

28 November 2022

Attention: Michael Bhullar
Bhullar Engineering Group Pty Ltd
5 Junction Street
Auburn NSW 2144
michael@bhullargroup.com.au

BY EMAIL

Dear Michael

Re: Geotechnical Investigation – Drovers Road Narrandera NSW 2700

I refer to the written request from yourself to conduct a geotechnical investigation at Drovers Road Narrandera NSW, the site. The intended recipient of this report is Bhullar Engineering Group Pty Ltd for the purpose of informing the qualified design engineer responsible for the engineering design and construction of a proposed commercial/industrial workshop development. It is assumed that third parties may rely on this report for engineering design and construction purposes, however DM McMahon Pty Ltd is required to be consulted during construction to confirm site conditions in relation to the site-specific development.

Objective and scope

The objective of the geotechnical investigation is to assess the subsurface conditions at the selected borehole and testing locations within the proposed development area (where accessible and feasible), and to provide geotechnical data and interpretation around the following:

- Site classification in accordance with Australian Standards AS2870:2011 Residential slabs and footings.
- Site earthquake sub-soil classification in accordance with AS1170.4 – Earthquake actions in Australia.
- Provide an interpreted design allowable bearing capacity based on the ground conditions at the investigated locations.
- Provide commentary on design subgrade CBR, subgrade preparation, engineered fill specifications and any other relevant geotechnical commentary.

The agreed scope of works included:

- Where available, review plans and other general related documents provided to us to gain a comprehensive understanding of the site.
- Drill nine bore holes to 3m depth (or refusal) within the assumed footprint of the proposed development, undertake a visual and tactile assessment of investigated locations.

- Undertake representative sampling of soils and test representative soil samples for Atterberg limits, maximum dry density, California bearing ratio and soil aggressivity to steel and concrete structures.
- Undertake Dynamic Cone Penetrometer testing at 1m and 3m below ground level (where possible) to determine soil consistency and allowable bearing capacity.
- Supply letter format report outlining subsurface conditions including the above deliverables.

Location and description of the project site and its history

The subject site is a 3.50ha (approx.) area of gently inclined land located with a real property description Lot 71 DP 1288793. The lot has a south-easterly aspect with an approximate relief of 5m. The proposed development includes the design and construction of three 4,012m² commercial/industrial workshops within the subject site, see **Attachment A**.

From a review of available historical aerial imagery (1960-2020), the site appears to be part of a larger lot of broadacre agricultural land from at least 1960. Development of the Red Hill Industrial Estate can be seen to occur in the 1990s. No further significant changes are evident to the subject site.

The following observations were made during the site visit on 26 October 2022. A large stockpile of soil materials is present to the western end of the lot. Stockpiled materials are likely locally sourced subgrade materials generated during the construction of the roadway. A track has been cut in and transects the site approx. north-south (BH03 to BH04). An existing swale drain is present but interrupted by the cut in track. The swale drain runs northwest to southeast in the southwest corner of the site. The site trafficability was poor across the majority of the undisturbed portion (east) of the site and near the cut off swale drain following recent and sustained above average rainfall.

Description of the regional and local geology

The local geology is Quaternary aeolian sand deposits overlying Ordovician sandstones of the Abercrombie Formation. Field investigation and general observations of the landscape generally confirm the available geological literature for the site.

Records of fieldwork, including methods and results

Subsurface investigation and representative sampling were conducted in accordance with AS1289.1.2.1:1998 clause 6.5.3 - *Power auger drilling* & 6.5.2 – *Hand auger drilling*. Boreholes were advanced to refusal depths ranging from 0.3m to 1.7m below ground level (bgl). Refusal was met with the drilling rig using solid flight augers with TC bit and the hand auger where access to the investigation locations was limited (BH07-BH09). The DCP testing was undertaken by reference to AS1289.6.3.2 (1997) with the allowable bearing capacity interpreted from the results, Stockwell (1977).

Eurocode 7 (2007) was used to identify geotechnical sampling frequency, a rectangular grid sampling pattern with spacings of 75 x 45m was deemed acceptable for the proposed development given the site condition and features. The investigation locations were judgementally selected based on the location of proposed developments and can be seen in **Attachment B**.

A visual and tactile assessment of the subsurface conditions was undertaken by reference to AS1726:2017. Records of the subsurface conditions can be found in the bore logs, **Attachment C**.

One bulk composite sample was obtained from BH01 – BH02 (1391H) and one bulk sample was obtained from BH08 (1391I) and tested for maximum dry density and California Bearing Ratio. Two representative disturbed grab samples were obtained from each BH02, BH05 and BH07 and tested for Atterberg Limits and linear shrinkage. Samples 1391E, 1391F and 1391G were submitted for chemical analysis.

Soil laboratory analysis was conducted in accordance with the following test methods.

- Liquid Limit (LL) AS1289.3.1.2
- Plastic Limit (PL) AS1289.3.2.1
- Plasticity Index (PI) AS1289.3.3.1
- Linear Shrinkage (LS) AS1289.3.4.1
- Maximum Dry Density (MDD) AS1289.5.1.1
- California Bearing Ratio (CBR) AS1289.6.1.1

Laboratory test reports may be found in **Attachment D**.

Soil samples (3) were also sent to an external NATA accredited laboratory to be tested for the following chemical characteristics:

- Moisture content.
- pH (1:5).
- Electrical conductivity.
- Electrical resistivity.
- Soluble sulfate.
- Soluble chloride.

External laboratory test reports may be found in **Attachment E**.

Summary of results

The visual and tactile assessment of natural subsurface materials generally confirmed the available literature for the area. Generally, subsurface conditions encountered can be divided into two general soil types loosely delineated by elevation.

Higher elevations to the northwest (BH01-BH04) generally consist of thin sandy topsoils underlain by residual gravelly sands overlying extremely weathered materials consistent with the underlying sandstone bedrock. Lower elevations to the southwest (BH05-BH09) typically consist of aeolian topsoils and fine sands to ~0.4m overlying residual sandy clays of low plasticity and firm to very stiff consistency.

Laboratory testing of physical material properties are summarised below.

- LL ranged from 16 to 43%.

- PL ranged from Not Obtainable to 19%.
- PI ranged from Non Plastic to 27%.
- LS ranged from 0 to 13%.
- MDD ranged from 1.78 to 2.05t/m³.
- CBR ranged from 6 to 60%.

The CBR sample was moulded under standard compactive effort and a 4-day soak. Laboratory density ratios ranged from 97.5 to 98.0% and laboratory moisture ratios ranged from 102.0 to 102.5%, with targets of 98% Standard Maximum Dry Density (SMDD) and 100% Optimum Moisture Content (OMC). Target density ratios were selected to replicate in-service long term equilibrium conditions, Austroads (2017) and replicate subgrade compaction recommendations for commercial lots as per AS3798. CBR test results will be used to provide an indicative subgrade design CBR and percentage swell values of in situ materials used at or near subgrade level to aid the structural engineer in determining the thickness of the proposed rigid pavements and slabs.

Soil chemical properties obtained from external laboratory testing returned results as follows:

- Moisture content ranged from 11.5-18.7%.
- pH value ranged from 6.9-7.9.
- Electrical conductivity ranged from 17-149µS/cm.
- Sulfate as SO₄²⁻ ranged from <10-10mg/kg.
- Chloride ranged from <10-220mg/kg.
- Soil resistivity ranged from 6,710-58,800Ω.cm.

Comments and Recommendations

Site classification

Based on the field assessment and laboratory data and assumptions therein, the site may be classified as **P – Problem Site**, owing to potential abnormal moisture conditions and potential for differential settlement from differing soil types across the proposed development envelope.

Underlying natural clay soils below unsuitable topsoils and saturated aeolian sand materials may be classified **M-D – Moderately reactive silt and clay sites**, which may experience moderate ground movement from moisture changes. The following caveats apply around the site classification:

- The site classification is based on the findings at the time of the investigation and conveyed herewith and as such is limited to the stated site conditions at the time of the investigation.
- Any changes to the site from the stated conditions may require a reassessment of the Site Classification.
- If any unconsolidated or saturated soils are encountered during excavation, or conditions that are not alike those described herewith, the site supervisor should be informed, the work stopped, and this office be contacted immediately for further evaluation.
- Site Classification is only applicable to those sites/developments as outlined in AS2870-2011 and as such, the site classification may not be applicable to the proposed commercial/industrial type development.

Seismic Sub-Soil Classification and Site Factor

Based on the location of the site and the subsurface conditions encountered, the following earthquake parameters are provided (AS1170.4-2007).

- Probability Factor (k_p) 1.0
- Hazard factor for Narrandera (Z) 0.09
- Site Sub-soil class C_e – Shallow Soil

Probability factor is based on annual probability of exceedance (P) 1/500 and may be increased to 1.3 if the designer deems the importance of the building is Level 3 (probability of exceedance 1/1000) as per Building Code of Australia.

Allowable Bearing Capacity

For the purpose of preliminary foundation design, a conservative bearing capacity of 100kPa can be adopted below 0.4m into the natural underlying gravelly sand or sandy clay subsoils.

Footings founded into the underlying weathered sandstone bedrock encountered to the east may adopt a conservative allowable bearing capacity of 300kPa. Deep foundations where used may adopt an allowable bearing capacity of 200kPa below 1m in the underlying residual sandy clay materials where encountered to the east. Shaft friction of 20kPa may be adopted (neglect top 1m) for bored piers.

The allowable bearing capacity as adopted by the design engineer is required to be confirmed prior to placement of footing systems.

Design CBR

The result of the California Bearing Ratio tests ranged from 6-60%. CBR samples were moulded to a target of 98% SMDD to match the design subgrade compaction specification. A subgrade design CBR of 6% is recommended to be adopted for the purpose of rigid pavement design.

Site preparation and earthworks

Fill materials and existing subgrade materials exposed for the preparation of pavement subgrade should be placed, compacted and tested to an engineering specification in general accordance with recommendations outlined in AS3798-2007, 'Guidelines on Earthworks for Commercial and Residential Developments'. The following procedures are provided as a summary only.

- Strip existing topsoil / fill and stockpile for possible future use or dispose off-site.
- Undertake proof rolling (using an 8 – 10 tonne roller) of the exposed natural soils to detect potentially weak spots (ground heave or matting). Excavate areas of localised heaving to a nominal 300mm depth and replace with granular materials, compacted as described below.
- Repeat proof rolling of soft spots backfilled with granular material. If the backfilled area shows movement during proof rolling, this office should be contacted for further recommendations.
- Place suitable fill material over proof rolled natural soil. The fill should be placed in layers of 200 to 250mm maximum loose thickness (depending on size of equipment) and compacted

to at least 98% to 100% of Standard Maximum Dry Density (SMDD) at a moisture content within 2% of Standard Optimum Moisture Content (SOMC).

- Placement of fill materials should be supervised at Level 2 or better to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to specifications herewith and as specified in AS 3798.

Site trafficability

At the time of the field investigation trafficability of the site was poor due to saturation of the overlying topsoils and sand layers to a notional depth of 0.4m.

Trafficking problems may arise for construction traffic and heavy machinery following precipitation and may remain poor for extended periods of time. Removal of vegetation and ground cover, disturbance of surface and near surface soils and excavation for construction purposes may all contribute to further decline in trafficability on site.

On site trafficability may be improved by:

- Controlling water seepage/drainage by diverting runoff away from the construction area.
- Adequate compaction of fill materials placed following excavation, especially trenching.
- Providing all weather construction access tracks and limiting construction traffic to those tracks. Tracks and working surfaces may consist of crushed concrete type materials, larger size gravels and/or imported sub-base materials.

Exposure Classification for Steel and Concrete

Soils that exhibit low pH values or high concentrations of sulfate and chloride have the capacity to affect durability of in-ground structures. AS 2159-2009 provides guidelines on exposure classification for steel and concrete piles. Based on laboratory test results of pH values and sulfate and chloride concentrations, exposure classifications have been determined from tables 6.4.2(C) and 6.5.2(C) of AS 2159-2009.

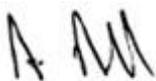
In-ground structure	Soil condition	Steel piles	Concrete piles
Exposure classification	A	Non Aggressive	Mild
	B	Non Aggressive	Non Aggressive

Soil Conditions A - High permeability soils (e.g., sands and gravels) which are in groundwater.

Soil Conditions B - Low permeability soils (e.g., silts and clays) or all soils above groundwater.

If you have any queries about the contents of the letter format report, please contact the undersigned.

Yours sincerely



Alexander Rudd BSc
MAGS MEIANZ MASSS

Disclaimer

The information contained in this report has been extracted from sources believed to be reliable and accurate. DM McMahon Pty Ltd will not assume any responsibility for the misinterpretation of information supplied in this report. The accuracy and reliability of recommendations identified in this report need to be evaluated with due care according to individual circumstances. The results of the assessment undertaken are an overall representation of the conditions encountered. It should be noted that the recommendations and findings in this report are based solely upon the said site location and the ground level conditions at the time of testing. The properties of the soil within the location may change due to variations in ground conditions outside of the tested area. The author has no control or liability over site variability that may warrant further investigation that may lead to significant design changes.

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Attachments

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|---|---------|
| A. Proposed development plans - extract | 2 pages |
| B. Investigation location map | 1 page |
| C. Bore logs | 9 pages |
| D. Laboratory reports - DMM | 6 pages |
| E. Laboratory reports - ALS | 3 pages |

References

- Austrroads, 2018. Guide to Pavement Technology Part 2: Pavement Structural Design. Edition 4.1, October 2018. Sydney, Australia.
- Colquhoun G.P., Hughes K.S., Deyssing L., Ballard J.C., Folkes C.B, Phillips G., Troedson A.L. & Fitzherbert J.A. 2021. New South Wales Seamless Geology dataset, version 2.1 [Digital Dataset]. Geological Survey of New South Wales, Department of Regional NSW, Maitland.
- EN 1997-2 (2007). Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing
- Standards Australia AS 1289.1.2.1:1998 - Methods of testing soils for engineering purposes - Sampling and preparation of soils - Disturbed samples (Standard method)
- Standards Australia AS 1289.3.1.2:2009 - Methods of testing soils for engineering purposes - Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (Subsidiary method)
- Standards Australia AS 1289.3.2.1:2009 - Methods of testing soils for engineering purposes - Soil classification tests - Determination of the plastic limit of a soil (Standard method)
- Standards Australia AS 1289.3.3.1:2009 - Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil
- Standards Australia AS 1289.5.1.1:2017 - Determination of the dry density/moisture content relation of a soil using standard compactive effort.
- Standards Australia AS 1289.6.1.1:2014 - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.
- Standards Australia AS1289.6.3.2 (1997). Soil Strength and Consolidation tests – Determination of penetration resistance of a soil – 9kg dynamic cone penetrometer test.
- Standards Australia AS1726 (2017). Geotechnical Site Investigations.
- Standards Australia AS 2159:2009. Piling - Design and Installation
- Standards Australia AS 2870:2011. Residential slabs and footings
- Standards Australia AS 3798:2007. Guidelines on earthworks for commercial and residential developments
- Standards Australia AS HB-160:2006 - Soils Testing Handbook
- Stockwell, M.J. (1977), Determination of Allowable Bearing Pressures Under Small Structures, New Zealand Engineering, Vol. 32, No. 6, Jun 1977: 132-135.

Attachment A : *Proposed development plans - extract*

EXHIBITION COPY
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1 SITE PLAN
A200 1:1500

DRAFT



<p>Issue Description Date Auth Chk</p>		<p>ADGarchitects Riverside Park Office Tower Suite 1.4, 61 Central Coast Highway West Gosford NSW 2250 Postal Address P.O. Box 431 Gosford NSW 2250 ph: 02 4312 5110 e: info@adgarchitects.com.au</p>	<p>Project PROPOSED WORKSHOP</p>	<p>Client BHULLAR GROUP PTY LTD</p>	<p>Location LOT 43 DRISCOLL ROAD NARRANDERA</p>	<p>Drawing SITE PLAN</p>	<p>Do not scale drawings. Use figured dimensions only. Check and verify levels and dimensions on site prior to commencement of any work. The fabrication of site drawings or the fabrication of instruments. This drawing is the copyright of ADG Architects and is protected under the Copyright Act 1968. It may not be altered, reproduced or transmitted in any form or by any means without the express permission of ADG Architects.</p> <p>PRELIMINARY NOT TO BE USED DURING CONSTRUCTION</p>	<p>Project Number 22_034</p>	<p>Drawing Number A003</p>	<p>Issue</p>
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Attachment B : *Investigation location map*

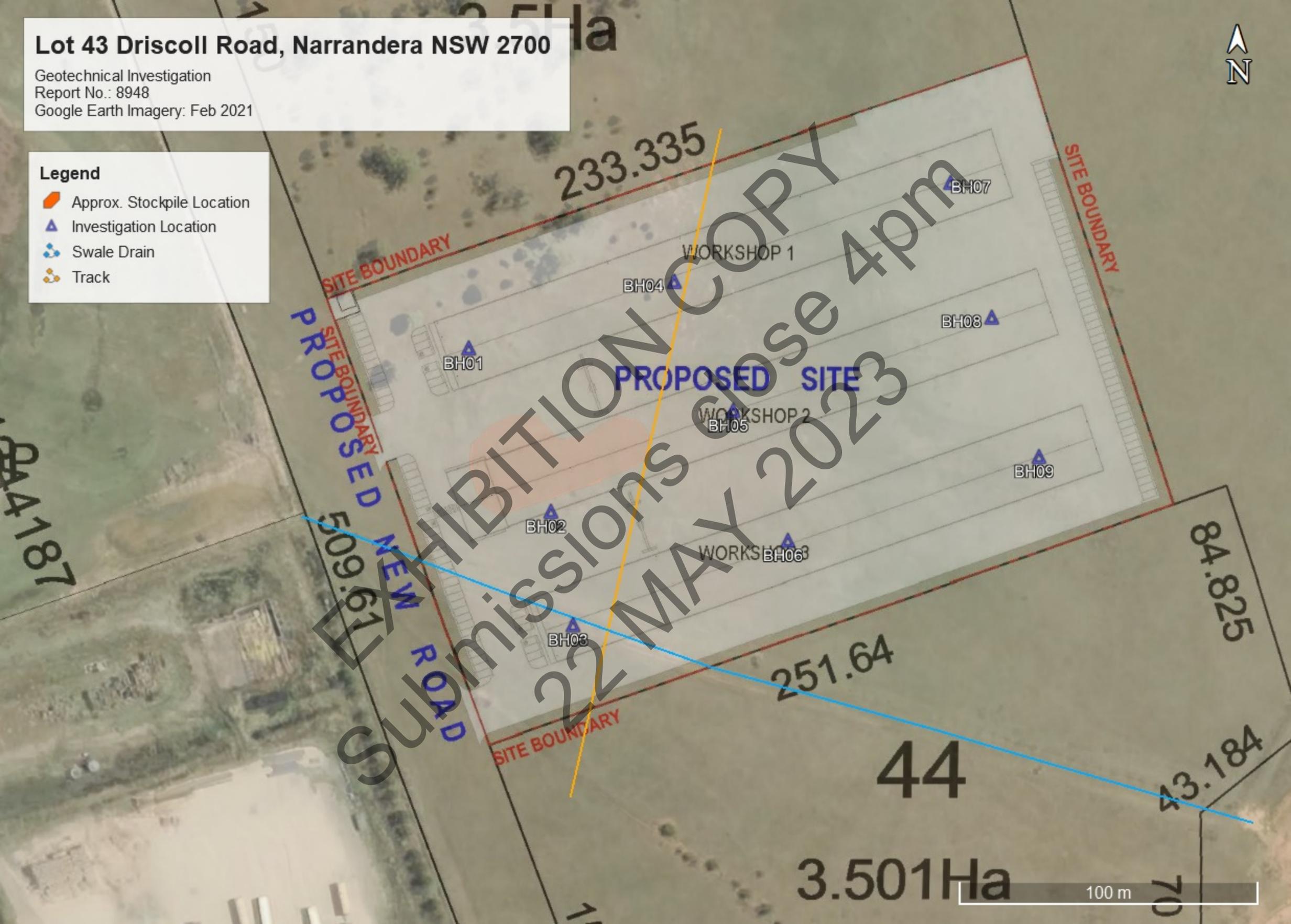
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Lot 43 Driscoll Road, Narrandera NSW 2700

Geotechnical Investigation
Report No.: 8948
Google Earth Imagery: Feb 2021

Legend

- Approx. Stockpile Location
- Investigation Location
- Swale Drain
- Track



Attachment C : *Bore logs*

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McMahon Earth Science

6 Jones St, Wagga Wagga
Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH01

UTM : 55H	Driller Rig : Christie Drilling Rig	Job Number : 8948
Easting : 460703.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157379.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1m	Date : 26/10/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
	0.2	Topsoil		(SP) : SAND, brown, loose, fine grained, moist,		
	0.5	Residual		(SW) : gravelly SAND, red, medium dense to dense, fine to medium grained, fine to medium sized gravel, moist,	20 kg disturbed: 8948/H	
	0.8	Extremely Weathered Material		(SW) : gravelly SAND, trace low plasticity clay, pale yellow, dense, fine to medium grained, medium sized gravel, moist,		
	1.0			BH01 refusal at 1m		
	1.5					
	2.0					
	2.5					
	3.0					
	3.5					

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22 MAY 2023



McMahon Earth Science

6 Jones St, Wagga Wagga
 Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH02

UTM : 55H	Driller Rig : Christie Drilling Rig	Job Number : 8948
Easting : 460729.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157328.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1m	Date : 26/10/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
Solid flight auger	0.2	Topsoil		(SP) : SAND, brown, loose, fine grained, moist,		
	0.5	Residual		(SW) : gravelly SAND, red, medium dense to dense, fine to medium grained, fine to medium sized gravel, moist,	20 kg disturbed: 8948/H Plastic Bag: 8948/A	
	0.8	Extremely Weathered Material		(SW) : gravelly SAND, trace low plasticity clay, pale yellow, dense, fine to medium grained, medium sized gravel, wet/moist,	Plastic Bag: 8948/B	
	1.0			BH02 refusal at 1m		
	1.5					
	2.0					
	2.5					
	3.0					
	3.5					

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McMahon Earth Science

6 Jones St, Wagga Wagga

Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH03

UTM : 55H	Driller Rig : Christie Drilling Rig	Job Number : 8948
Easting : 460736.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157292.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 0.3m	Date : 07/11/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
Solid flight auger		Topsoil		(SP) : SAND, brown, loose, fine grained, wet/moist, (seepage noted) .		
	0.5			BH03 refusal at 0.3m		
	1					
	1.5					
	2					
	2.5					
	3					
	3.5					

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McMahon Earth Science

6 Jones St, Wagga Wagga
Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH04

UTM : 55H	Driller Rig : Christie Drilling Rig	Job Number : 8948
Easting : 460768.7	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157400.5	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1m	Date : 07/11/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
Solid flight auger	0.3	Topsoil		(SP) : SAND, red brown, medium dense, fine grained, moist,		
	0.5	Residual		(SW) : gravelly SAND, with low plasticity clay, pale yellow, dense, fine to medium grained, fine to medium sized gravel, moist,		
	0.7	Extremely Weathered Material		(SW) : gravelly SAND, trace low plasticity clay, red, dense, fine to medium grained, fine to medium sized gravel, moist/dry,		
	1			BH04 refusal at 1m		
	1.5					
	2					
	2.5					
	3					
	3.5					

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22 MAY 2023



McMahon Earth Science

6 Jones St, Wagga Wagga
Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH05

UTM : 55H	Driller Rig : Christie Drilling Rig	Job Number : 8948
Easting : 460787.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157360.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1.7m	Date : 07/11/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
Solid flight auger	0.2	Topsoil		(SC) : clayey SAND, brown, low plasticity, medium dense, fine to medium grained, moist,		
	0.5	Residual		(CL) : CLAY, with fine grained sand, yellow brown, low plasticity, stiff, w > pl,	Plastic Bag: 8948/C	
	0.7	Residual		(CL) : sandy CLAY, brown yellow, low plasticity, stiff to very stiff, w = pl,		
	1.1	Extremely Weathered Material		(CL) : silty to sandy to gravelly CLAY, red, low plasticity, stiff to very stiff, w < pl,		
	1.5				Plastic Bag: 8948/D	
	2.0			BH05 refusal at 1.7m		
	2.5					
	3.0					
	3.5					

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Submissions close 22 MAY 2023



McMahon Earth Science

6 Jones St, Wagga Wagga
Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH06

UTM : 55H	Driller Rig : Christie Drilling Rig	Job Number : 8948
Easting : 460805.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157319.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1.1m	Date : 07/11/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
Solid flight auger	0.2	Topsoil		(SW) : SAND, trace low plasticity clay, brown, loose to medium dense, fine to medium grained, wet/moist,		
	0.5	Residual		(CL) : sandy CLAY, brown yellow, low plasticity, firm to stiff, w < pl,		
	0.6	Residual		(CL) : sandy CLAY, pale brown yellow, low plasticity, stiff to very stiff, w = pl,		
	1			BH06 refusal at 1.1m		
	1.5					
	2					
	2.5					
	3					
	3.5					

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22 MAY 2023



McMahon Earth Science

6 Jones St, Wagga Wagga
Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH07

UTM : 55H	Driller Rig : Hand Auger	Job Number : 8948
Easting : 460856.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157432.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1.3m	Date : 07/11/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
Hand auger	0.2	Topsoil		(SM) : silty SAND, red brown, loose to medium dense, fine to medium grained, moist,		
	0.4	Aeolian		(SW) : SAND, red brown, loose to medium dense, fine to medium grained, wet, (seepage noted) .	Plastic Bag: 8948/E	
	0.5	Residual		(CL) : silty CLAY, trace fine grained sand, trace fine grained sand, brown red, low plasticity, firm, w > pl,	Plastic Bag: 8948/F	
	0.9	Residual		(CL) : CLAY, trace fine grained sand, trace fine grained sand, red yellow, low plasticity, stiff, w ≈ pl,	Plastic Bag: 8948/G	
	1.0			BH07 refusal at 1.3m		
	1.5					
	2.0					
	2.5					
	3.0					
	3.5					

EXHIBITION COPY
Submissions close 22 MAY 2023



McMahon Earth Science

6 Jones St, Wagga Wagga
Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH08

UTM : 55H	Driller Rig : Hand Auger	Job Number : 8948
Easting : 460870.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157390.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1.7m	Date : 07/11/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
	0.2	Topsoil		(SM) : silty SAND, red brown, loose to medium dense, fine to medium grained, moist,		
	0.4	Aeolian		(SW) : SAND, red brown, loose to medium dense, fine to medium grained, wet, (seepage noted) .		
	0.5	Residual		(CL) : sandy CLAY, red mottled brown, low plasticity, firm, w > pl.	20 kg disturbed: 8948/1	
	0.9	Residual		(CL) : sandy CLAY, red yellow, low plasticity, stiff, w > pl.		
	1					
	1.5					
	2					
	2.5					
	3					
	3.5					
				BH08 refusal at 1.7m		

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22 MAY 2023



McMahon Earth Science

6 Jones St, Wagga Wagga
Phone: 02 6931 0510

Engineering Log - Borehole

Borehole No: BH09

UTM : 55H	Driller Rig : Hand Auger	Job Number : 8948
Easting : 460886.0	Driller Supplier : McMahon Earth Science	Client : Bhullar Engineering Group Pty Ltd
Northing : 6157346.0	Logged By : A. Rudd	Project : Geotech Investigation
RL : N/A	Reviewed By : A. Rudd	Location : Lot 43 Driscoll Road, Narrandera NSW 2700
Total Depth : 1.6m	Date : 07/11/2022	

Drilling Method	Depth (m)	Soil Origin	Graphic Log	Material Description	Samples	Observations
Hand auger	0.2	Topsoil		(SM) : silty SAND, red brown, loose to medium dense, fine to medium grained, moist,		
	0.4	Aeolian		(SW) : SAND, red brown, loose to medium dense, fine to medium grained, wet, (seepage noted) .		
	0.5	Residual		(CL) : sandy CLAY, yellow mottled brown, low plasticity, firm, w > pl,		
	0.7	Residual		(CL) : silty CLAY, with fine to medium grained sand, yellow red, low plasticity, stiff,		
	1	Residual		(CL) : silty CLAY, trace fine grained sand, trace fine grained sand, red yellow mottled brown, low plasticity, firm to stiff, w > pl,		
	1.5					
				BH09 refusal at 1.6m		
	2					
	2.5					
	3					
	3.5					

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Attachment D : *Laboratory reports - DMM*

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22 MAY 2023

Material Test Report



Report Number: 8948-1
 Issue Number: 1
 Date Issued: 22/11/2022
 Client: Bhullar Engineering Group Pty Ltd

DM McMahon Pty Ltd
 Wagga Wagga Laboratory
 6 Jones Street Wagga Wagga NSW 2650
 Phone: (02) 6931 0510
 Email: lab@dmmcmahon.com.au

Contact: Michael Bhullar
 Project Number: 8948
 Project Name: Geotechnical Investigation
 Project Location: Lot 43 Driscoll Road, Narrandera NSW 2700
 Work Request: 1391
 Sample Number: 1391H
 Date Sampled: 07/11/2022
 Dates Tested: 08/11/2022 - 22/11/2022
 Sample Location: BH01-BH02 (0.2-0.8 m)
 Material: Gravelly SAND
 Material Source: In-situ

Accredited for compliance with ISO/IEC 17025 - Testing

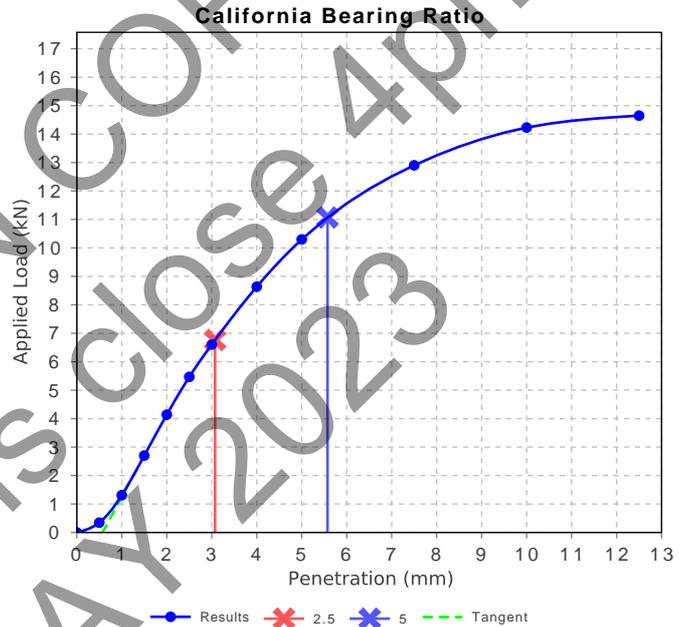


Approved Signatory: Dr Hoang Han Nguyen
 Lab manager
 NATA Accredited Laboratory Number: 3349

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m ³)	2.05		
Optimum Moisture Content (%)	9.0		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	8		
Method used to Determine Plasticity	AS 1289.3.1.1 & 3.2.1 & 3.3.1		
Curing Hours (h)	24.0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	9.1

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	60		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	AS 1289.3.1.1 & 3.2.1 & 3.3.1		
Maximum Dry Density (t/m ³)	2.05		
Optimum Moisture Content (%)	9.0		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	102.0		
Moisture Content at Placement (%)	9.0		
Moisture Content Top 30mm (%)	10.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	7.8		



Material Test Report

Report Number: 8948-1
 Issue Number: 1
 Date Issued: 22/11/2022
 Client: Bhullar Engineering Group Pty Ltd



DM McMahon Pty Ltd
 Wagga Wagga Laboratory
 6 Jones Street Wagga Wagga NSW 2650
 Phone: (02) 6931 0510
 Email: lab@dmmcmahon.com.au

Contact: Michael Bhullar
 Project Number: 8948
 Project Name: Geotechnical Investigation
 Project Location: Lot 43 Driscoll Road, Narrandera NSW 2700
 Work Request: 1391
 Sample Number: 1391I
 Date Sampled: 07/11/2022
 Dates Tested: 08/11/2022 - 22/11/2022
 Sample Location: BH08 E: 460870, N: 6157390, Depth: 0.4-1.0 m
 Material: Sandy CLAY
 Material Source: In-situ

Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Dr Hoang Han Nguyen
 Lab manager

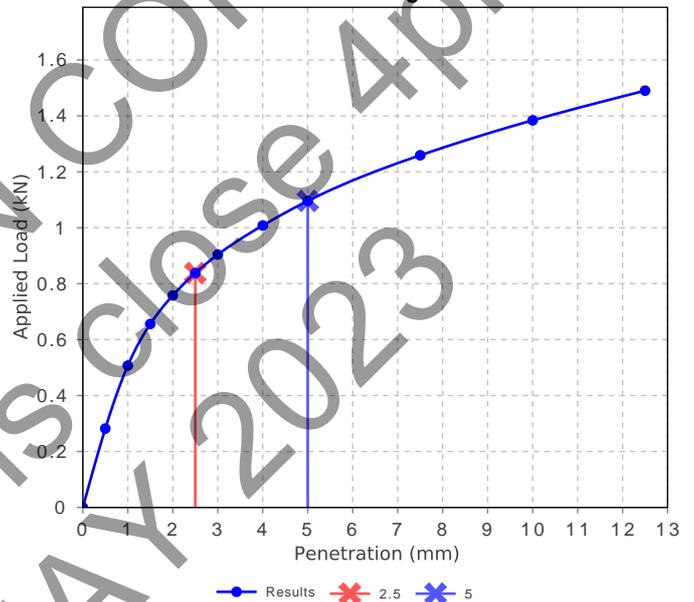
NATA Accredited Laboratory Number: 3349

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m ³)	1.78		
Optimum Moisture Content (%)	16.0		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	AS 1289.3.1.1 & 3.2.1 & 3.3.1		
Curing Hours (h)	24.0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	15.0

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	6		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	AS 1289.3.1.1 & 3.2.1 & 3.3.1		
Maximum Dry Density (t/m ³)	1.78		
Optimum Moisture Content (%)	16.0		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	102.5		
Moisture Content at Placement (%)	16.4		
Moisture Content Top 30mm (%)	18.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

California Bearing Ratio



Material Test Report

Report Number: 8948-1
Issue Number: 1
Date Issued: 22/11/2022
Client: Bhullar Engineering Group Pty Ltd

Contact: Michael Bhullar
Project: 8948 - Geotechnical Investigation
Project Location: Lot 43 Driscoll Road, Narrandera NSW 2700
Work Request: 1391
Location: Lot 43 Driscoll Road, Narrandera NSW 2700



DM McMahon Pty Ltd
 Wagga Wagga Laboratory
 6 Jones Street Wagga Wagga NSW 2650
 Phone: (02) 6931 0510
 Email: lab@dmmcmahon.com.au

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Approved Signatory: Dr Hoang Han Nguyen
 Lab manager
 NATA Accredited Laboratory Number: 3349

Dynamic Cone Penetrometer AS 1289 6.3.2

Sample Number	1391J	1391K	1391L	1391M	1391N
Location	BH01	BH02	BH03	BH04	BH05
Easting	460703	460717	460736	460777	460794
Northing	6157379	6157336	6157292	6157409	6157362
Date Tested	07/11/2022	07/11/2022	07/11/2022	07/11/2022	07/11/2022
Soil Description	SAND	SAND	SAND	SAND	SAND - CLAY
Reduced Level (mm)	0	0		0	0
Moisture Condition	Moist	Moist	**	Moist	Wet
Start Depth (mm)	0	0		0	0
0-100 blows/100 mm	2	5		5	1
100-200 blows/100 mm	4	14		3	1
200-300 blows/100 mm	4	9		2	7
300-400 blows/100 mm	10	11		4	20
400-500 blows/100 mm	14	9		3	18
500-600 blows/100 mm	15	8		8	17
600-700 blows/100 mm	13	10		25+	17
700-800 blows/100 mm	10	13		End	17
800-900 blows/100 mm	Bounce	End			16
900-1000 blows/100 mm	End				12
1000-1100 blows/100 mm					19
1100-1200 blows/100 mm					End
1200-1300 blows/100 mm					
1300-1400 blows/100 mm					
1400-1500 blows/100 mm					
1500-1600 blows/100 mm					
Ground Water Level					
Remarks					

Material Test Report

Report Number: 8948-1
Issue Number: 1
Date Issued: 22/11/2022
Client: Bhullar Engineering Group Pty Ltd

Contact: Michael Bhullar
Project: 8948 - Geotechnical Investigation
Project Location: Lot 43 Driscoll Road, Narrandera NSW 2700
Work Request: 1391
Location: Lot 43 Driscoll Road, Narrandera NSW 2700



DM McMahon Pty Ltd
 Wagga Wagga Laboratory
 6 Jones Street Wagga Wagga NSW 2650
 Phone: (02) 6931 0510
 Email: lab@dmmcmahon.com.au

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Approved Signatory: Dr Hoang Han Nguyen
 Lab manager

NATA Accredited Laboratory Number: 3349

Dynamic Cone Penetrometer AS 1289 6.3.2

Sample Number	1391O	1391P	1391Q	1391R
Location	BH06	BH07	BH08	BH09
Easting	460813	460856	460870	460886
Northing	6157320	6157432	6157390	6157346
Date Tested	07/11/2022	07/11/2022	07/11/2022	07/11/2022
Soil Description	SAND - CLAY	SAND - CLAY	SAND - CLAY	SAND - CLAY
Reduced Level (mm)	0	0	0	0
Moisture Condition	Moist	Moist	Moist	Moist
Start Depth (mm)	0	0	0	0
0-100 blows/100 mm	2	1	1	2
100-200 blows/100 mm	2	2	2	1
200-300 blows/100 mm	5	1	1	1
300-400 blows/100 mm	9	4	1	1
400-500 blows/100 mm	15	2	5	5
500-600 blows/100 mm	14	3	3	4
600-700 blows/100 mm	17	3	6	6
700-800 blows/100 mm	18	3	14	8
800-900 blows/100 mm	End	End	End	End
900-1000 blows/100 mm				
1000-1100 blows/100 mm		10	9	3
1100-1200 blows/100 mm		18	16	5
1200-1300 blows/100 mm		25+	17	6
1300-1400 blows/100 mm		End	25+	17
1400-1500 blows/100 mm			End	25+
1500-1600 blows/100 mm				End
Ground Water Level				
Remarks				

Material Test Report

Report Number: 8948-1
Issue Number: 1
Date Issued: 22/11/2022
Client: Bhullar Engineering Group Pty Ltd

Contact: Michael Bhullar
Project Number: 8948
Project Name: Geotechnical Investigation
Project Location: Lot 43 Driscoll Road, Narrandera NSW 2700
Work Request: 1391
Location: Lot 43 Driscoll Road, Narrandera NSW 2700



DM McMahon Pty Ltd
 Wagga Wagga Laboratory
 6 Jones Street Wagga Wagga NSW 2650
 Phone: (02) 6931 0510
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Approved Signatory: Dr Hoang Han Nguyen
 Lab manager

NATA Accredited Laboratory Number: 3349

Sample Details				Min	Max
Sample Number	1391A	1391B	1391C		
Date Sampled	07/11/2022	07/11/2022	07/11/2022		
Sample Location	BH02 E: 460729 N: 6157328	BH02 E: 460729 N: 6157328	BH05 E: 460787 N: 6157360		
Sample Depth	0.3-0.5 m	0.8-1.0 m	0.4-0.5 m		
Material	Gravelly SAND	Gravelly SAND	CLAY with sand		
Atterberg Limits Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)				Min	Max
Sample History	Oven Dried	Oven Dried	Oven Dried		
Preparation Method	Dry Sieve	Dry Sieve	Dry Sieve		
Liquid Limit (%)	16	16	42		
Plastic Limit (%)	Not Obtainable	Not Obtainable	15		
Plasticity Index (%)	Non Plastic	Non Plastic	27		
Linear Shrinkage (AS 1289 3.4.1)				Min	Max
Sample History	Oven Dried	Oven Dried	Oven Dried		
Preparation Method	Dry Sieve	Dry Sieve	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.2	AS 1289.3.1.2	AS 1289.3.1.2		
Linear Shrinkage (%)	0.0	1.0	13.0		
Cracking Crumbling Curling	None	None	Cracking		

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Material Test Report

Report Number: 8948-1
Issue Number: 1
Date Issued: 22/11/2022
Client: Bhullar Engineering Group Pty Ltd

Contact: Michael Bhullar
Project Number: 8948
Project Name: Geotechnical Investigation
Project Location: Lot 43 Driscoll Road, Narrandera NSW 2700
Work Request: 1391
Location: Lot 43 Driscoll Road, Narrandera NSW 2700



DM McMahon Pty Ltd
 Wagga Wagga Laboratory
 6 Jones Street Wagga Wagga NSW 2650
 Phone: (02) 6931 0510
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Approved Signatory: Dr Hoang Han Nguyen
 Lab manager

NATA Accredited Laboratory Number: 3349

Sample Details				Min	Max
Sample Number	1391D	1391F	1391G		
Date Sampled	07/11/2022	07/11/2022	07/11/2022		
Sample Location	BH05 E: 460787 N: 6157360	BH07 E: 460856 N: 6157432	BH07 E: 460856 N: 6157432		
Sample Depth	1.5-1.7 m	0.5-0.7 m	1.1-1.2 m		
Material	CLAY with gravel sand and silt	CLAY with silt trace sand	CLAY trace sand		
Atterberg Limits Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)				Min	Max
Sample History	Oven Dried	Oven Dried	Oven Dried		
Preparation Method	Dry Sieve	Dry Sieve	Dry Sieve		
Liquid Limit (%)	36	43	43		
Plastic Limit (%)	14	18	19		
Plasticity Index (%)	22	25	24		
Linear Shrinkage (AS 1289 3.4.1)				Min	Max
Sample History	Oven Dried	Oven Dried	Oven Dried		
Preparation Method	Dry Sieve	Dry Sieve	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.2	AS 1289.3.1.2	AS 1289.3.1.2		
Linear Shrinkage (%)	10.0	11.0	11.0		
Cracking Crumbling Curling	Cracking	Cracking	Cracking		

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 Submissions close 22 MAY 2023

Attachment E : *Laboratory reports - ALS*

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22 MAY 2023



CERTIFICATE OF ANALYSIS

Work Order : ES2240826
Client : DM MCMAHON PTY LTD
Contact : ALEX RUDD
Address : 6 JONES ST
 Wagga Wagga NSW, AUSTRALIA 2650
Telephone : +61 02 6931 0510
Project : 8948 - Bhullar Engineering
Order number : 8948
C-O-C number : ----
Sampler : Alexander Rudd
Site : ----
Quote number : EN/222
No. of samples received : 3
No. of samples analysed : 3

Page : 1 of 3
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 11-Nov-2022 11:30
Date Analysis Commenced : 14-Nov-2022
Issue Date : 17-Nov-2022 11:13



Accreditation No. 825
 Accredited for compliance with
 ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW

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 Submissions Close 22 MAY 2023



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Corrosion assessment for Concrete and Steel piles in soil per Australian Standard AS2159-2009 uses a combination of soil and groundwater data (Tables 6.4.2 C & 6.5.2 C). In the absence of groundwater data, assessment has been made against soil criteria only. Refer to AS2159-2009 section 6.4 for further interpretation of corrosion assessment. ALS is not NATA accredited for Corrosion Assessment comments
- EA167: Soil Condition A – High permeability soils (e.g. sands and gravels) which are in groundwater
- EA167: Soil Condition B – Low permeability soils (e.g. silts and clays) or all soils above groundwater

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22 MAY 2023



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Sample ID		8948/E	8948/F	8948/G	----	----
		Sampling date / time		07-Nov-2022 00:00	07-Nov-2022 00:00	07-Nov-2022 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2240826-001	ES2240826-002	ES2240826-003	-----	-----
				Result	Result	Result	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.9	7.8	7.9	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	17	108	149	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	11.5	18.7	13.8	----	----
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	58800	9260	6710	----	----
EA167: Corrosion Classification (per AS2159-2009)								
∅ Exposure Classification - Concrete Piles Soil Condition A	----	-	-	Mild	Mild	Mild	----	----
∅ Exposure Classification - Concrete Piles Soil Condition B	----	-	-	Non Aggressive	Non Aggressive	Non Aggressive	----	----
∅ Exposure Classification - Steel Piles Soil Condition A	----	-	-	Non Aggressive	Non Aggressive	Non Aggressive	----	----
∅ Exposure Classification - Steel Piles Soil Condition B	----	-	-	Non Aggressive	Non Aggressive	Non Aggressive	----	----
ED040S: Soluble Major Anions								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	10	10	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	180	220	----	----

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