designed for the 'active' (K_a) condition.

Embedment of the wall can be used to achieve passive support. A triangular passive earth pressure distribution (increasing linearly with depth) may be assumed, starting from 0.5 m below excavation toe/base level.

Lateral pressures due to surcharge loads from adjacent buildings, sloping ground surfaces, pavements and construction machinery should be included where relevant. Hydrostatic pressure acting on retaining walls should also be included in the design where adequate drainage is not provided behind the full height of the walls.

9.6 Groundwater

During DP's previous investigation (DP, 2021) no groundwater seepages were noted in auger only holes or during the auger phase of cored boreholes. Piezometers were installed in boreholes BH02, BH08 and BH09. Groundwater was observed in boreholes BH02 and BH08 at 5.39 m and 5.84 m respectively on 4 May 2021. During the walkover for the additional northern area of the site, evidence of groundwater was not observed (i.e. no water seepage was occurring from the slopes on site). However, seepages at a higher level are likely to occur through fractures within the rock and/or within the extremely weathered permeable layers (i.e. gravelly sand/silty sand), particularly following periods of prolonged rain.

It is also possible for shallower groundwater to be present within the additional northern portion of the site due to the location being adjacent to Turallo Creek and the area is also lower in elevation compared to the rest of the site.

Surface drainage measures are recommended to divert overland stormwater flows around future structures and pavements to minimise the risk of adverse impacts of moisture ingress.

Drainage measures will also need to be provided for any subsurface structures or behind retaining walls to allow any seepage to flow around the structures rather than exert hydrostatic pressures against them.

Groundwater conditions rarely remain constant and can change seasonally due to variations in rainfall, temperature and soil permeability. For these reasons, it is noted that the moisture condition of the site soils may vary considerably from the time of the assessment compared to at the time of construction.

9.7 Foundations

All footings must found within a uniform bearing stratum of suitable strength/material, below the zone of influence of any uncontrolled fill (if left in place), service trenches, backfill zones, retaining walls or underground structures. Masonry walls should be articulated in accordance with current best practice.

It is recommended that either bored piers or pad footings founding on rock would provide the most robust footing system to support columns, especially for two to three storey structures. Footings to rock would minimise total and differential settlements as it allows a strong uniform bearing stratum to be utilised. Bulk earthworks in areas of structures could then be treated as form fill as the structural loading would be transferred to the rock stratum. It should be noted that suitable compaction of the form fill still needs

to be applied as the fill would be required to support services (i.e. piling rig, plant etc.). This should be to a Level 2 standard as defined in AS3798:2007.

Structure design will need to ensure suitable drainage and uniform moisture conditions are maintained in the vicinity of the footings otherwise footing performance would be compromised. Footing systems must be confirmed by a structural engineer taking into consideration any onsite or offsite constraints.

For building structures, suitable footing systems could include pad and strip footings (in controlled fill) or bored cast-in situ reinforced concrete piers. Suggested allowable base bearing pressures are as follows:

- Controlled fill 150 kPa
- Stiff / medium dense natural soils 100 kPa
- Very stiff to hard / dense natural soils 150 kPa
- Extremely low to very low strength bedrock 500 kPa
- Low strength bedrock 1000 kPa
- Medium to high strength bedrock 2500 kPa

Settlements of footings will be dependent on the applied load and the sizing of the footing and at this stage cannot be determined. Confirmation of suitable footing systems and expected settlements can be undertaken once building design is suitably advanced.

It is recommended that an intrusive investigation is undertaken for the additional northern portion of the site as it is likely that deep fill and unconsolidated alluvial soils may be present. Intrusive investigations should aim to target bedrock.

9.8 Pavement Subgrades

A design California bearing ratio (CBR) of 2% is suggested as a preliminary value for silty clay natural soils at the site. It noted that a CBR value of 0.5% was obtained from DP's previous investigation (DP, 2021) in BH06 at 0.5 – 0.8 m depth and subgrade replacement in this area and any other area that records a CBR value less than the design value will be required. Confirmatory CBR tests should be undertaken for all subgrade areas during construction. A higher CBR value (say 3%) could be adopted for design however, this could lead to larger areas of subgrade replacement due the extent of high plasticity soils underlying the site.

Areas with weathered rock exposed at subgrade level, a design CBR of 7% to 10% could be adopted, pending weathering and strength of the rock.

The CBR of any imported fill should also be assessed to confirm the suggested design value is appropriate.

All pavement preparation works should be undertaken under close supervision and consultation with the geotechnical consultant in order to avoid any unnecessary earthworks. The standard of construction, the selection of materials and quality of workmanship for the roads should satisfy the latest requirements of Queanbeyan Palerang Regional Council.

Surface and subsoil drainage must be installed and maintained to protect the pavement and subgrade. Subsoil drains should be located at a minimum of 0.5 m depth below the subgrade level and be included adjacent to any traffic islands.

9.9 Seismic Loading

In accordance with AS1170:2007, *Structural Design Actions, Part 4: Earthquake Actions in Australia*, a hazard factor (Z) of 0.05 and a site subsoil Class C_e are considered appropriate for the site.

Investigations at the site will be required to confirm the site subsoil class.

9.10 Recommended Further Geotechnical Investigation

It is recommended that intrusive geotechnical investigations are undertaken within the additional northern area to obtain specific information on the site. The investigations should include:

- Cored boreholes for soil and rock identification and collection of samples; and
- Laboratory testing for soil and rock classification, design CBR and aggressivity to buried structural elements.

10. References

AS 1289.6.3.1:1997 Rec 2013, *Soil strength and consolidation tests—Determination of the penetration resistance of a soil—Standard penetrometer test (SPT)*, Standards Australia.

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

AS 3798:2007, *Guidelines on Earthworks for Commercial and Residential Developments*, Standards Australia.

AS1170:2007, *Structural Design Actions, Part 4: Earthquake Actions in Australia*, Standards Australia

BMR, 1992, *Geology of Canberra 1:100 000 Geological Series Sheet 8727*, Bureau of Mineral Resources, Geology and Geophysics.

DP, 2021, *'Report on Geotechnical Investigation, Proposed Bungendore Public School, Majara Street and Gibraltar Street, Bungendore'*, Douglas Partners Pty Ltd dated 12 May 2021.

11. Limitations

Douglas Partners (DP) has prepared this report for this project at Majara Street, Bungendore in accordance with DP's proposal 94188.03.P.002.Rev0 dated 6 July 2021 and acceptance received from Doug MacPherson dated 14 July 2021. The work was carried out under contract ID SINSW01327/20, dated 3 March 2021. This report is provided for the exclusive use of NSW Department of Education - School Infrastructure NSW for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

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

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.

Douglas Partners Pty Ltd

Appendix A

About This Report

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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.

Appendix B

Drawing 1

Locality Plan

LEGEND

- Approximate Site Boundary
- Queanbeyan-Palerang Regional Council Offices
- Community Centre
- Swimming Pool Boundary
- Fill Mound
- Approximate Extent of Observed Surface Fill
- Approximate Borehole Location

0 15 30 45 60 75

1:1500 @ A3

NOTE: Base drawing from Google Earth Pro, dated 2019)

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: School Infrastructure NSW		
OFFICE: Canberra	DRAWN BY: SDG	
SCALE: As Shown	DATE: 07.08.2021	

TITLE: **Site Features and Test Location Plan**
Proposed High School
Majara Street, Bungendore

N

PROJECT No:	202107.02
DRAWING No:	1
REVISION:	2

Appendix C

Explanatory Notes
Borehole Logs

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).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

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

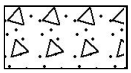
Symbols & Abbreviations

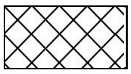
Graphic Symbols for Soil and Rock

General

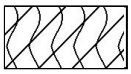

Asphalt

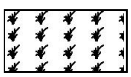

Road base

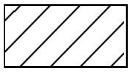

Concrete

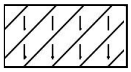

Filling

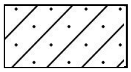
Soils


Topsoil

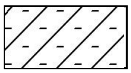

Peat

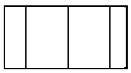

Clay

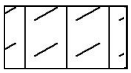

Silty clay

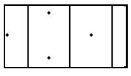

Sandy clay

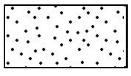

Gravelly clay

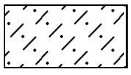

Shaly clay

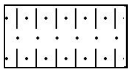

Silt


Clayey silt


Sandy silt

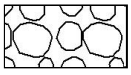

Sand

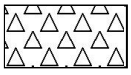

Clayey sand


Silty sand


Gravel

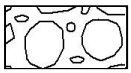

Sandy gravel


Cobbles, boulders

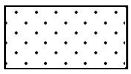

Talus

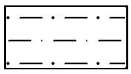
Sedimentary Rocks

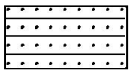

Boulder conglomerate

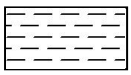

Conglomerate


Conglomeratic sandstone

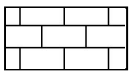

Sandstone


Siltstone

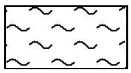

Laminite

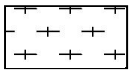

Mudstone, claystone, shale

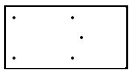

Coal


Limestone

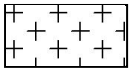
Metamorphic Rocks

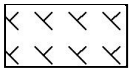

Slate, phyllite, schist

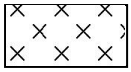

Gneiss

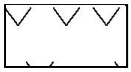

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 696.5 AHD
EASTING: 722530
NORTHING: 6096130
DIP/AZIMUTH: 90°/--

BORE No: BH01
PROJECT No: 202107.03
DATE: 25/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Type	Core Rec. %	RQD %	Test Results & Comments
696	0.2	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist to dry, w>PL, firm, TOPSOIL FILL	E			PID < 1
			D			
	0.4	FILL/Silty SAND (SM): fine grained, brown and pale brown, low plasticity silt, moist to wet, loose to medium dense, FILL	D			
	0.6	FILL/Silty CLAY (CI/CH): medium to high plasticity, brown and pale brown, trace gravel and rootlets, dry to moist, w<PL, hard, FILL	D E			PID < 1
			S			6,10,26 N = 36
	1.0	Silty CLAY (CI): medium plasticity, pale brown and grey, trace fine grained sand, dry to moist, w<PL, hard, extremely weathered siltstone	D E			PID = 1
		SILTSTONE: fine grained, pale brown, dry to moist, low strength, highly weathered, highly fractured	S			18,24,30/50 refusal
695						
	2	-from 2.0m, grey	D E			PID < 1
694		-from 2.5m, grey and pale red	D			
			S			15/75 refusal
		2.7m: J, 70°, pl, sm, cly vn 2.77m: J, 10°, pl, he	C	100	36	PL(D) = 0.05
	3	2.95m: J, 40°, un, ro, cly vn 3m: drillers break 3.13m: J, 70°, pl, sm, cly vn 3.15m: J, 25°, ir, ro, cly vn 3.2m: J, 25°, ir, ro, cly vn 3.25m: J, 80°, un, ro, cly vn 3.3m: End of run 3.46m: J, 40°, pl, ro 3.65m: J, 40°, pl, ro				
693		-from 3.4m, medium strength, moderately weathered				PL(D) = 0.78 UCS = 4.9MPa
	4	3.87m: J, 10°, pl, ro 3.88m: - 4.00m: drillers break	C	100	100	PL(D) = 0.77
		4.16m: J, 45°, un, ro 4.19m: J, 10°, ir, he 4.28m: J, 35°, un, ro				PL(A) = 0.45 UCS = 7.3MPa
692		-from 4.5m, grey and brown 4.48m: J, 20°, pl, he				
		-from 4.7m, low to medium strength, highly weathered 4.63m: J, 45°, pl, ro, cly vn 4.75m: End of run				
		-from 4.9m, pale brown and grey 4.82m: J, 20°, ir, ro, cly vn	C	100	75	

Degree of Weathering: EW, HW, MW, SW, FS, FR
Graphic Log
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Water
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00
Discontinuities: B - Bedding J - Joint S - Shear F - Fault

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO/EAGL **CASING:** HQ to 2.6m

TYPE OF BORING: Continuous flight auger to 2.6m, coring to 6.15m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 696.5 AHD
EASTING: 722530
NORTHING: 6096130
DIP/AZIMUTH: 90°/--

BORE No: BH01
PROJECT No: 202107.03
DATE: 25/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
691		SILTSTONE: fine grained, pale brown, dry to moist, low strength, highly weathered, highly fractured *(continued)* -from 5.35m, pale red and pale brown						5.16m: J, 55°, pl, sm, cly vn 5.24m: J, 30°, ir, sm, cly vn 5.3m: - 5.35m: drillers break 5.35m: End of run 5.43m: J, 25°, ir, ro 5.5m: J, 30°, pl, he 5.56m: J, 10°, ir, ro 5.61m: J, 15°, ir, ro, cly vn 5.73m: J, 30°, ir, ro, cly vn 5.75m: J, 30°, pl, ro, cly vn 5.81m: J, 30°, ir, he 5.92m: J, 30°, st, sm 6m: J, 30°, un, sm 6.06m: J, 40°, pl, sm 6.08m: J, 40°, pl, sm 6.11m: J, 40°, pl, sm 6.15m: End of run	C	100	75	
	6								C	100	52	PL(A) = 0.12 PL(D) = 0.21 PL(D) = 0.40
	6.15	Bore discontinued at 6.15m -limit of investigation										
690	7											
689	8											
688	9											
687												

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO/EAGL **CASING:** HQ to 2.6m

TYPE OF BORING: Continuous flight auger to 2.6m, coring to 6.15m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697 AHD
EASTING: 722565
NORTHING: 6096143
DIP/AZIMUTH: 90°/--

BORE No: BH02
PROJECT No: 202107.03
DATE: 26/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
697	0.2	TOPSOIL FILL/Sandy CLAY (CL): low plasticity, brown, fine grained sand, with rootlets, moist, w~PL, stiff, TOPSOIL FILL	EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00		E			PID = 2.7
		FILL/CLAY (CI): medium plasticity, pale brown-yellow, with fine to medium grained sand and low plasticity silt, moist, w~PL, stiff, FILL							D			
	0.5	Silty CLAY (CL/CI): low to medium plasticity, pale brown and orange, trace fine grained sand, dry to moist, w<PL, very stiff to hard, residual							D E			PID < 1
		-from 0.7m, extremely weathered siltstone							S			3,5,8 N = 13
696	1								D E			PID < 1
	1.2	SILTSTONE: fine grained, dry to moist, low strength, highly weathered, highly fractured							U_{50}			
									D S			30/130 refusal
		-from 1.8m, pale blue, pale red, medium strength, moderately weathered, fractured						1.86m: J, 80°, i, sm 2m: drillers break 2.01m: - 2.12m: J, generally 50°, pl, he, 40mm in spacing 2.17m: J, 30°, pl, sm 2.44m: J, 75°, pl, sm, cly vn 2.45m: J, 10°, pl, ro 2.7m: J, 75°, pl, ro 2.87m: J, 45°, ir, ro 3m: J, 30°, pl, ro 3.08m: J, 15°, un, ro, cly vn 3.2m: - 3.40m: J, generally 30°, pl, ro, 20-80mm in spacing 3.4m: End of run 3.45m: too fractured to distinguish 3.49m: J, 50°, ir, sm 3.575m: J, 50°, un, ro 3.6m: J, 5°, ir, ro, cly vn 3.77m: J, 50°, ir, sm 3.86m: J, 75°, pl, sm 3.91m: drillers break 4m: drillers break 4.28m: J, 45°, un, ro 4.51m: J, 15°, pl, ro 4.58m: J, 15°, st, sm 4.7m: - 4.95m: quartz band	C	100	65	PL(A) = 0.37 UCS = 1.9MPa
695	2											
												PL(D) = 0.27
694	3	-from 3.05m, pale brown and pale blue										PL(A) = 0.33
		-from 3.55m, pale blue and red, low to medium strength, highly weathered										PL(D) = 0.43
		-from 3.7m, pale red and yellow										
		-from 3.9m, grey and pale orange										
693	4								C	100	59	UCS = 6.1MPa
												PL(D) = 0.68
		-from 4.5m, blue and pale red										PL(A) = 0.21
		-from 4.7m to 4.95m, quartz band, low to medium strength, highly fractured										

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO/EAGL **CASING:** HQ to 1.8m

TYPE OF BORING: Continuous flight auger to 1.8m, coring to 6.00m

WATER OBSERVATIONS: Well installed after hole completion

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697 AHD
EASTING: 722565
NORTHING: 6096143
DIP/AZIMUTH: 90°/--

BORE No: BH02
PROJECT No: 202107.03
DATE: 26/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
692		-from 4.95m, medium strength, moderately weathered, fractured SILTSTONE: fine grained, dry to moist, low strength, highly weathered, highly fractured *(continued)*						5m: End of run				
								5.19m: J, 20°, un, sm				PL(A) = 0.36 PL(D) = 0.29
								5.375m: J, 30°, pl, sm 5.41m: J, 30°, un, ro 5.515m: J, 30°, ir, ro	C	100	91.5	
								5.66m: J, 30°, un, sm				PL(A) = 0.29 PL(D) = 0.46 UCS = 6.0MPa
691	6 6.0	Bore discontinued at 6.0m -limit of investigation						5.95m: J, 20°, pl, sm 6m: End of run				
690	7											
689	8											
688	9											

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO/EAGL **CASING:** HQ to 1.8m

TYPE OF BORING: Continuous flight auger to 1.8m, coring to 6.00m

WATER OBSERVATIONS: Well installed after hole completion

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 694.75 AHD
EASTING: 722468
NORTHING: 6096157
DIP/AZIMUTH: 90°/--

BORE No: BH01-T
PROJECT No: 202107.03
DATE: 25/3/2021
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
694	0.3	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist to dry, w>PL, firm, TOPSOIL FILL		E	0.1		PID = 2.4		
	0.6	FILL/Silty CLAY (CL): low plasticity, brown and pale brown, trace fine gravel and fine to medium grained sand, moist to dry, w<PL, very stiff, FILL		D E	0.5		PID = 2		
		Silty CLAY (CL/CI): low to medium plasticity, yellow-pale brown, trace fine gravel, dry to moist, w<PL, hard, residual/extremely weathered siltstone		B S	0.8		6,10,22 N = 32		
	1	-from 0.9m, orange-pale brown		D E S	0.95 1.0 1.21		PID < 1 10,30/60 refusal		1
		-from 1.3m, orange-pale red							
693		-from 1.5m, hard, with rock fragments, extremely weathered siltstone							
	2			D E	2.0		PID < 1		2
		-from 2.4m, pale orange-grey		D S	2.5 2.63		30/130 refusal		
692	3 3.0	Bore discontinued at 3.0m -limit of investigation		D	3.0				3
691	4								4
690									

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO/EAGL **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 695 AHD
EASTING: 722503
NORTHING: 6096153
DIP/AZIMUTH: 90°/--

BORE No: BH02-T
PROJECT No: 202107.03
DATE: 25/3/2021
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
695		TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist, w>PL, firm, TOPSOIL FILL		E	0.1		PID < 1		
	0.3	FILL/Silty SAND (SM): fine grained, brown and pale brown, low plasticity silt, moist to wet, loose to medium dense, FILL		D E	0.3		PID = 1.10		
	0.5	FILL/Silty CLAY (CL): low plasticity, brown and pale brown, trace fine gravel and fine to medium grained sand, dry to moist, w<PL, hard, FILL		D E	0.5		PID < 1		
	0.7			S			6,30/130 refusal		
		Silty CLAY (CL/CI): low to medium plasticity, yellow-pale brown, trace fine gravel, dry to moist, w<PL, hard, residual/extremely weathered siltstone			0.78				
694	1			D E	1.0		PID = 1.4		1
				U_{50}					
		-from 1.3m, orange-pale red			1.4				
		-from 1.5m, with rock fragments, extremely weathered siltstone		D S	1.5 1.64		30/140 refusal		
693	2	-from 2.0m, pale red/orange-brown		D E	2.0		PID = 1.1		2
				S	2.5 2.59		30/85 refusal		
692	3 3.0	Bore discontinued at 3.0m -limit of investigation		D	3.0				3
691	4								4

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO/EAGL **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697.5 AHD
EASTING: 722590
NORTHING: 6096147
DIP/AZIMUTH: 90°/--

BORE No: BH03
PROJECT No: 202107.03
DATE: 26/3/2021
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
697	0.2	TOPSOIL FILL/Sandy CLAY (CL): low plasticity, brown, fine grained sand, with rootlets, moist, w>PL, stiff, TOPSOIL FILL		E	0.1		PID < 1		
	0.4	FILL/CLAY (CI): medium plasticity, pale brown-yellow, with fine to medium grained sand and low plasticity silt, dry to moist, w<PL, hard, FILL		D	0.3				
		Silty CLAY (CL/CI): low to medium plasticity, pale brown and orange, trace fine grained sand, dry to moist, w<PL, hard, residual		D E S	0.5		PID < 1 3,30 refusal		
					0.8				
696	1.0	SILTSTONE: fine grained, dry to moist, low strength, highly weathered, highly fractured		D E	1.0		PID < 1		1
		-from 1.5m, highly to moderately weathered, low to medium strength		D S	1.5 1.55		30/50 refusal		
	1.7	Bore discontinued at 1.7m -refusal							
695	2								2
694	3								3
693	4								4

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO/EAGL **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 1.7m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 696.25 AHD
EASTING: 722514
NORTHING: 6096090
DIP/AZIMUTH: 90°/--

BORE No: BH04
PROJECT No: 202107.03
DATE: 29/3/2021
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
696	0.2	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist, w>PL, firm, TOPSOIL FILL		E	0.1		PID < 1		
	0.4	FILL/CLAY (Cl/CH): medium to high plasticity, dark brown and red, with low plasticity silt, moist, w~PL, stiff to very stiff, FILL		D E S	0.5 0.53		PID < 1 5,30 refusal		
	0.7	Silty CLAY (Cl): medium plasticity, pale brown, dry to moist, w<PL, hard, possibly alluvium							
	1 1.0	Clayey SILT (ML): low plasticity, pale brown and grey, dry to moist, w<PL, hard, possibly alluvium		D E	1.0		PID < 1		1
695	1.3	Silty CLAY (CL/Cl): low to medium plasticity, pale brown and grey, dry to moist, w<PL, hard, extremely weathered siltstone							
		SILTSTONE: fine grained, pale brown and grey, dry to moist, very low strength, highly weathered, highly fractured		D	1.5				
				S			19,30/130 refusal		
					1.78				
	2			D E	2.0		PID < 1		2
694		-from 2.2m, pale red and grey							
		-from 2.5m, yellow and grey			2.5				
				S			15,30/50 refusal		
					2.85				
	3 3.0	Bore discontinued at 3.0m -limit of investigation							3
693									
	4								4
692									

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697 AHD
EASTING: 722555
NORTHING: 6096087
DIP/AZIMUTH: 90°/--

BORE No: BH05
PROJECT No: 202107.03
DATE: 26/3/2021
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
697		TOPSOIL FILL/Sandy CLAY (CL): low plasticity, brown, fine grained sand, with rootlets, moist, w>PL, stiff,		E	0.1		PID < 1		
	0.2	TOPSOIL FILL							
		FILL/Silty SAND (SM): fine grained, brown and pale brown, low plasticity silt, moist to wet, loose to medium dense, FILL		D	0.3				
	0.4								
		FILL/Silty CLAY (CI): medium plasticity, brown, trace fine to coarse grained sand, moist to dry, w<PL, very stiff, FILL		D E	0.5		PID < 1		
	0.6								
		Silty CLAY (CL/CI): low to medium plasticity, pale brown and orange, trace fine grained sand, dry to moist, w<PL, very stiff, residual		S			3,7,11 N = 18		
696	1				0.95				
		-from 1.0m, extremely weathered siltstone		D E	1.0		PID < 1		1
	1.4								
		SILTSTONE: fine grained, pale brown, dry to moist, low strength, highly weathered, highly fractured		D	1.5				
		-from 1.7m, grey and pale brown		S			8,24,30/130 refusal		
695	2				1.93				
				D E	2.0		PID < 1		2
		-from 2.5m, pale brown and pale red			2.5				
				S			6,22,30/120 refusal		
694	3				2.92				
	3.0	Bore discontinued at 3.0m		D E	3.0		PID < 1		3
		-limit of investigation							
693	4								4

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697.5 AHD
EASTING: 722592
NORTHING: 6096079
DIP/AZIMUTH: 90°/--

BORE No: BH06
PROJECT No: 202107.03
DATE: 26/3/2021
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
697	0.2	TOPSOIL FILL/Sandy CLAY (CL): low plasticity, brown, fine grained sand, with rootlets, moist, w>PL, stiff, TOPSOIL FILL		E	0.1		PID < 1		
	0.4	FILL/CLAY (CI): medium plasticity, pale brown-yellow, with fine to medium grained sand and low plasticity silt, dry to moist, w<PL, stiff, FILL		D	0.3				
	0.5	Silty CLAY (CL): low plasticity, pale brown, moist, w<PL, stiff to very stiff, residual		D E	0.5		PID < 1		
		Silty CLAY (CL/CI): low to medium plasticity, pale brown and orange, trace fine grained sand, dry to moist, w<PL, stiff, residual		B S	0.8		3,5,30 N = 35		
	1.0	-from 0.7m, pale brown and grey, extremely weathered siltstone		D E	0.95 1.0		PID < 1		
696		SILTSTONE: fine grained, dry to moist, low strength, highly weathered, highly fractured		U_{50}	1.4				
				D S	1.5 1.65		30/140 refusal		
695				D E S	2.5 2.7		PID < 1 15,30/50 refusal		
	3.0	Bore discontinued at 3.0m -limit of investigation		D E	3.0		PID < 1		
694									
693									

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 696.5 AHD
EASTING: 722499
NORTHING: 6096034
DIP/AZIMUTH: 90°/--

BORE No: BH07
PROJECT No: 202107.03
DATE: 30/3/2021
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
696	0.2	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist, w>PL, firm, TOPSOIL FILL		E	0.1		PID < 1		
	0.3	FILL/Silty CLAY (CL): low plasticity, dark brown, with fine grained sand and rootlets, moist to dry, w<PL, firm to stiff, FILL		D	0.5		PID < 1		
		Silty CLAY (CL/CI): low to medium plasticity, yellow/pale brown, with fine to coarse grained sand, dry to moist, w<PL, hard		E					
		-from 0.6m, yellow and pale red, extremely weathered siltstone		S			7,15,30/120 refusal		
					0.92				
	1			D	1.0		PID < 1		1
695		-from 1.5m, pale red and pale brown		E					
				D	1.5				
				S			24,30/60 refusal		
					1.86				
	2			D	2.0		PID < 1		2
694				E					
					2.5				
				S			18,30/75 refusal		
					2.88				
	3								3
	3.0	Bore discontinued at 3.0m -limit of investigation							
693									
	4								4
692									

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697 AHD
EASTING: 722515
NORTHING: 6096032
DIP/AZIMUTH: 90°/--

BORE No: BH08
PROJECT No: 202107.03
DATE: 29/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
697	0.2	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist, w>PL, firm, TOPSOIL FILL							E			PID < 1
	0.7	FILL/Silty CLAY (CL): low plasticity, brown/grey, with rootlets, trace fine to coarse grained sand, moist to dry, w~PL, very stiff, FILL							D E			PID < 1
696	1	Silty CLAY (CI/CH): medium to high plasticity, yellow and brown, with siltstone gravel, dry to moist, w<PL, very stiff to hard, extremely weathered siltstone							S			5,18,30/140 refusal
	1.2	SILTSTONE: fine grained, pale brown and grey, dry to moist, low strength, highly weathered, fractured							D E U			PID < 1
								1.5m: - 1.57m: too fractured	D E S			PID < 1 30 refusal
		-from 1.65m, yellow-pale red and grey						1.57m: J, 10°, ir, ro, cly co 2mm 1.625m: J, 10°, ir, sm, cly co 2mm 1.665m: J, 10°, pl, sm 1.75m: J, 40°, pl, he 1.795m: J, 20°, ir, sm 1.95m: J, 60°, pl, sm	C	100	63	PL(A) = 0.22 PL(D) = 0.43
695	2	-from 2.1m, pale red-yellow and grey						2.11m: J, 30°, ir, ro 2.12m: - 2.20m: too fractured to distinguish 2.2m: End of run 2.21m: - 2.28m: too fractured to distinguish 2.28m: J, 10°, pl, sm, cly vn 2.32m: J, 80°, pl, sm, cly vn 2.37m: - 3.10m: J, generally 15°-45°, or 80°, pl, or un, sm, every 0.05m	C	100	0	PL(D) = 0.14
694	3	-from 3.1m, yellow and pale red						3.18m: J, 330°, pl, cly co 2mm 3.25m: End of run 3.28m: J, 60°, un, he 3.29m: - 3.40m: too fractured to distinguish 3.4m: - 3.70m: J, generally 20°-30°, pl, sm 3.65m: J, 70°, pl, sm 3.7m: - 3.77m: too fractured to distinguish	C	100	0	PL(A) = 0.23 PL(D) = 0.23
		-from 3.3m, red and yellow, highly fractured										
		-from 3.7m, pale yellow and grey										
693	4							3.85m: J, 30°, ir, ro 3.86m: - 4.10m: too fractured to distinguish 4.1m: End of run 4.11m: - 4.25m: too fractured to distinguish 4.25m: CORE LOSS: 50mm 4.45m: J, 45°, pl, sm 4.47m: - 4.58m: too fractured to distinguish	C	92	40	PL(D) = 0.15
	4.3	-from 4.3m, fractured										
								4.71m: J, 10°, ir, ro 4.72m: - 4.80m: drillers break 4.8m: End of run	C	100	0	PL(A) = 0.05
		-from 4.9m, highly fractured										

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** HQ to 1.5m

TYPE OF BORING: Continuous flight auger to 1.5m, coring to 6.5m

WATER OBSERVATIONS: Well installed after hole completion

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697 AHD
EASTING: 722515
NORTHING: 6096032
DIP/AZIMUTH: 90°/--

BORE No: BH08
PROJECT No: 202107.03
DATE: 29/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
692		SILTSTONE: fine grained, pale brown and grey, dry to moist, low strength, highly weathered, fractured *(continued)* -from 5.3m, grey and pale brown -from 5.5m, fractured						4.81m: - 4.95m: too fractured to distinguish 5m: J, 5°, pl, ro 5.01m: - 5.15m: cly 5.15m: - 5.41m: J, generally 10°-30°, pl, ro, 30-70mm 5.41m: - 5.50m: drillers break 5.5m: End of run 5.51m: - 5.60m: too fractured to distinguish 5.69m: J, 10°, un, ro, fe stn, cly co 4mm 5.74m: J, 30°, un, ro 5.82m: J, 30°, ir, ro 5.83m: - 5.86m: too fractured to distinguish 5.96m: J, 20°, pl, ro, cly vn 5.97m: - 6.00m: drillers break	C	100	0	
									C	100	20	PL(D) = 0.09 PL(A) = 0.07 PL(D) = 0.14
691	6 6.0	Bore discontinued at 6.0m -limit of investigation										
690	7											
689	8											
688	9											

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** HQ to 1.5m

TYPE OF BORING: Continuous flight auger to 1.5m, coring to 6.5m

WATER OBSERVATIONS: Well installed after hole completion

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 696.25 AHD
EASTING: 722471
NORTHING: 6095980
DIP/AZIMUTH: 90°/--

BORE No: BH09
PROJECT No: 202107.03
DATE: 30/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
696	0.2	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist, w>PL, firm, TOPSOIL FILL		E	0.1		PID < 1		Close well with concrete capping at gatic over a 50mm Torque plug
	0.4	FILL/Silty CLAY (CL): low plasticity, dark brown/dark grey, with fine grained sand, fine to medium gravel, and rootlets, moist, w~PL, firm to stiff, FILL							From 0.0m to 0.5m, filling
	0.6	CLAY (CH): high plasticity, pale brown-yellow, with low plasticity silt, trace fine gravel,moist, w<PL, stiff		D E	0.5		PID < 1		
		Silty CLAY (CI): medium plasticity, pale yellow-brown, dry to moist, w<PL, very stiff, residual		S			2,3,14 N = 17		From 0.5m to 1.0m, bentoile plug
	1	-from 1.0m, very stiff		D E	0.95 1.0		PID < 1		1
695		-from 1.3m, yellow and red							
		-from 1.5m, extremely weathered siltstone		D	1.5				
				S			8,16,30 N = 46		
	2			D E	1.95 2.0		PID < 1		2
694				D	2.5				
				S			9,19,30 N = 49		
	3	3.0 SILTSTONE: fine grained, yellow-brown, dry, very low strength, highly weathered, highly fractured to fractured			2.95				3
693									From 1.0m to 6.0m, wash graded sand
									From 1.5m to 6.0m, 50mm diameter class 18 PVC pipe screen and sock
	4			D E	4.0		PID < 1		4
				S			7,30 refusal		
692					4.3				
				D	5.0		PID < 1		

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 6.0m

WATER OBSERVATIONS: Well installed after hole completion

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 696.25 AHD
EASTING: 722471
NORTHING: 6095980
DIP/AZIMUTH: 90°/--

BORE No: BH09
PROJECT No: 202107.03
DATE: 30/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
691		SILTSTONE: fine grained, yellow-brown, dry, very low strength, highly weathered, highly fractured to fractured *(continued)*		E					
				S	5.5		14,30 refusal		
					5.8				End cap at 6.0m
	6 6.0	Bore discontinued at 6.0m -limit of investigation		D E	6.0		PID < 1		6
690									
	7								7
689									
	8								8
688									
	9								9
687									

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** TBO **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 6.0m

WATER OBSERVATIONS: Well installed after hole completion

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697.25 AHD
EASTING: 722506
NORTHING: 6095987
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 202107.03
DATE: 30/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
697	0.2	TOPSOIL FILL/Silty CLAY (CL): low plasticity, dark brown, with rootlets, trace fine grained sand, moist, w>PL, firm, TOPSOIL FILL		E	0.1		PID < 1		
		FILL/Silty CLAY (CI): medium plasticity, pale brown, trace fine grained sand, moist to dry, w~PL, very stiff, FILL		D E	0.5		PID < 1		
	0.7	Silty CLAY (CL/CI): low to medium plasticity, pale brown, with fine to coarse grained sand, dry to moist, w<PL, very stiff		S			3,11,15 N = 26		
696	1			D E U_{50}	0.95 1.0		PID < 1		1
		-from 1.3m, trace fine gravel							
		-from 1.5m, hard, extremely weathered siltstone		D	1.5				
				S			8,16,30 N = 46		
695	2			D E	1.95 2.0		PID < 1		2
				D S	2.5 2.55		30/50 refusal		
694	3			D E	3.0		PID < 1		3
	3.5	SILTSTONE: fine grained, pale red and pale brown, dry to moist, very low to low strength, highly weathered, highly fractured							
693	4			D E	4.0		PID < 1		4
				S	4.5 4.65		30 refusal		
				D	5.0		PID < 1		

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** EAGL **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 6.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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: School Infrastructure NSW
PROJECT: Proposed High School
LOCATION: Majara Street, Bungendore

SURFACE LEVEL: 697.25 AHD
EASTING: 722506
NORTHING: 6095987
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 202107.03
DATE: 30/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
692		SILTSTONE: fine grained, pale red and pale brown, dry to moist, very low to low strength, highly weathered, highly fractured *(continued)*		E					
		-from 5.0m, pale brown-yellow			5.5				
				S			15,30/75 refusal		
					5.73				
	6 6.0	Bore discontinued at 6.0m -limit of investigation							6
691									
	7								7
690									
	8								8
689									
	9								9
688									

RIG: EVH2100 **DRILLER:** S2S **LOGGED:** EAGL **CASING:** N/A

TYPE OF BORING: Continuous flight auger to 6.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55. Surface levels and coordinates are approximate only and must not be relied upon

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

Appendix D

Results of Laboratory Testing

Uniaxial Compressive Strength

Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Email: peter.gorseski@douglaspartners.com.au

Report Number:	202107.01_1
Issue Number:	1
Date Issued:	07.04.2021
Client:	NSW Dept of Education - School Infrastructure NSW Level 8, 259 George Street, Sydney NSW 2000
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School
Project Location:	Bungendore
Work Request:	6634
Date Sampled:	25 - 30.03.2021
Sampling Method:	Sampled by Others

The results apply to the sample as received

Accredited for Compliance with ISOIEC 17025 - Testing

Approved Signatory: Peter Gorseski
NATA Accredited Laboratory Number: 828

Uniaxial Compressive Strength of Rock Core AS 4133.4.2.2 < 50MPa, AS 4133.1.1.1

Sample Number	NC-6634A
Sample Location	BH01
Depth (m)	3.65 - 3.9
Rock Description	Siltstone
Storage History and Environment	Tested as Received
Orientation to Bedding	-
Compression Machine	Automax Multitest
Date of Testing	06.04.2021
Duration of Test (seconds)	4
Average Diameter (mm)	51.9
Average Height (mm)	128
Height to Diameter Ratio	2.5 : 1
Moisture Content (%)	3.2
Wet Mass / Unit Volume (t/m^3)	2.42
Dry Mass / Unit Volume (t/m^3)	2.34
Uniaxial Compressive Strength (MPa)	**4.9**
Comments	

Uniaxial Compressive Strength

Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Email: peter.gorseski@douglaspartners.com.au

Report Number:	202107.01_1
Issue Number:	1
Date Issued:	07.04.2021
Client:	NSW Dept of Education - School Infrastructure NSW
	Level 8, 259 George Street, Sydney NSW 2000
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School
Project Location:	Bungendore
Work Request:	6634
Date Sampled:	25 - 30.03.2021
Sampling Method:	Sampled by Others

The results apply to the sample as received

Accredited for Compliance with ISOIEC 17025 - Testing

Approved Signatory: Peter Gorseski
NATA Accredited Laboratory Number: 828

Uniaxial Compressive Strength of Rock Core AS 4133.4.2.2 < 50MPa, AS 4133.1.1.1

Sample Number	NC-6634B
Sample Location	BH01
Depth (m)	4.27 - 4.51
Rock Description	Siltstone
Storage History and Environment	Tested as Received
Orientation to Bedding	-
Compression Machine	Automax Multitest
Date of Testing	06.04.2021
Duration of Test (seconds)	13
Average Diameter (mm)	51.9
Average Height (mm)	135
Height to Diameter Ratio	2.6 : 1
Moisture Content (%)	3.8
Wet Mass / Unit Volume (t/m^3)	2.48
Dry Mass / Unit Volume (t/m^3)	2.39
Uniaxial Compressive Strength (MPa)	**7.3**
Comments	

Uniaxial Compressive Strength

Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Email: peter.gorseski@douglaspartners.com.au

Report Number:	202107.01_1
Issue Number:	1
Date Issued:	07.04.2021
Client:	NSW Dept of Education - School Infrastructure NSW Level 8, 259 George Street, Sydney NSW 2000
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School
Project Location:	Bungendore
Work Request:	6634
Date Sampled:	25 - 30.03.2021
Sampling Method:	Sampled by Others

The results apply to the sample as received

Accredited for Compliance with ISOIEC 17025 - Testing

Approved Signatory: Peter Gorseski
NATA Accredited Laboratory Number: 828

Uniaxial Compressive Strength of Rock Core AS 4133.4.2.2 < 50MPa, AS 4133.1.1.1

Sample Number	NC-6634C
Sample Location	BH02
Depth (m)	2.18 - 2.38
Rock Description	Siltstone
Storage History and Environment	Tested as Received
Orientation to Bedding	-
Compression Machine	Automax Multitest
Date of Testing	06.04.2021
Duration of Test (seconds)	8
Average Diameter (mm)	51.5
Average Height (mm)	129
Height to Diameter Ratio	2.5 : 1
Moisture Content (%)	9.0
Wet Mass / Unit Volume (t/m^3)	2.36
Dry Mass / Unit Volume (t/m^3)	2.17
Uniaxial Compressive Strength (MPa)	**1.9**
Comments	

Uniaxial Compressive Strength

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Email: peter.gorseski@douglaspartners.com.au

Report Number:	202107.01_1
Issue Number:	1
Date Issued:	07.04.2021
Client:	NSW Dept of Education - School Infrastructure NSW
	Level 8, 259 George Street, Sydney NSW 2000
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School
Project Location:	Bungendore
Work Request:	6634
Date Sampled:	25 - 30.03.2021
Sampling Method:	Sampled by Others

The results apply to the sample as received

Accredited for Compliance with ISOIEC 17025 - Testing

Approved Signatory: Peter Gorseski
NATA Accredited Laboratory Number: 828

Uniaxial Compressive Strength of Rock Core AS 4133.4.2.2 < 50MPa, AS 4133.1.1.1

Sample Number	NC-6634D
Sample Location	BH02
Depth (m)	4.02 - 4.28
Rock Description	Siltstone
Storage History and Environment	Tested as Received
Orientation to Bedding	-
Compression Machine	Automax Multitest
Date of Testing	06.04.2021
Duration of Test (seconds)	7
Average Diameter (mm)	51.6
Average Height (mm)	132
Height to Diameter Ratio	2.5 : 1
Moisture Content (%)	9.7
Wet Mass / Unit Volume (t/m^3)	2.38
Dry Mass / Unit Volume (t/m^3)	2.17
Uniaxial Compressive Strength (MPa)	**6.1**
Comments	

Uniaxial Compressive Strength

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
Newcastle Laboratory
15 Callistemon Close Warabrook Newcastle NSW 2310
Phone: (02) 4960 9600
Email: peter.gorseski@douglaspartners.com.au

Report Number:	202107.01_1
Issue Number:	1
Date Issued:	07.04.2021
Client:	NSW Dept of Education - School Infrastructure NSW
	Level 8, 259 George Street, Sydney NSW 2000
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School
Project Location:	Bungendore
Work Request:	6634
Date Sampled:	25 - 30.03.2021
Sampling Method:	Sampled by Others

The results apply to the sample as received

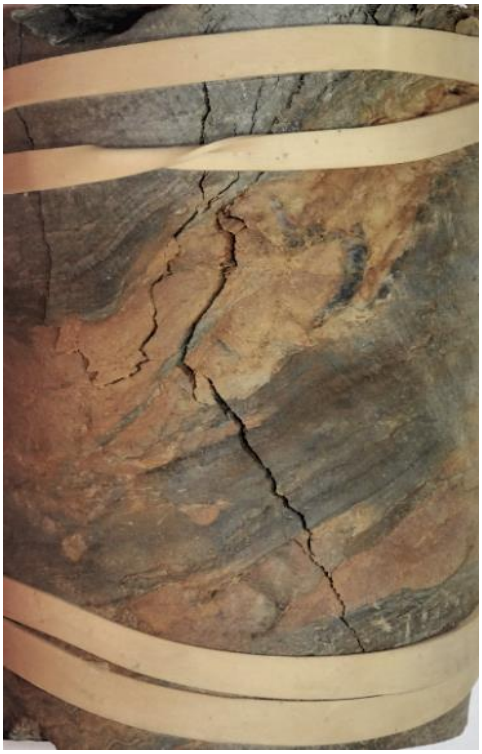
Accredited for Compliance with ISOIEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Peter Gorseski
NATA Accredited Laboratory Number: 828

Uniaxial Compressive Strength of Rock Core AS 4133.4.2.2 < 50MPa, AS 4133.1.1.1

Sample Number	NC-6634E
Sample Location	BH02
Depth (m)	5.65 - 5.94
Rock Description	Siltstone
Storage History and Environment	Tested as Received
Orientation to Bedding	-
Compression Machine	Automax Multitest
Date of Testing	06.04.2021
Duration of Test (seconds)	13
Average Diameter (mm)	51.6
Average Height (mm)	84
Height to Diameter Ratio	1.6 : 1
Moisture Content (%)	7.5
Wet Mass / Unit Volume (t/m^3)	2.42
Dry Mass / Unit Volume (t/m^3)	2.25
Uniaxial Compressive Strength (MPa)	**6.0**
Comments	



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Unanderra Laboratory
Unit 1/1 Luso Drive Unanderra NSW 2526
Phone: (02) 4271 1836
Fax: (02) 4271 1897
Email: anes.ibricic@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Anes Ibricic
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-2**
Issue Number: 1
Date Issued: 14/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 6966
Sample Number: WO-6966A
Date Sampled: 25/03/2021
Dates Tested: 06/04/2021 - 13/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH08-O , Depth: 1.0 - 1.4m**
Material: Silty Clay / Siltstone

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	37		
Plastic Limit (%)	20		
Plasticity Index (%)	**17**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	7.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	10.8

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Unanderra Laboratory
Unit 1/1 Luso Drive Unanderra NSW 2526
Phone: (02) 4271 1836
Fax: (02) 4271 1897
Email: anes.ibricic@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Anes Ibricic
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-2**
Issue Number: 1
Date Issued: 14/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 6966
Sample Number: WO-6966B
Date Sampled: 25/03/2021
Dates Tested: 06/04/2021 - 13/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH02-T , Depth: 1.0 - 1.4m**
Material: Silty Clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	38		
Plastic Limit (%)	29		
Plasticity Index (%)	**9**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	4.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	13.0

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Unanderra Laboratory
Unit 1/1 Luso Drive Unanderra NSW 2526
Phone: (02) 4271 1836
Fax: (02) 4271 1897
Email: anes.ibricic@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Anes Ibricic
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-2**
Issue Number: 1
Date Issued: 14/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 6966
Sample Number: WO-6966C
Date Sampled: 25/03/2021
Dates Tested: 06/04/2021 - 12/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH06 , Depth: 1.0 - 1.4m**
Material: Silty Clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	38		
Plastic Limit (%)	26		
Plasticity Index (%)	**12**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	5.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	7.1

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Unanderra Laboratory
Unit 1/1 Luso Drive Unanderra NSW 2526
Phone: (02) 4271 1836
Fax: (02) 4271 1897
Email: anes.ibricic@douglaspartners.com.au

Report Number:	**202107.01-2**
Issue Number:	1
Date Issued:	14/04/2021
Client:	NSW Department of Education - School Infrastructure NSW Level 8, 259 George Street, Sydney NSW 2000
Contact:	Nick Mentis
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location:	Majara Street and Gibraltar Street, Bungendore
Work Request:	6966
Date Sampled:	25/03/2021
Dates Tested:	06/04/2021 - 09/04/2021
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Location:	Majara and Gibraltar Streets Bungendore

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Anes Ibricic
Laboratory Manager
Laboratory Accreditation Number: 828

Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	WO-6966D	WO-6966E	WO-6966F		
Date Sampled	25/03/2021	25/03/2021	25/03/2021		
Date Tested	09/04/2021	09/04/2021	09/04/2021		
Material Source	In situ	In situ	In situ		
Sample Location	BH10 (1.0 - 1.4m)	BH12 (1.0 - 1.4m)	BH4-O (1.0 - 1.4m)		
Inert Material Estimate (%)	3	5	15		
Pocket Penetrometer before (kPa)	430	600+	600+		
Pocket Penetrometer after (kPa)	300	450	500		
Shrinkage Moisture Content (%)	22.4	20.6	19.2		
Shrinkage (%)	**1.5**	**2.4**	**3.6**		
Swell Moisture Content Before (%)	23.2	18.7	15.8		
Swell Moisture Content After (%)	29.2	23.1	18.1		
Swell (%)	**0.7**	**0.7**	**0.8**		
Shrink Swell Index Iss (%)	**1.0**	**1.5**	**2.2**		
Visual Description	Silty Clay	Silty Clay	Silty clay		
Cracking	UC	MC	MC		
Crumbling	No	No	No		
Remarks	**	**	**		

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.
NATA Accreditation does not cover the performance of pocket penetrometer readings.

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-3**
Issue Number: 1
Date Issued: 27/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 5774
Sample Number: GU-5774A
Date Sampled: 25/03/2021
Dates Tested: 07/04/2021 - 12/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01-T , Depth: 0.5**
Material: Fill/Silty Clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	25		
Plastic Limit (%)	13		
Plasticity Index (%)	**12**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	7.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	11.5

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-3**
Issue Number: 1
Date Issued: 27/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 5774
Sample Number: GU-5774B
Date Sampled: 25/03/2021
Dates Tested: 07/04/2021 - 12/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH14 , Depth: 0.5**
Material: Silty Clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	54		
Plastic Limit (%)	20		
Plasticity Index (%)	**34**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	15.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	23.8

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-3**
Issue Number: 1
Date Issued: 27/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 5774
Sample Number: GU-5774C
Date Sampled: 25/03/2021
Dates Tested: 07/04/2021 - 13/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH07 , Depth: 1.0**
Material: Silty Clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	30		
Plastic Limit (%)	21		
Plasticity Index (%)	**9**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	3.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	9.7

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

Report Number:	**202107.01-3**
Issue Number:	1
Date Issued:	27/04/2021
Client:	NSW Department of Education - School Infrastructure NSW Level 8, 259 George Street, Sydney NSW 2000
Contact:	Nick Mentis
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location:	Majara Street and Gibraltar Street, Bungendore
Work Request:	5774
Sample Number:	GU-5774D
Date Sampled:	25/03/2021
Dates Tested:	07/04/2021 - 13/04/2021
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**BH09 , Depth: 1.0**
Material:	Silty Clay

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	40		
Plastic Limit (%)	27		
Plasticity Index (%)	**13**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	4.5		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	21.2

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-3**
Issue Number: 1
Date Issued: 27/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 5774
Sample Number: GU-5774E
Date Sampled: 25/03/2021
Dates Tested: 07/04/2021 - 13/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH02-O , Depth: 0.5**
Material: Silty Clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	45		
Plastic Limit (%)	16		
Plasticity Index (%)	**29**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	15.0		
Cracking Crumbling Curling	None		

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

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

Report Number:	**202107.01-3**
Issue Number:	1
Date Issued:	27/04/2021
Client:	NSW Department of Education - School Infrastructure NSW Level 8, 259 George Street, Sydney NSW 2000
Contact:	Nick Mentis
Project Number:	202107.01
Project Name:	SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location:	Majara Street and Gibraltar Street, Bungendore
Work Request:	5774
Sample Number:	GU-5774F
Date Sampled:	25/03/2021
Dates Tested:	07/04/2021 - 13/04/2021
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**BH07-O , Depth: 1.0**
Material:	Clay

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	80		
Plastic Limit (%)	24		
Plasticity Index (%)	**56**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.1		
Linear Shrinkage (%)	19.0		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	24.3

This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

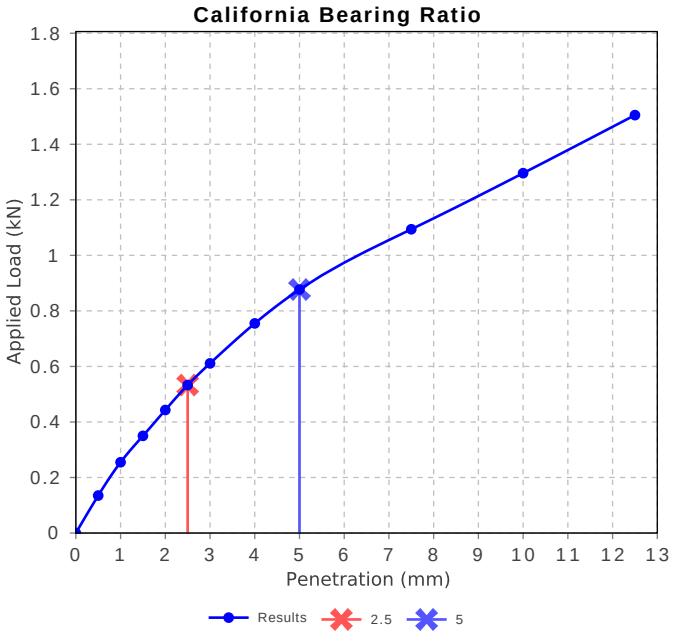
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-3**
Issue Number: 1
Date Issued: 27/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 5774
Sample Number: GU-5774G
Date Sampled: 25/03/2021
Dates Tested: 07/04/2021 - 19/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01-T , Depth: 0.5-0.8**
Material: Silty Clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	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)	1.72		
Optimum Moisture Content (%)	19.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.67		
Field Moisture Content (%)	17.0		
Moisture Content at Placement (%)	19.0		
Moisture Content Top 30mm (%)	26.8		
Moisture Content Rest of Sample (%)	22.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	69.7		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	17.0



This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

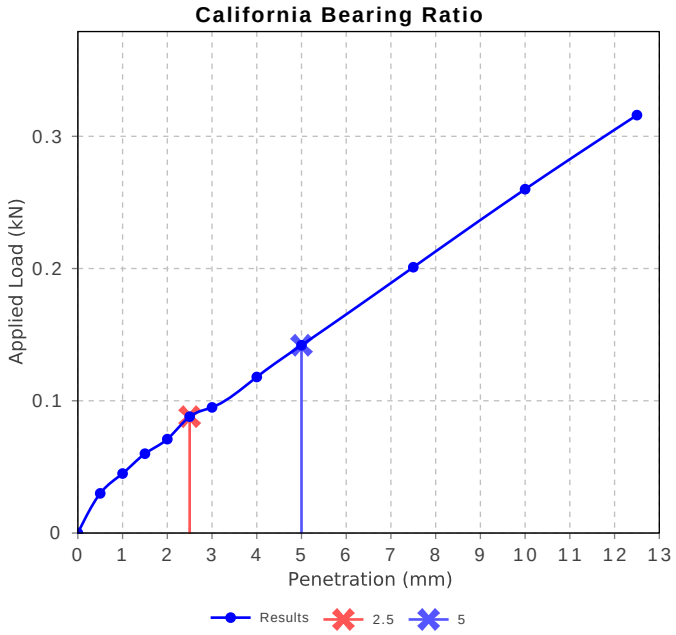
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-3**
Issue Number: 1
Date Issued: 27/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 5774
Sample Number: GU-5774H
Date Sampled: 25/03/2021
Dates Tested: 07/04/2021 - 19/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH06 , Depth: 0.5-0.8**
Material: Silty Clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**0.5**		
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)	1.73		
Optimum Moisture Content (%)	16.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.0		
Dry Density after Soaking (t/m^3)	1.59		
Field Moisture Content (%)	15.5		
Moisture Content at Placement (%)	16.1		
Moisture Content Top 30mm (%)	31.2		
Moisture Content Rest of Sample (%)	24.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	70.9		
Swell (%)	9.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	15.5



This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: brachlan.harris@douglaspartners.com.au

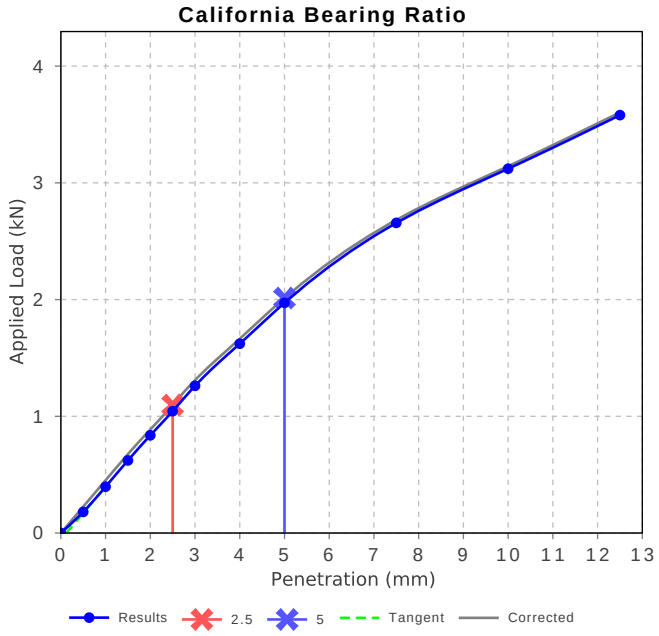
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brachlan Harris
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **202107.01-3**
Issue Number: 1
Date Issued: 27/04/2021
Client: NSW Department of Education - School Infrastructure NSW
Level 8, 259 George Street, Sydney NSW 2000
Contact: Nick Mentis
Project Number: 202107.01
Project Name: SINSW01327/20, Bungendore Public School - Geotechnical Services
Project Location: Majara Street and Gibraltar Street, Bungendore
Work Request: 5774
Sample Number: GU-5774I
Date Sampled: 25/03/2021
Dates Tested: 07/04/2021 - 23/04/2021
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH12 , Depth: 0.5-0.8**
Material: Clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**10**		
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)	1.95		
Optimum Moisture Content (%)	12.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.0		
Dry Density after Soaking (t/m^3)	1.95		
Field Moisture Content (%)	16.9		
Moisture Content at Placement (%)	11.9		
Moisture Content Top 30mm (%)	13.5		
Moisture Content Rest of Sample (%)	12.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	93.6		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	16.9



This document shall not be reproduced except in full without approval of the laboratory.
Results relate only to the items tested/sampled.

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 265912-A

Client Details

Client	Douglas Partners Canberra
Attention	Shannon Goodsell
Address	Unit 2, 73 Sheppard St,, HUME, ACT, 2620

Sample Details

Your Reference	**202107.01, Bungendore Highschool**
Number of Samples	121 Soil
Date samples received	07/04/2021
Date completed instructions received	08/04/2021

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	15/04/2021
Date of Issue	15/04/2021

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 ***

Asbestos Approved By
Analysed by Asbestos Approved Identifier:
Results Approved By
Giovanni Agosti, Group Technical Manager
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		265912-A-4	265912-A-14	265912-A-17	265912-A-32	265912-A-84
Your Reference	UNITS	BH01/2.0	BH04/2.0	BH05/1.0	BH08/1.5	BH03-O/1.5
Date Sampled		25/03/2021	29/03/2021	26/03/2021	29/03/2021	30/03/2021
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	12/04/2021	12/04/2021	12/04/2021	12/04/2021	13/04/2021
Date analysed	-	12/04/2021	12/04/2021	12/04/2021	12/04/2021	12/04/2021
pH 1:5 soil:water	pH Units	9.0	8.4	9.2	7.8	9.2
Electrical Conductivity 1:5 soil:water	µS/cm	260	640	480	410	320
Chloride, Cl 1:5 soil:water	mg/kg	310	840	410	510	24
Sulphate, SO4 1:5 soil:water	mg/kg	47	72	110	65	41
Resistivity in soil*	ohm m	38	16	21	24	32
Estimated Salinity*	mg/kg	890	2,200	1,600	1,400	1,100

Misc Inorg - Soil		
Our Reference		265912-A-112
Your Reference	UNITS	BH10-O/0.5
Date Sampled		29/03/2021
Type of sample		Soil
Date prepared	-	12/04/2021
Date analysed	-	12/04/2021
pH 1:5 soil:water	pH Units	9.5
Electrical Conductivity 1:5 soil:water	µS/cm	340
Chloride, Cl 1:5 soil:water	mg/kg	150
Sulphate, SO4 1:5 soil:water	mg/kg	110
Resistivity in soil*	ohm m	30
Estimated Salinity*	mg/kg	1,100

CEC			
Our Reference		265912-A-4	265912-A-32
Your Reference	UNITS	BH01/2.0	BH08/1.5
Date Sampled		25/03/2021	29/03/2021
Type of sample		Soil	Soil
Date prepared	-	14/04/2021	14/04/2021
Date analysed	-	14/04/2021	14/04/2021
Exchangeable Ca	meq/100g	0.2	0.4
Exchangeable K	meq/100g	<0.1	<0.1
Exchangeable Mg	meq/100g	0.77	0.95
Exchangeable Na	meq/100g	0.23	0.13
Cation Exchange Capacity	meq/100g	1.3	1.5

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.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
Inorg-034	Soil samples are extracted and measured using a conductivity cell and dedicated meter.
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.
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	-			12/04/2021	[NT]	[NT]	[NT]	[NT]	12/04/2021	[NT]
Date analysed	-			12/04/2021	[NT]	[NT]	[NT]	[NT]	12/04/2021	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	103	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	112	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	119	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Estimated Salinity*	mg/kg	5	Inorg-034	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			14/04/2021	[NT]	[NT]	[NT]	[NT]	14/04/2021	[NT]
Date analysed	-			14/04/2021	[NT]	[NT]	[NT]	[NT]	14/04/2021	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	116	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	121	[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

Samples received in good order: Holding time exceedance for pH/EC