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SUPER STAR HOLDING GROUP PTY LTD

Geotechnical Investigation

164-170 Croatia Avenue, Edmondson Park NSW

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Revision	Details	Date	Amended By
	Draft	11 September 2020	
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1. Introduction

1.1 Background

At the request of Tony Owen Partners Pty Ltd on behalf of Super Star Holding Group Pty Ltd (the Client), EI Australia (EI) has carried out a Geotechnical Investigation (GI) for the proposed development at 164-170 Croatia Avenue, Edmondson Park NSW (the Site).

This GI report has been prepared to provide advice and recommendations to assist in the preparation of designs for the proposed development. The investigation has been carried out in accordance with the agreed scope of works outlined in EI's proposal referenced P18210.1, dated 25 May 2020.

1.2 Proposed Development

The following documents, supplied by the Client, were used to assist with the preparation of this GI report:

- Architectural drawings prepared by Tony Owen Partners Pty Ltd - Project No. 1008, Drawing No CP090, CP000 to CP004, A300, Rev. B, dated June 2020; and
- Site survey plan prepared by Strata Surv Registered Surveyors – Drawing No. 4418DT01a2, Rev. A, Sheet 1 to 4 of 4. The datum in the survey plan is in Australian Height Datum (AHD), hence all Reduced Levels (RL) mentioned in this report are henceforth in AHD.

Based on the provided documents, EI understands that the proposed development involves the construction of eight residential apartments (labelled as Building A to H) which consist of six to eight storeys. All buildings are proposed to overly two basement levels. No Finished Floor Level (FFL) of the basements are provided, and step down with the slope, and excavation depths of between 6 to 8.5m Below Existing Ground Level (BEGL) have been estimated. Locally deeper excavations may be required for footings, lift overrun pits, crane pads, and service trenches. Local roads are also proposed between the combined basements.

1.3 Objectives

The objective of the GI was to assess site surface and subsurface conditions at five borehole and four test pit locations, and to provide geotechnical advice and recommendations addressing the following:

- Excavation methodologies and monitoring requirements;
- Groundwater considerations;
- Vibration considerations;
- Excavation support requirements, including preliminary geotechnical design parameters for retaining walls and shoring systems;
- Building foundation options, including;
  - Preliminary design parameters.
  - Earthquake loading factor in accordance with AS1170.4:2007.
- CBR for pavement design; and
- The requirement for additional geotechnical works.

1.4 Scope of Works

The scope of works for the GI included:

- Preparation of a Work Health and Safety Plan;
- Review of relevant geological maps for the project area;
- Site walkover inspection by a Geotechnical Engineer to assess topographical features and site conditions;
- Scanning of proposed borehole locations for buried conductive services using a licensed service locator with reference to Dial Before You Dig (DBYD) plans;
- Auger drilling of five boreholes (BH1, BH2, BH3M, BH4M and BH5M) by a track-mounted drill rig using solid-stem, continuous flight augers equipped with 'Tungsten-Carbide' (T-C) bit. BH1, BH2, BH3M, BH4M and BH5M were auger drilled to depths and levels as shown in **Table 1-1**;
  - Standard Penetration Testing (SPT) was carried out (as per AS 1289.6.3.1-2004), where possible, during auger drilling of the boreholes to assess soil strength/relative densities;
  - Measurements of groundwater seepage/levels, where possible, in the augered sections of the boreholes during and shortly after completion of auger drilling;
  - The strength of the bedrock in the augered sections of the boreholes was assessed by observation of the auger penetration resistance using a T-C drill bit and examination of the recovered rock cuttings. It should be noted that rock strengths assessed from augered boreholes are approximate and strength variances can be expected;
  - The approximate surface levels shown on the borehole logs were interpolated from spot levels shown on the supplied survey plan. Approximate borehole locations are shown on **Figure 2**;
- Continuation of BH1, BH2, BH3M, BH4M and BH5M using NMLC diamond coring techniques to termination depths and levels as shown in **Table 1-1**. The rock core photographs are presented in **Appendix A**;

Table 1-1 Summary of Borehole Depths

Borehole	Auger Depth (m BEGL)	Auger RL (m AHD)	Core Depth (m BEGL)	Core RL (m AHD)
BH1	3.04	48.26	14.23	37.07
BH2	3.02	46.58	13.42	36.18
BH3M	2.51	52.49	13.14	41.86
BH4M	3.10	45.90	13.54	35.46
BH5M	3.41	43.99	13.33	34.07

- Boreholes BH3M, BH4M and BH5M were converted groundwater monitoring wells with depths of 5.8m (RL 49.2m), 4.5m (RL 44.50m), and 10.0m (RL 37.40m) BEGL;
- Excavation of four test pits (TP1, TP2, TP3 and TP4) by an excavator to termination depths ranging from 2.4m to 2.55m BEGL (from RL 44.70m to 47.00m);

- Boreholes BH1 and BH2 and all test pits were backfilled with drilling and excavated spoils upon completion;
- Soil and rock samples were sent to Macquarie Geotechnical Pty Ltd (Macquarie) and SGS Australia (SGS), which are National Australian Testing Authority (NATA) accredited laboratories, for testing and storage; and
- Preparation of this GI report.

An EI Geotechnical Engineer was present full-time onsite to set out the borehole locations, direct the testing and sampling, log the subsurface conditions and record groundwater levels.

1.5 Constraints

The GI was limited by the intent of the investigation. The discussions and advice presented in this report are intended to assist in the preparation of initial designs for the proposed development. Further geotechnical investigations should be carried out prior to final design to confirm the geotechnical and groundwater models, and the design parameters provided in this report.

2. Site Description

2.1 Site Description and Identification

The site identification details and associated information are presented in **Table 2-1** below while the site locality is shown on **Figure 1.** An aerial photograph of the site is presented in **Plate 1** below.

Table 2-1 Summary of Site Information

Information	Detail
Street Address	164-170 Croatia Avenue, Edmondson Park NSW
Lot and Deposited Plan (DP) Identification	Lot 25 and 26 in DP 228850
Brief Site Description	The site is a trapezoid in shape. At the time of our investigation, the site comprised of a vacant field with overgrown grass and some trees. A creek is situated in the northern portion of the site, running in a north-west to south-east direction. The site surface was uneven, especially south of the creek where farmland furrows ran parallel in the east-west direction. Wire fences were situated throughout the site area. The entrance to the site is located near the intersection between Croatia Avenue and Soldiers Parade. A dirt track connects the entrance to a bridge in the north-western portion of the creek and then, the dirt track continues through the site towards the southern site boundary. The southern site boundary is marked by chain-link fencing.
Site Area	The site area is approximately 42,920m^2 (based on the provided site survey plan referenced above).

Plate 1: Aerial photograph of the site (source: SIX Maps, accessed 28 August 2020)

2.2 Local Land Use

The site is situated within a rural area used for farmland and residential purposes. Current uses on surrounding land at the time of our presence on site are described in **Table 2-2** below.

Table 2-2 Summary of Local Land Use

Direction Relative to Site	Land Use Description
North	Croatia Avenue, a two-lane asphalt-paved road. Beyond this road is the property at No.165 Croatia Avenue which is used for residential and farmland purposes.
East	Vacant land with dense vegetation and trees.
South	Vacant land with mild vegetation and no trees. Beyond this is a two-lane asphalt-paved road. The road directly abuts the southern site boundary at the south-western site corner. Beyond this are train lines. The train tracks are set back 30m or more from the south-western site corner and are at a lower elevation.
West	Beyond the northern portion of the western site boundary is vacant land with overgrown grass and some trees. Beyond this land is Soldiers Parade, a two-lane asphalt paved road at a slightly lower elevation to the site. Beyond the southern portion of the western site boundary, Soldiers Parade directly abuts the site and is at a higher elevation.

2.3 Regional Setting

The site topography and geological information for the locality is summarised in **Table 2-3** below**.**

Table 2-3 Topographic and Geological Information

Attribute	Description
Topography	The site is located on the low eastern side of Soldiers Parade and the low southern side of Croatia Avenue. Site levels vary from RL 48.6m at the north-western site corner to RL 56.2m at the south-western site corner. The site is within gently dipping northeast topography and dips towards the creek in the northern portion of the site. The level of the creek is below RL 47.0m.
Regional Geology	Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Penrith 1:100,000 Geological Series Sheet 9030 (DMR 1991) indicates the site is located at the boundary between Bringelly Shale (Rwb) which typically comprises of shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal and tuff; and Quaternary Fluvial Deposits (Qpn) which typically comprises of medium-grained sand, clay and silt.

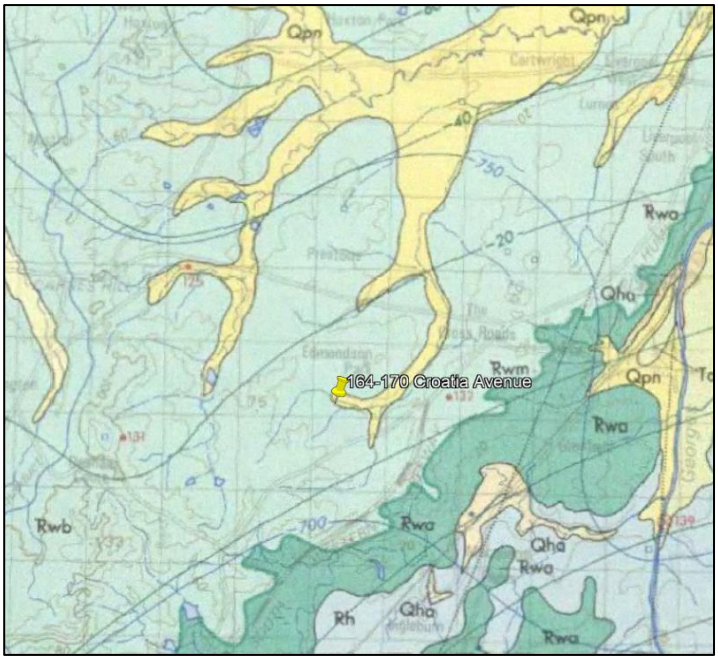


Plate 2: Excerpt of geological map showing location of site.

3. Assessment Results

3.1 Stratigraphy

For the development of a site-specific geotechnical model, the stratigraphy observed in the GI has been grouped into five geotechnical units. A summary of the subsurface conditions across the site, interpreted from the assessment results, is presented in **Table 3-1** below. More detailed descriptions of subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**. The details of the methods of soil and rock classifications, explanatory notes and abbreviations adopted on the borehole logs are also presented in **Appendix A.**

Table 3-1 Summary of Subsurface Conditions

Unit	Material[2]	Depth to Top of Unit (m BEGL)[1]	RL of Top of Unit (m AHD)[1]	Observed Thickness (m)	Comments
1	**Topsoil/Fill**	Surface	47.10 to 55.00	0.20 to 0.45	Medium plasticity, silty clay fill with fine gravels and some rootlets. Fill was assessed to be poorly to moderately compacted.
2	**Residual Soil**	0.20 to 0.45	46.80 to 54.70	1.90 to 3.01[3]	Medium to high plasticity, firm to very stiff silty clay, with bands of ironstone grading to hard (extremely weathered shale) clay with depth. SPT 'N' values varied from 6 to refusal. The clay next to the creek in the northern portion of the site, as observed in BH4M, BH5M, TP1 and TP2, were generally of high plasticity.
3	**Very Low to Low Strength Shale**	2.20 to 3.41	43.99 to 52.80	0.32 to 6.00[4]	Distinctly weathered, very low strength shale. Generally, this shale unit consisted of some extremely weathered seams and crushed seams. Core loss from 7.56m to 8.18m was observed in BH4M. Core loss is inferred to be bands of decomposed or highly fractured material.
4	**Medium Strength Shale**	3.02 to 6.00	41.40 to 49.38	3.20 to 5.88	Slightly weathered to fresh, medium strength shale. Not observed in BH4M
5	**High to Very High Strength Interbedded Shale and Sandstone**	7.62 to 11.50	38.20 to 43.50	-[5]	Slightly weathered to fresh, high to very high strength shale and sandstone.

Note 1 Approximate depth and level at the time of our assessment. Depths and levels may vary across the site.
Note 2 For more detailed descriptions of the subsurface conditions, reference should be made to the borehole logs attached to **Appendix A.**
Note 3 Observed up to termination depth in TP2
Note 4 Observed up to termination depth in TP1, TP3 and TP4.
Note 5 Observed up to termination depth in all boreholes.

Table 3-2 RL of Bedrock Units in Boreholes

Borehole ID	RL of top of Unit		
	Unit 3 – Very Low to Low Strength Shale	Unit 4 – Medium Strength Shale	Unit 5 – High to Very High Strength Shale and Sandstone
BH1	48.70	47.20	42.10
BH2	46.90	46.58	41.98
BH3M	52.80	49.38	43.50
BH4M	43.60	Not Encountered	40.60
BH5M	43.99	41.40	38.20

3.2 Groundwater Observations

During auger drilling and test pit excavation, all boreholes and test pits were observed to be dry and no seepage was noted.

Following completion of augering, groundwater monitoring wells were installed in BH3M, BH4M and BH5M. BH3M was bailed dry, and the groundwater levels were then measured within the monitoring wells as per **Table 3-2** below on the same day and one month following installation. We note that the groundwater levels may not have become evident or stabilised in the augered boreholes within the limited observation period.

Table 3-2 Groundwater Levels

Borehole ID	Measurement Date	Depth to Groundwater (m BEGL)	Groundwater RL (m AHD)
BH3M	06/08/2020 (on the same day as installation)	4.25	50.75
	15/09/2020	5.50	49.50
BH4M	15/09/2020	Artesian Flow	
BH5M	15/09/2020	Artesian Flow	

We note that artesian flow was observed within the wells BH4M and BH5M, with steady water flow within BH4M and a stable, above surface groundwater level within the stick up section of the monitoring well BH5M.

The creek adjacent to BH4M and BH5M is a perennial stream with stagnant and relatively shallow ponded water.

3.2.1 Infiltration test

A Rising Head Test was completed on 15 September 2020 in the monitoring well installed in BH5M. The following procedure was adopted:

- The groundwater level within the well was initially recorded;
- The well was purged using a PVC bailer;

The rising groundwater level within the temporary well was measured at various time intervals for 1 hour.

The results were then used to estimate the permeability of the bedrock using the Hvorslev Method based on the borehole geometry. The estimated permeability of the bedrock is calculated to be 2 x 10^{-7} m/s.

3.3 Test Results

Eight soil and three bulk samples were selected for laboratory testing to assess the following:

- Atterberg Limits and Linear Shrinkage.
- Soil aggressivity (pH, chloride and sulfate content and electrical conductivity).
- California Bearing Ratio (CBR);
- Dry Density/Optimum Moisture Content.

A summary of the soil test results is provided in **Table 3-3 and Table 3-4** below. Laboratory test certificates are presented in **Appendix B**.

Table 3-3 Summary of Soil Laboratory Test Results

Test/ Sample ID		BH1_ 0.5-0.95	BH2_ 1.5-1.95	BH3M_ 1.5-1.79	BH4M_ 1.5-1.95	BH5M_ 3.0-3.45	BH1_ 1.5-1.95	BH4M_ 0.5-0.90	BH5M_ 1.5-1.95
Unit		2	2	2	2	2	2	2	2
Material Description [1]		Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay
Aggressivity	Chloride Cl (ppm)	180	1200	280	960	280	-	-	-
	Sulfate SO_4 (ppm)	140	160	280	800	300	-	-	-
	pH	4.8	8.1	5.8	5.4	8.3	-	-	-
	Electrical Conductivity (µS/cm)	250	770	130	320	81	-	-	-
	Moisture Content (%)	17	19.4	6.4	16.9	8.5	15.9	23.1	23.0
Attergerg Limits	Liquid Limit (%)	-	-	-	-	-	36	63	58
	Plastic Limit (%)	-	-	-	-	-	23	25	23
	Plasticity Index (%)	-	-	-	-	-	13	38	35
	Linear Shrinkage (%)	-	-	-	-	-	8	16.5	15.5

Note 1 More detailed descriptions of the subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**.

The Atterberg Limits result on the selected clay sample indicated clays to be of medium to high plasticity and moderate to high shrink-swell potential.

The assessment indicated low permeability soil was present above the groundwater table. In accordance with Tables 6.4.2(C) and 6.5.2(C) of AS 2159:2009 'Piling – Design and

Installation', the results of the pH, chloride and sulfate content and electrical conductivity of the soil provided the following exposure classifications:

- 'Mild' for buried concrete structural elements; and
- 'Non-Aggressive' for buried steel structural elements.

In accordance with Table 4.8.1 of AS3600-2009 'Concrete Structures' these soils would be classified as exposure classification 'A2' for concrete in sulfate soils.

Table 3-4 Summary of CBR Test Results

Test/ Sample ID	TP1_0.9-1.2	TP2_0.8-1.1	TP3_0.6-0.9
Depth (m BEGL)	0.9 to 1.2	0.8 to 1.1	0.6 to 0.9
Unit	2	2	2
Material Description [1]	Silty Clay	Silty Clay	Silty Clay
CBR (4-day Soaked) (%)	3	7	5
Maximum Dry Density (t/m^3)	1.791	1.778	1.608
Optimum Moisture Content (%)	17.7	17.5	23.0

Note 1 More detailed descriptions of the subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**.

Bulk samples of the Unit 2 material from TP1, TP2 and TP3 were tested for compaction and four day soaked CBR, resulted in values of 3% to 7% when compaction to 100% of Standard Maximum Dry Density (SMDD) and surcharged with 9kg.

54 selected rock core samples were tested by Macquarie to estimate the Point Load Strength Index (Is_{50}) values to assist with rock strength assessment. The results of the testing are summarised on the attached borehole logs.

The point load strength index tests correlated reasonably well with our field assessments of rock strength. The approximate Unconfined Compressive Strength (UCS) of the rock core, estimated from correlations with the point load strength index test results, varied from <1 MPa to 128 MPa.

4. Recommendations

4.1 Geotechnical Issues

Based on the results of the assessment, we consider the following to be the main geotechnical issues for the proposed development:

- Basement excavation and retention to limit lateral deflections and ground loss as a result of excavations, resulting in damage to nearby structures;
- Rock excavation;
- Groundwater within the depth of the excavation;
- Foundation design for building loads.

4.2 Dilapidation Surveys

Prior to excavation and construction, we recommend that detailed dilapidation surveys be carried out on all structures and infrastructures surrounding the site that falls within the zone of influence of the excavation to allow assessment of the recommended vibration limits and protect the client against spurious claims of damage. The zone of influence of the excavation is defined by a distance back from the excavation perimeter of twice the total depth of the excavation. The reports would provide a record of existing conditions prior to commencement of the work. A copy of each report should be provided to the adjoining property owner who should be asked to confirm that it represents a fair assessment of existing conditions. The reports should be carefully reviewed prior to demolition and construction.

4.3 Excavation Methodology

4.3.1 Excavation Assessment

Prior to any excavation commencing, we recommend that reference be made to the Safe Work Australia Excavation Work Code of Practice, dated August 2019.

EI assumes that excavation depths ranging between 6.5m and 8.5m BEGL will be required for the two level basement. Locally deeper excavations for footings, service trenches, crane pads and lifts overrun pits may be required.

Based on the borehole logs, the proposed basement excavations will extend through all units as outlined in **Table 3-1** above. As such, an engineered retention system must be installed prior to excavation commencing.

Units 1 and 2 could be excavated using buckets of large earthmoving Hydraulic Excavators, particularly if fitted with ‘Tiger Teeth’. Excavation of Units 3, 4 and 5 (where encountered) may present hard or heavy ripping, or “hard rock” excavation conditions. Ripping would require a high capacity and heavy bulldozer for effective production. Wear and tear should also be allowed for. The use of a smaller size bulldozer will result in lower productivity and higher wear and tear, and this should be allowed for. Alternatively, hydraulic rock breakers, rock saws, ripping hooks or rotary grinders could be used, though productivity would be lower and equipment wear increased, and this should be allowed for.

Should rock hammers be used for the excavation of the bedrock, excavation should commence away from the adjoining structures and the transmitted vibrations monitored to assess how close the hammer can operate to the adjoining structures while maintaining transmitted vibrations within acceptable limits. To fall within these limits, we recommend that the size of rock

hammers do not exceed a medium sized rock hammer, say 900 kg, such as a Krupp 580, and be trialled prior to use. The transmitted vibrations from rock hammers should be measured to determine how close each individual hammer can operate to the adjoining buildings.

The vibration measurements can be carried out using either an attended or an unattended vibration monitoring system. An unattended vibration monitoring system must be fitted with an alarm in the form of a strobe light or siren or alerts sent directly to the site supervisor to make the plant operator aware immediately when the vibration limit is exceeded. The vibration monitor must be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds set limits outlined by a vibration monitoring plan. Reference should be made to **Appendix C** for a guide to acceptable limits of transmitted vibrations.

If it is found that the transmitted vibrations by the use of rock hammers are unacceptable, then it would be necessary to change to a smaller excavator with a smaller rock hammer, or to a rotary grinder, rock saws, jackhammers, ripping hooks, chemical rock splitting and milling machines. Although these are likely to be less productive, they would reduce or possibly eliminate risks of damage to adjoining properties through vibration effects transmitted via the ground. Such equipment would also be required for detailed excavation, such as footings or service trenches, and for trimming of faces. Final trimming of faces may also be completed using a grinder attachment rather than a rock breaker in order to assist in limiting vibrations. The use of rotary grinders generally generates dust and this may be supressed by spraying with water.

To assist in reducing vibrations and over-break of the shale and sandstone, we recommend that initial saw cutting of the excavation perimeters through the bedrock may be provided using rock saw attachments fitted to the excavator. Rock sawing of the excavation perimeter has several advantages as it often reduces the need for rock bolting as the cut faces generally remain more stable and require a lower level of rock support than hammer cut excavations, ground vibrations from rock saws are minimal and the saw cuts will provide a slight increase in buffer distance for use of rock hammers. However, the effectiveness of such approach must be confirmed by the results of vibration monitoring.

Also, there is a potential for poorly oriented defects within the excavated bedrock to result in localized rock slide/topple failure with potential impact to the work site or the adjacent structures. However through selection of suitable excavation equipment, geotechnical inspections and mapping during the excavation works along with the installation of support measures as determined necessary by the inspections, the risk from the proposed works can be maintained within ‘Acceptable’ levels. In addition, we recommend that only excavation contractors with appropriate insurances and experience on similar projects be used. The contractor should also be provided with a copy of this report to make his own judgement on the most appropriate excavation equipment.

Groundwater seepage monitoring should be carried out during bulk excavation works and prior to finalising the design of a pump out facility. Outlets into the stormwater system will require Council approval.

Furthermore, any existing buried services, which run below the site, will require diversion prior to the commencement of excavation or alternatively be temporarily supported during excavation, subject to permission or other instructions from the relevant service authorities. Enquiries should also be made for further information and details, such as invert levels, on the buried services.

4.3.2 Excavation Monitoring

Consideration should be made to the impact of the proposed development upon neighbouring structures, roadways and services. Basement excavation retention systems should be designed so as to limit lateral deflections.

Contractors should also consider the following limits associated with carrying out excavation and construction activities:

- Limit lateral deflection of temporary or permanent retaining structures;
- Limit vertical settlements of ground surface at common property boundaries and services easement; and
- Limit Peak Particle Velocities (PPV) from vibrations, caused by construction equipment or excavation, experienced by any nearby structures and services.

Monitoring of deflections of retaining structures and surface settlements should be carried out by a registered surveyor at agreed points along the excavation boundaries and along existing building foundations/ services/ pavements and other structures located within or near the zone of influence of the excavation. Owners of existing services adjacent to the site should be consulted to assess appropriate deflection limits for their infrastructures. Measurements should be taken in the following sequence:

- Before commencing installation of retaining structures where appropriate to determine the baseline readings. Two independent sets of measurements must be taken confirming measurement consistency;
- After installation of the retaining structures, but before commencement of excavation;
- After excavation to the first row of supports or anchors, but prior to installation of these supports or anchors;
- After excavation to any subsequent rows of supports or anchors, but prior to installation of these supports or anchors;
- After excavation to the base of the excavation;
- After de-stressing and removal of any rows of supports or anchors; and
- One month after completion of the permanent retaining structure or after three consecutive measurements not less than a week apart showing no further movements, whichever is the latter.

4.4 Groundwater Considerations

Groundwater in BH3M and artesian flow in BH4M and BH5M was observed in the installed monitoring wells as detailed in **Section 3-2**, all of which are above the assumed BEL of all buildings.

For the basements towards the southern half of the site, due to the low permeability of the soil and bedrock profile any groundwater inflows into the excavation should not have an adverse impact on the proposed development or on the neighbouring sites and should be manageable. However, we expect that some groundwater inflows into the excavation along the soil/rock interface and through any defects within the shale and sandstone bedrock (such as jointing, and bedding planes, etc.) particularly following a period of heavy rainfall. The initial flows into the excavation may be locally high, but would be expected to decrease considerably with time as the bedding seams/joints are drained. We recommend that monitoring of seepage be implemented during the excavation works to confirm the capacity of the drainage system.

We expect that any seepage that does occur will be able to be controlled by a conventional sump and pump system. We recommend that a sump-and-pump system be used both during construction and for permanent groundwater control below the basement floor slab.

In the long term, drainage should be provided behind all basement retaining walls, around the perimeter of the basement and below the basement slab. The completed excavation should be inspected by the hydraulic engineer to confirm that adequate drainage has been allowed for. Drainage should be connected to the sump-and-pump system and discharging into the stormwater system. The permanent groundwater control system should take into account any possible soluble substances in the groundwater which may dictate whether or not groundwater can be pumped into the stormwater system.

For the basements within the northern half of the site particularly adjacent to the creek, further investigations will be required to assess hydrogeological conditions within this area and to investigate the possibility of the requirements of tanking.

It is interpreted that the BH4M and BH5M have penetrated into an Aquitard which is defined as "*A low-permeability unit that can store groundwater and also transmit it slowly from one formation to another. Aquitards retard but do not prevent the movement of water to or from adjacent aquifers*".

It is to be noted that the shale formation encountered over the project site is known to act as aquitard with perched groundwater as highlighted below in **Table 4-1**.

Table 4-1 Hydrogeological Properties of Stratigraphic Units in Sydney Area [1]

Age	Stratigraphic Unit	Type of Hydrogeological Unit	Hydraulic Conductivity (Horizontal) (m/d)	Hydraulic Conductivity (Vertical) (m/d)	Transmissivity (m^2/day)	Permeability (m/s)
Quaternary/ Tertiary	Alluvial Deposits	Unconfined aquifer	1 - 10		>20	-
Triassic	**Wianamatta Group**	**Aquitard – Unconfined / perched**	**0.01**	**0.05**	**<1 (Shale)**	-
	Hawkesbury Sandstone	Unconfined / semi- confined aquifer	0.1	$0.05 – 6 \times 10^{-4}$	1 – 5 (0.016 – 9.2, mean of 2.8)	3×10^{-8}
	Bald Hill Claystone	Aquitard	1.0×10^{-5}	2.0×10^{-6}	-	5×10^{-9}
	Bulgo Sandstone	Minor confined aquifer	5.50×10^{-4}	1.0×10^{-4}	0.1 – 0.5	6×10^{-8}
	Stanwell Park Claystone	Aquitard	3.00×10^{-5}	6.00×10^{-6}	-	3×10^{-9}
	Scarborough Sandstone	Minor confined aquifer	0.01	5.00×10^{-3}	0.1 – 0.5	2×10^{-7}
	Wombarra Claystone	Aquitard	3.00×10^{-5}	6.00×10^{-6}	-	1×10^{-9}
Permian	Illawarra Coal Measures	Confined water bearing zones	5.00×10^{-2}	2.50×10^{-2}	0.005 – 0.1	1×10^{-5}

Notes:
1 Adopted from Broadstock, B., 2011. Impact of groundwater pumping on stacked water sources, NSW Office of Water, Sydney.

It is recommended that two additional groundwater monitoring wells be installed in between BH4M and BH5M to further investigate the groundwater conditions within the northern portion of the site prior to final design.

The design of drainage and pump systems should take the above issues into account along with careful ongoing inspections and maintenance programs.

4.5 Excavation Retention

4.5.1 Support Systems

From a geotechnical perspective, it is critical to maintain the stability of all adjacent structures and infrastructures during demolition, excavation and construction works.

Based on the provided architectural plans, the combined basement outline of Building A to D has a setback of about 3m from the western site boundary; the combined basement outline of Building E and F has minimal to no setback from the southern site boundary and a setback of 30m or greater from the eastern site boundary; and the combined basement outline of Building G and H has a setback of nil to 3m from the southern site boundary and 3m from the western site boundary.

Based on the above, the encountered subsurface conditions, the depth of excavation, temporary batters of no steeper than a safe angle of 1 Vertical (V) to 1 Horizontal (H) may be feasible where space allows for the fill and residual soil profile. Potential areas where batters can be installed include the eastern excavation boundary of Building E and F; and in between adjacent excavations.

The above temporary batters should remain stable provided that all surcharge loads, including construction loads, are kept at a distance of at least 2h (where ‘h’ is the height of the batter in metres) from the crest of the batter. If steeper batters are to be used, then these must be supported by shotcrete and soil nail system designed by a suitable structural or geotechnical engineer. The stability of these batters can be assessed using computer slope stability analysis software such as Slope/W. EI can complete such analysis, if commissioned to do so.

Where batters are used, the space between the batters and the permanent retaining walls will need to be carefully backfilled to reduce future settlement of the backfill. Only light compaction equipment should be used for compaction behind retaining walls so that excessive lateral pressures are not placed on the walls. This will require the backfill to be placed in thin layers, say 100mm loose thickness, appropriate to the compaction equipment being used. The compaction specification for the backfill will depend on whether paving or structures are to be supported on the fill. If the fill is to support paved areas it should be compacted to a density of at least 98% of Standard Maximum Dry Density (SMDD) for granular fill materials, but if it is only to support landscaped areas of lower compaction specification, say 95% of SMDD, may be appropriate, provided the risk of future settlement and maintenance can be accepted. An alternative for backfill would also be to use a uniform granular material, wrapped in geofabric.

Where space for temporary batters is not available or is undesirable (such as where local roads are planned) a suitable retention system will be required for the support of the entire depth of the excavations. For this site, we recommend that an anchored soldier pile wall with mass concrete in between the piles to be the most suitable. The soldier pile walls will be installed to below BEL in all excavations. Anchors and mass concrete must be installed progressively as excavation proceeds. **Where tanking is required (subject to the additional investigation of groundwater) a water-tight wall such as a secant pile shoring wall may be required towards the north.**

Working platforms may also be required. We can complete the design of the working platform, if commissioned to do so.

4.5.2 Retaining Wall Design Parameters

The following parameters may be used for static design of temporary and permanent retaining walls at the subject site:

- For progressively anchored or propped walls where minor movements can be tolerated (provided there are no buried movement sensitive services), we recommend the use of a trapezoidal earth pressure distribution of 4H kPa for soil, where H is the retained height in meters. These pressures should be assumed to be uniform over the central 50% of the support system, tapering to nil at top and bottom;
- For progressively anchored or propped walls which support areas which are highly sensitive to movement (such as areas where movement sensitive structures or infrastructures or buried services are located in close proximity), we recommend the use of a trapezoidal earth pressure distribution of 8H kPa for soil, where 'H' is the retained height in meters. These pressures should be assumed to be uniform over the central 50% of the support system, tapering to nil at top and bottom;
- All surcharge loading affecting the walls (including from construction equipment, construction loads, adjacent high level footings, etc.) should be adopted in the retaining wall design as an additional surcharge using an 'at rest' earth pressure coefficient, Ko;
- The retaining walls should be designed as drained and measures are to be taken to provide complete and permanent drainage behind the walls. Strip drains protected with a non-woven geotextile fabric should be used behind the shotcrete infill panels for soldier pile walls;
    - **Subject to the groundwater investigation, the shoring wall may need to be designed as fully watertight and take into account water pressures where required.**
- For piles embedded into Unit 4 or better, the allowable lateral toe resistance values outlined in **Table 4-2** below may be adopted. These values assume excavation is not carried out within the zone of influence of the wall toe and the rock does not contain adverse defects etc. The upper 0.3m depth of the socket should not be taken into account to allow for tolerance and disturbance effects during excavation.
- If temporary anchors extend beyond the site boundaries, then permission from the neighbouring properties would need to be obtained prior to installation. Also, the presence of services and their levels must be confirmed prior to finalising anchor design**.**
- Anchors should have their bond length within Unit 3 or better. For the design of anchors bonded into Unit 3 or better, the allowable bond stress value outlined in **Table 4-2** below may be used, subject to the following conditions:
    1. Anchor bond lengths of at least 3m behind the 'active' zone of the excavation (taken as a 45 degree zone above the base of the excavation) is provided;
    2. Overall stability, including anchor group interaction, is satisfied;
    3. All anchors should be proof loaded to at least 1.33 times the design working load before locked off at working load. Such proof loading is to be witnessed by and engineer independent of the anchoring contractor. We recommend that only experienced contractors be considered for anchor installation with appropriate insurances;
    4. If permanent anchors are to be used, these must have appropriate corrosion provisions for longevity.

Table 4-2 Geotechnical Design Parameters

Material [1]		Unit 1 Fill/Topsoil	Unit 2 Residual Soil	Unit 3 Very Low to Low Strength Shale	Unit 4 Medium Strength Shale	Unit 5 High to Very High Strength Interbedded Shale and Sandstone
RL of Top of Unit (m AHD) [2]		**47.10 to 55.00**	**46.80 to 54.70**	**43.99 to 52.80**	**41.97 to 49.38**	**38.20 to 47.20**
Bulk Unit Weight (kN/m^3)		**18**	**20**	**23**	**24**	**24**
Friction Angle, ϕ' (°)		**25**	**28**	**-**	**-**	**-**
Earth Pressure Coefficients	At rest, K_o [3]	0.58	0.53	0.47	-	-
	Active, K_a [3]	0.41	0.36	0.31	-	-
	Passive, K_p [3]	-	-	3.25	-	-
Allowable Bearing Pressure (kPa) [5]		-	-	700	3000	3500
Allowable Shaft Adhesion (kPa) [4, 5]	in Compression	-	-	70	300	350
	in Uplift	-	-	35	150	175
Allowable Toe Resistance (kPa)		-	-	-	300	350
Allowable Bond Stress (kPa)		-	-	50	200	250
Earthquake Site Risk Classification		▪ AS 1170.4:2007 indicates an earthquake subsoil class of Class C_e (Shallow Soil) ▪ AS 1170.4:2007 indicates that the hazard factor (z) for Sydney is 0.08.				

Notes:

1 More detailed descriptions of subsurface conditions are available on the borehole logs presented in **Appendix A.**

2 Approximate levels of top of unit at the time of our investigation. Levels may vary across the site.

3 Earth pressures are provided on the assumption that the ground behind the retaining walls is horizontal.

4 Side adhesion values given assume there is intimate contact between the pile and foundation material and should achieve a clean socket roughness category R2 or better. Design engineer to check both 'piston pull-out' and 'cone liftout' mechanics in accordance with AS4678-2002 Earth Retaining Structures.

5 To adopt these parameters we have assumed that:

- Footings have a nominal socket of at least 0.3m, into the relevant founding material;
- For piles, there is intimate contact between the pile and foundation material (a clean socket roughness category of R2 or better);
- Potential soil and groundwater aggressivity will be considered in the design of piles and footings;
- Piles should be drilled in the presence of a Geotechnical Engineer prior to pile construction to verify that ground conditions meet design assumptions. Where groundwater ingress is encountered during pile excavation, concrete is to be placed as soon as possible upon completion of pile excavation. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremmie system could be used;
- The bases of all pile, pad and strip footing excavations are cleaned of loose and softened material and water is pumped out prior to placement of concrete;
- The concrete is poured on the same day as drilling, inspection and cleaning.
- The allowable bearing pressures given above are based on serviceability criteria of settlements at the footing base/pile toe of less than or equal to 1% of the minimum footing dimension (or pile diameter).

4.6 Foundations

Following bulk excavations we expect either Unit 3, 4 or 5 material to be exposed.

It is recommended that all footings for the building be founded within bedrock of similar strength to provide uniform support and reduce the potential for differential settlements.

Pad or strip footings founded within Unit 3, 4, or 5 may be preliminarily designed for an allowable bearing capacity of 700kPa, 3000kPa, or 3500kPa, respectively, based on serviceability. Piles may also be used where required. Bored Piles are suitable for this site.

Geotechnical inspections of foundations are recommended to determine that the required bearing capacity has been achieved and to determine any variations that may occur between the boreholes and inspected locations.

4.7 Pavement Design

The design of new pavements will depend on subgrade preparation, subgrade drainage, the nature and composition of fill excavated or imported to the site, as well as vehicle loadings and use. Various alternative types of construction could be used for the pavements. Concrete construction would undoubtedly be the best in areas where heavy vehicles manoeuvre such as trucks turning and manoeuvring. Flexible pavements may have a lower initial cost, but maintenance will be higher. These factors should be considered when making the final choice.

Based on the laboratory test results, the samples collected from the natural subgrade at the proposed pavement areas registered the CBR value to range between 3% and 7%. We recommend that pavement design may be based on the CBR value of 3.0%, or an equivalent coefficient of subgrade reaction of 30kPa/mm (500mm plate).

The 3% CBR value is low but it may be increased by stabilising the subgrade to a depth of 200mm to 300mm by the addition of lime. When thoroughly mixed and re-compacted to a minimum of 90% of SMDD, a reduction in reactivity along with substantial increase in strength will be achieved. As a guide, the addition of approximately 4% lime by dry weight of clay should result in a soaked CBR value of around 6% or an equivalent subgrade reaction of 60kPa/mm. this should, however, be confirmed by laboratory testing. If lime stabilisation is undertaken, an experienced contractor with appropriate equipment should complete it.

Alternatively, an appropriate select fill layer comprising of good quality, well graded granular material (such as unbound base or ripped, crushed sandstone with CBR greater than 10%, a maximum particle size of 60mm, well graded and Plastic Index less than 10, compacted to at least 98% of SMDD) may be used below the pavement.

We recommend that in situ density tests be completed on the proof rolled and prepared subgrade to confirm that at least 98% Standard Maximum Dry Density (SMDD) has been achieved. If the existing fill is removed and replaced with imported fill, the CBR of the imported material may be taken into account. These design values should be confirmed by inspection and Dynamic Cone Penetration (DCP) testing of the subgrade following proof rolling.

All upper (base) course should be crushed rock to RMS QA specification 3051 (2013) unbound base and compacted to at least 100% of SMDD. All lower (sub-base) course should be crushed rock to RMS QA specification 3051 (2013) unbound base or ripped/crushed sandstone with CBR greater than 40%, maximum particle size of 60mm, well graded and Plastic Index less than 10. All lower course material should be compacted to an average of no less than 100% of SMDD, but with a minimum acceptance value of 98% of SMDD.

Concrete pavements should have a sub-base layer of at least 100mm thickness of crushed rock to RMS QA specification 3051 (2013) unbound base material (or equivalent good quality and

durable fine crushed rock) which is compacted to at least 100% SMDD. Concrete pavements should be designed with an effective shear transmission of all joints by way of either doweled or keyed joints.

Careful attention to subsurface and surface drainage is required in view of the effect of moisture on the clay soils. Pavement levels will need to be graded to promote rapid removal of surface water so ponding does not occur on the surface of pavements. The drainage trenches should be excavated with a uniform longitudinal fall to appropriate discharge points so as to reduce the risk of water ponding. The capacity of the stormwater collection system from the pavement should be checked and upgraded if necessary. In order to protect the pavement edge, subsoil drains should be provided along the perimeter of all proposed new external pavement areas, particularly in those areas of cut, with invert levels of at least 200mm below subgrade level.

The long-term successful performance of the pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance programme should not be limited to routine compaction density testing only. Other important factors associated with the earthworks includes subgrade preparation, selection of fill materials, control of moisture content and drainage, etc.

5. Further Geotechnical Inputs

Below is a summary of the previously recommended additional work that needs to be carried out:

- Additional Geotechnical Investigation in the form of at least five cored boreholes across the site to confirm the depth and quality of Unit 4 shale bedrock or better;
- Additional groundwater monitoring wells, long term groundwater monitoring and seepage modelling, particularly along the creek to the north;
- Stability assessment of temporary batters using computer modelling, if required;
- Dilapidation surveys;
- Design of working platforms (if required) for construction plant by an experienced and qualified geotechnical engineer;
- Classification of all excavated material transported off site;
- Witnessing installation of support measures and proof-testing of anchors (if required).
- Geotechnical inspections of all new footings/piles by an experienced geotechnical professional before concrete or steel are placed to verify their bearing capacity and the in-situ nature of the founding strata; and
- Ongoing monitoring of groundwater inflows into the bulk excavation;

We recommend that a meeting be held after initial structural design has been completed to confirm that our recommendations have been correctly interpreted. We also recommend a meeting at the commencement of construction to discuss the primary geotechnical issues and inspection requirements.

6. Statement of Limitations

This report has been prepared for the exclusive use of Marx Lin and Super Star Holding Group Pty Ltd who is the only intended beneficiary of EI's work. The scope of the assessment carried out for the purpose of this report is limited to those agreed with Marx Lin and Super Star Holding Group Pty Ltd

No other party should rely on the document without the prior written consent of EI, and EI undertakes no duty, or accepts any responsibility or liability, to any third party who purports to rely upon this document without EI's approval.

EI has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the geotechnical industry in Australia as at the date of this document. No other warranty, expressed or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including its appendices and attachments.

The conclusions presented in this report are based on a limited investigation of conditions, with specific sampling and test locations chosen to be as representative as possible under the given circumstances.

EI's professional opinions are reasonable and based on its professional judgment, experience, training and results from analytical data. EI may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified by EI.

EI's professional opinions contained in this document are subject to modification if additional information is obtained through further investigation, observations, or validation testing and analysis during construction. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.

We draw your attention to the document "Important Information", which is included in **Appendix D** of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by EI, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Should you have any queries regarding this report, please do not hesitate to contact EI.

References

AS1289.6.3.1:2004, *Methods of Testing Soils for Engineering Purposes,* Standards Australia.

AS1726:2017, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

AS3600:2009, *Concrete Structures,* Standards Australia

Safe Work Australia Excavation Work Code of Practice, dated August 2019 – WorkCover NSW

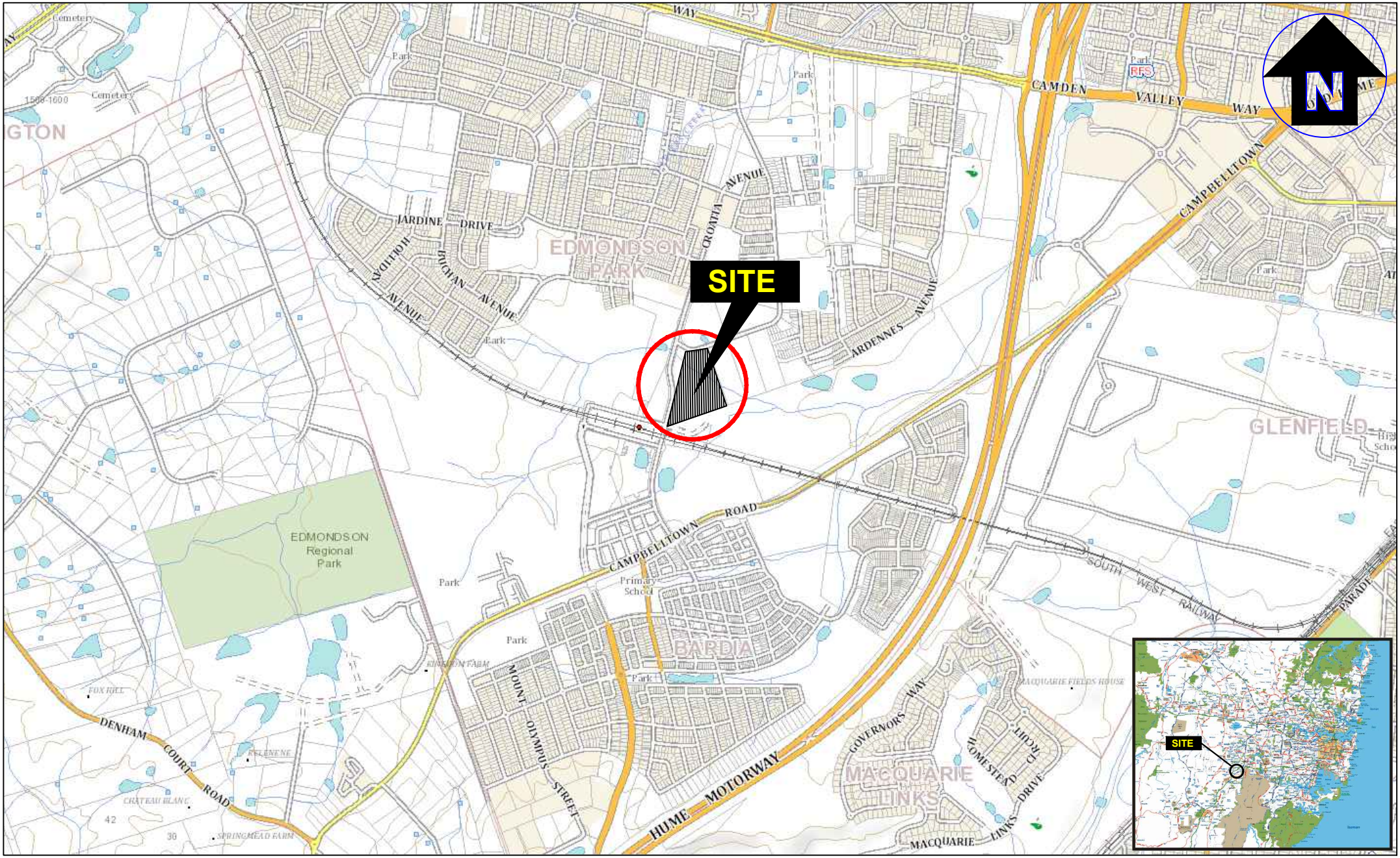
NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

NSW Department of Mineral Resources (1983) Penrith 1:100,000 Geological Series Sheet 9130 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

Abbreviations

AHD	Australian Height Datum
AS	Australian Standard
BEL	Bulk Excavation Level
BEGL	Below Existing Ground Level
BH	Borehole
DBYD	Dial Before You Dig
DP	Deposited Plan
EI	EI Australia
GI	Geotechnical Investigation
NATA	National Association of Testing Authorities, Australia
RL	Reduced Level
SPT	Standard Penetration Test
T-C	Tungsten-Carbide
UCS	Unconfined Compressive Strength

Figures



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Approved:	S.K
Date:	25/09/2020
Scale:	Not To Scale

Super Star Holding Group Pty Ltd

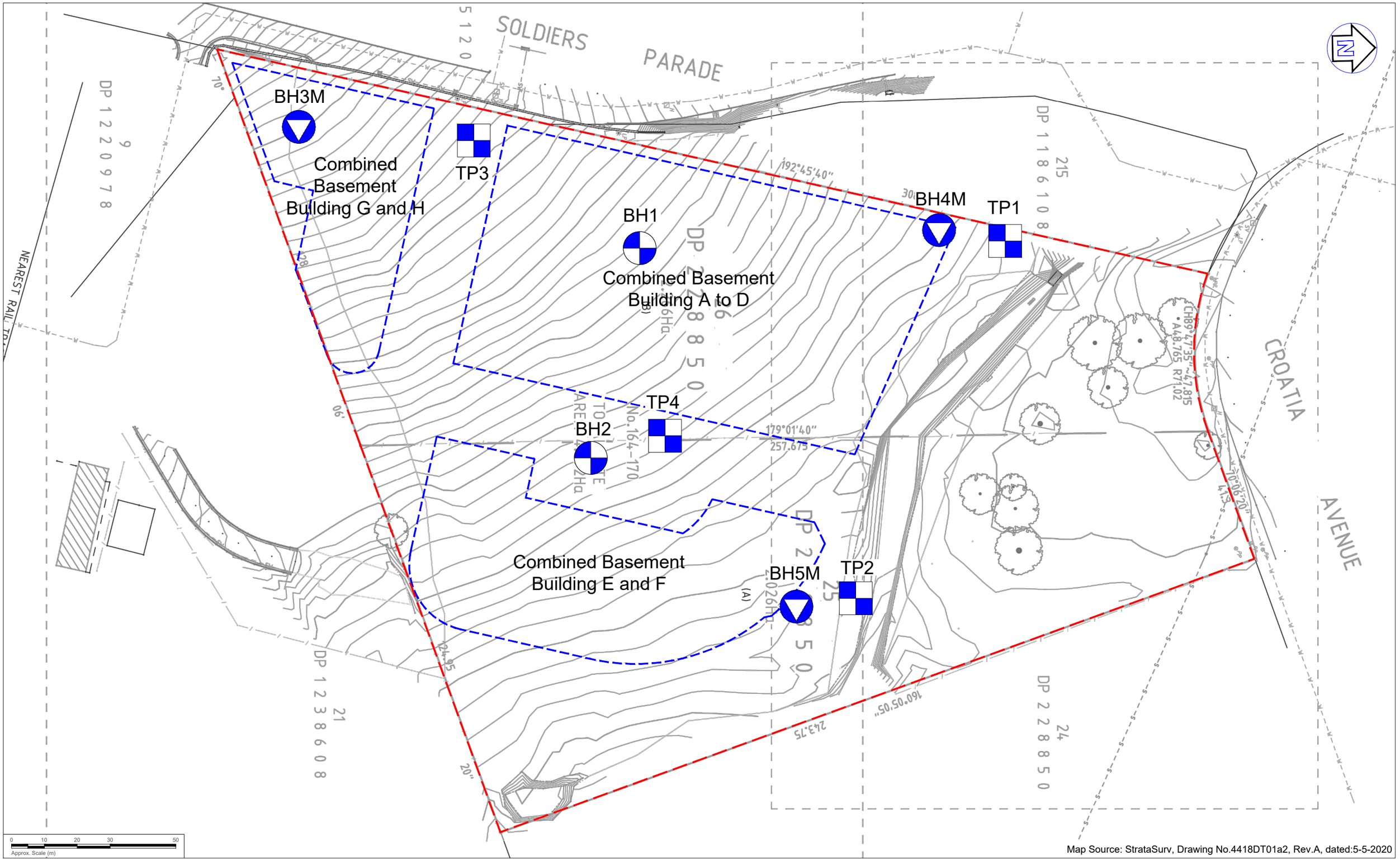
Geotechnical Investigation

164-170 Croatia Avenue, Edmondson Park, NSW

Site Locality Plan

Figure: 1

Project: E24744.G03



LEGEND

- Approximate outline of site boundary
- Approximate outline of combined basement boundaries
- Approximate borehole location
- Approximate borehole / monitoring well location
- Approximate test pit location

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Date:	25/09/2020

Super Star Holding Group Pty Ltd
Geotechnical Investigaition
164-170 Croatia Avenue, Edmondson Park, NSW

Borehole Location Plan

Figure: 2

Project: E24744.G03

Appendix A – Borehole Logs And Explanatory Notes

BOREHOLE LOG

BH NO. BH1

Project	Proposed Development	**Sheet**	1 of 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	22/07/2020
Position	Refer to Figure 2	**Date Completed**	22/07/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 22/07/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor	Rockwell Drilling Services Pty Ltd	**Surface RL**	≈51.30 m AHD
Drill Rig	Auger Drill	**Inclination**	-90°

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY REL. DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	GWNE	0	51.30				-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-rounded to rounded gravels and some rootlets.	M (>PL)	-	FILL/TOPSOIL
				0.20								
				51.10				CI	Silty CLAY; medium plasticity, pale grey to orange-red.			RESIDUAL SOIL
					SPT 0.50-0.95 m 4,3,4 N=7					M (>PL)	F	
			1									
				1.50								
				49.80	SPT 1.50-1.95 m 6,11,12 N=23				From 1.5 m, grading to pale grey extremely weathered shale.	M (<PL)	VSt	
			2									
				2.60								
	M			48.70				-	SHALE; grey, very low strength, distinctly weathered.	-	-	BEDROCK
			3	*3.04*	SPT 3.00-3.02 m 4/20mm HB				Continued as Cored Borehole			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH1

Project	Proposed Development	**Sheet**	2 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	22/07/2020
Position	Refer to Figure 2	**Date Completed**	22/07/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 22/07/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈51.30 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3	*3.04* 48.26		Continuation from non-cored borehole				
NMLC	100% RETURN	100	81	4			SHALE; dark grey to brown-orange, thinly to medium bedded with fine grained, pale grey sandstone laminations, with occasional bands of ironstaining.	DW		3.10-3.15: XWS, Silty clay 3.31-3.32: XWS, Silty clay	
	100% RETURN	100	98	5				SW		4.28-4.30: CS	
	60% RETURN	100	85	6							
				7						6.88-6.89: CS	
				8							
				9	*9.20* 42.10					8.56-8.58: CS 8.74-8.75: CS, with extremely weathered sandstone returned as sand	
		100	88	10			SANDSTONE; pale grey, fine grained with siltstone laminations.	FR			

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH1

Project	Proposed Development	**Sheet**	3 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	22/07/2020
Position	Refer to Figure 2	**Date Completed**	22/07/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 22/07/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈51.30 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
NMLC	100% RETURN	100	88	10			SANDSTONE; pale grey, fine grained with siltstone laminations.	FR			
				11							
				12	*12.20*						
	100% RETURN	100	81		39.10		SHALE; dark grey-brown, thinly to medium bedded, with fine grained sandstone laminations.				
				13	*13.82*						
				14	37.48		SANDSTONE; pale grey, fine grained, with siltstone laminations.				
					14.23						
					37.07		Hole Terminated at 14.23 m				
				15							
				16							
				17							
				18							
				19							
				20							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH1

Project	Proposed Residential Development			**Depth Range**	3.04m to 7.00m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈ 51.3m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	22 / 07 / 2020
Client	Tony Owen Pty Ltd	**Box**	1 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

CORE PHOTOGRAPH OF BOREHOLE: BH1

Project	Proposed Residential Development			**Depth Range**	7.00m to 14.23m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈ 51.3m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	22 / 07 / 2020
Client	Tony Owen Pty Ltd	**Box**	2-3 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

BOREHOLE LOG

BH NO. BH2

Project	Proposed Development	**Sheet**	1 of 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	22/07/2020
Position	Refer to Figure 2	**Date Completed**	22/07/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 22/07/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor	Rockwell Drilling Services Pty Ltd	**Surface RL**	≈49.60 m AHD
Drill Rig	Auger Drill	**Inclination**	-90°

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY REL. DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	GWNE	0	49.60				-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-rounded to rounded gravels and some rootlets.	M (>PL)	-	FILL/TOPSOIL
				0.45								
				49.15	SPT 0.50-0.95 m 2,3,4 N=7			Cl	Silty CLAY; medium plasticity, pale grey to orange.			RESIDUAL SOIL
			1	*1.00*								
				48.60					From 1.0 m, orange-red.	M (>PL)	F	
				1.70	SPT 1.50-1.95 m 2,5,18 N=23							
				47.90					From 1.7 m, grading to pale grey, extremely weathered shale.	M (<PL)	VSt	
			2	*2.70*								
	M			46.90				-	SHALE; grey, very low strength, distinctly weathered.	-	-	BEDROCK
				3.02								
			3		SPT 3.00-3.02 m 3/20mm HB				Continued as Cored Borehole			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH2

Project	Proposed Development	**Sheet**	2 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	22/07/2020
Position	Refer to Figure 2	**Date Completed**	22/07/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 22/07/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈49.60 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	*DEPTH* RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3	*3.02*		Continuation from non-cored borehole				
NMLC	100% RETURN	100	65	4	46.58		SHALE; dark grey to brown-orange, thinly to medium bedded with fine grained, pale grey sandstone laminations, with occasional bands of ironstaining.	DW - SW		3.76: JT, 70°, CN, IR, SM 3.82-3.90: CS, 80 mm	
				5						4.52: JT, 45°, CN, UN, SM 4.57: JT, 30°, CN, CU, SM 4.79-4.81: XWS, Silty clay, 20 mm 4.81-4.84: CS, 30 mm	
	100% RETURN	100	83	6						5.47-5.49: XWS, 20 mm	
				7	*7.62*					6.51: JT, 90°, CN, PR, SM	
	100% RETURN	100		8	41.98		SANDSTONE; pale grey, fine grained with siltstone laminations.	FR		7.47-7.50: CS, 30 mm	
				9							
				10							

CORED BOREHOLE LOG

BH NO. BH2

Project	Proposed Development	**Sheet**	3 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	22/07/2020
Position	Refer to Figure 2	**Date Completed**	22/07/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 22/07/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈49.60 m AHD
Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	*DEPTH* RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
NMLC		100		10			SANDSTONE; pale grey, fine grained with siltstone laminations.	FR		10.18: JT, 80°, CN, IR, SM 10.46-10.49: CS, 30 mm	
	100% RETURN	100	62	11							
				12						11.89: JT, 60°, CN, PR, SM 12.03: JT, 30°, CN, IR, SM 12.31: JT, 45°, CN, PR, SM	
				13	*13.42* 36.18		Hole Terminated at 13.42 m				
				14							
				15							
				16							
				17							
				18							
				19							
				20							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH2

Project	Proposed Residential Development			**Depth Range**	3.02m to 7.00m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈49.6m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	22 / 07 / 2020
Client	Tony Owen Pty Ltd	**Box**	1 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

CORE PHOTOGRAPH OF BOREHOLE: BH2

Project	Proposed Residential Development			**Depth Range**	7.00m to 13.42m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈49.6m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	22 / 07 / 2020
Client	Tony Owen Pty Ltd	**Box**	2-3 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

BOREHOLE LOG

BH NO. BH3M

Project	Proposed Development	**Sheet**	1 of 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	06/08/2020
Position	Refer to Figure 2	**Date Completed**	06/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 06/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor	Rockwell Drilling Services Pty Ltd	**Surface RL**	≈55.00 m AHD
Drill Rig	Auger Drill	**Inclination**	-90°

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY REL. DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	GWNE	0	55.00 *0.30*				-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-rounded to rounded gravels and some rootlets.	M (<PL)	-	FILL/TOPSOIL
				54.70 *0.70*	SPT 0.50-0.79 m 8,20/140mm HB			CI	Silty CLAY; medium plasticity, pale grey to orange-brown. From 0.7 m, pale grey only.	M (<PL)	H	RESIDUAL SOIL
			1	54.30 *1.50*								
				53.50 *2.20*	SPT 1.50-1.79 m 12,28/140mm HB				From 1.5 m, grading to extremely weathered shale.			
	H		2	52.80 *2.51*				-	SHALE; grey, very low strength, distinctly weathered.	-	-	BEDROCK
									Continued as Cored Borehole			
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH3M

Project	Proposed Development	**Sheet**	2 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	06/08/2020
Position	Refer to Figure 2	**Date Completed**	06/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 06/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈55.00 m AHD
Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
				0							
				1							
				2	2.51		Continuation from non-cored borehole				
NMLC	80% RETURN	100	28	3	52.49		SHALE; dark grey to brown-orange, thinly bedded, with layers of black siltstone.	DW		2.51-2.54: XWS, Silty clay, 30 mm 2.58-2.71: CS, 130 mm 2.71-2.73: XWS, Silty clay, 20 mm 2.94-2.96: XWS, Silty clay, 20 mm 3.04-3.06: XWS, Silty clay, 20 mm 3.13-3.17: XWS, Silty clay, 40 mm 3.23-3.24: XWS, Silty clay, 10 mm 3.43-3.44: XWS, Silty clay, 10 mm 3.50-3.52: XWS, Silty clay, 20 mm 3.54-3.56: XWS, Silty clay, 20 mm 3.67-3.72: XWS, Silty clay, 50 mm	
	90% RETURN	100	53	4						4.06: JT, 90°, CN, IR, SM 4.37: JT, 30°, CN, PR, SM 4.54: JT, 30°, CN, PR, SM 4.62-4.63: XWS, Silty clay, 10 mm 4.80: JT, 90°, CN, PR, RO 5.04-5.07: CS, 30 mm, fine to coarse, sub-angular to angular 5.47: JT, 90°, CN, IR, RO	
				5	5.62						
				6	49.38		From 5.62 m, with pale grey siltstone laminations.	SW		5.60: JT, 80°, CN, IR, RO 6.29-6.32: CS, 30 mm, fine to medium, sub-angular to angular 6.48: JT, 80°, CN, CU, SM 6.63-6.72: CS, 90 mm, medium to course, sub-angular to angular	
	100% RETURN	100	54	7	6.83 48.17 48.11		From 6.83 to 6.89 m, fine grained, pale grey mottled orange sandstone. From 6.89 m, thinly to medium bedded.			6.93: JT, 80°, CN, IR, RO 7.46: JT, 30°, CN, PR, RO	
	100% RETURN	100	86	8				FR		7.67: JT, 80°, CN, IR, RO 8.47: JT, 60°, CN, PR, SM 8.56: JT, 60°, CN, IR, SM	
				9							
				10							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH3M

Project	Proposed Development	**Sheet**	3 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	06/08/2020
Position	Refer to Figure 2	**Date Completed**	06/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 06/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈55.00 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
NMLC	100% RETURN	100	86	10			SHALE; dark grey to brown-orange, thinly bedded, with layers of black siltstone.	FR			
				11						11.13-11.14: XWS, Silty clay, 10 mm	
					11.50 43.50						
		100	92	12			SANDSTONE; fine grained, grey, medium bedded, with siltstone laminations.				
				13	*13.14* 41.86		Hole Terminated at 13.14 m				
				14							
				15							
				16							
				17							
				18							
				19							
				20							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH3M

Project	Proposed Residential Development			**Depth Range**	2.51m to 6.00m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈55.0m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	06 / 08 / 2020
Client	Tony Owen Pty Ltd	**Box**	1 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

CORE PHOTOGRAPH OF BOREHOLE: BH3M

Project	Proposed Residential Development			**Depth Range**	6.0m to 13.14m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈55.0m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	06 / 08 / 2020
Client	Tony Owen Pty Ltd	**Box**	2-3 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

MONITORING WELL LOG

MW NO. BH3M

Project	Proposed Development	**Sheet**	1 of 2
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	06/08/2020
Position	Refer to Figure 2	**Date Completed**	06/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 06/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

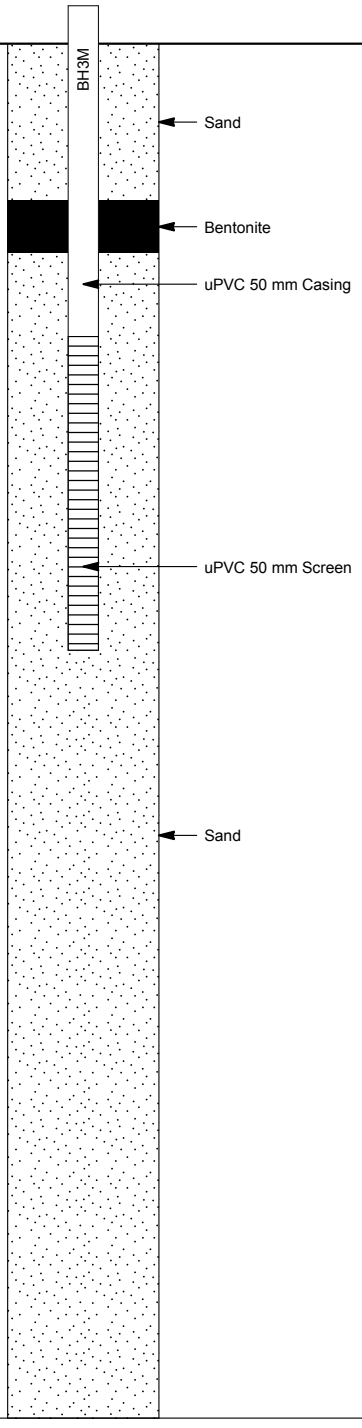
Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈55.00 m AHD

Drill Rig Auger Drill **Inclination** -90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
AD/T	GWNE	0	54		FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-rounded to rounded gravels and some rootlets.
					Silty CLAY; medium plasticity, pale grey to orange-brown.
					From 0.7 m, pale grey only.
		2			From 1.5 m, grading to extremely weathered shale.
					SHALE; grey, very low strength, distinctly weathered.
NMLC	80% RETURN		52		SHALE; dark grey to brown-orange, thinly bedded, with layers of black siltstone.
	90% RETURN	4	50		From 5.62 m, with pale grey siltstone laminations.
	100% RETURN	6	48		From 6.83 to 6.89 m, fine grained, pale grey mottled orange sandstone.
	100% RETURN	8	46		From 6.89 m, thinly to medium bedded.
	100% RETURN	10	44		
		12	42		SANDSTONE; fine grained, grey, medium bedded, with siltstone laminations.
					Hole Terminated at 13.14 m

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH3M	Standpipe	0.75 m 49.95 m	5.80 m 49.20 m		



This well log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE LOG

BH NO. BH4M

Project	Proposed Development	**Sheet**	1 of 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	04/08/2020
Position	Refer to Figure 2	**Date Completed**	04/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 04/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈49.00 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY REL. DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	GWNE	0	49.00				-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-angular to sub-rounded gravel and some rootlet.	M (<PL)	-	FILL/TOPSOIL
				0.25								
				48.75				CH	Silty CLAY; high plasticity, pale grey to orange-red.			RESIDUAL SOIL
			1		SPT 0.50-0.95 m 2,4,5 N=9						St	
				1.50						M (<PL)		
				47.50	SPT 1.50-1.95 m 3,7,10 N=17				From 1.5 m, grading to pale grey extremely weathered shale.			
			2								VSt	
				2.40								
	M			46.60				-	SHALE; grey, very low strength, distinctly weathered.	-	-	BEDROCK
			3	*3.10*					Continued as Cored Borehole			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH4M

Project	Proposed Development	**Sheet**	2 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	04/08/2020
Position	Refer to Figure 2	**Date Completed**	04/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 04/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈49.00 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3	*3.10*		Continuation from non-cored borehole				
NMLC	100% RETURN	100	71	4	45.90		SHALE; dark grey to brown-orange, thinly to medium bedded, with occasional fine grained pale grey brown sandstone lamination and interbeds.	DW		3.47-3.49: XWS, Silty clay, 20 mm 4.16-4.21: XWS, Silty clay, 50 mm	
	100% RETURN	100	76	5						4.91-4.93: XWS, Silty clay, 20 mm 5.43: JT, 80°, CN, IR, RO 5.62: JT, 45°, CN, PR, SM 5.80-5.81: CS, 10 mm, fine to medium, sub-angular to sub-rounded	
	100% RETURN	68	22	6						6.37: JT, 80°, CN, IR, SM	
				7	*7.56*					6.91: JT, 80°, CN, IR, RO 7.05-7.06: XWS, Silty clay, 10 mm 7.12-7.14: XWS, Silty clay, 20 mm 7.20-7.21: XWS, Silty clay, 10 mm	
					41.44		CORELOSS: 620 mm.				
	100% RETURN	91	55	8	*8.18*					8.18-8.21: CS, 30 mm, fine to medium, sub-angular to angular 8.21-8.24: XWS, Silty clay, 30 mm 8.31-8.35: XWS, Silty clay, 40 mm	
					40.82			DW			
					8.40		SHALE; dark grey to brown-orange, thinly to medium bedded, with occasional fine grained pale grey brown sandstone lamination and interbeds. From 8.4 m, pale grey sandstone laminations.				
				9	40.60			SW		8.76-8.85: CS, 90 mm, fine to medium, sub-angular to angular 9.32: JT, 70°, CN, CU, SM	
								DW		9.65: JT, 40°, CN, CU, SM 9.69-9.75: CS, 60 mm, fine to medium, sub-angular to angular	
		100	78	10							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH4M

Project	Proposed Development	**Sheet**	3 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	04/08/2020
Position	Refer to Figure 2	**Date Completed**	04/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 04/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈49.00 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
NMLC	100% RETURN	100	78	10			SHALE; dark grey to brown-orange, thinly to medium bedded, with occasional fine grained pale grey brown sandstone lamination and interbeds.	FR		9.89: JT, 90°, CN, PR, SM 10.81: JT, 80°, CN, IR, RO 10.99: JT, 80°, CN, IR, RO 11.18: JT, 70°, CN, PR, RO	
	100% RETURN	100	93	11 12 13	*13.54* 35.46		Hole Terminated at 13.54 m				
				14 15 16 17 18 19 20							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH4M

Project	Proposed Residential Development			**Depth Range**	3.10m to 7.00m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈ 49.0m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	06 / 08 / 2020
Client	Tony Owen Pty Ltd	**Box**	1 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

CORE PHOTOGRAPH OF BOREHOLE: BH4M

Project	Proposed Residential Development			**Depth Range**	7.00m to 13.54m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈ 49.0m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	06 / 08 / 2020
Client	Tony Owen Pty Ltd	**Box**	2-3 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

MONITORING WELL LOG

MW NO. BH4M

Project	Proposed Development	**Sheet**	1 of 2
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	04/08/2020
Position	Refer to Figure 2	**Date Completed**	04/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 04/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

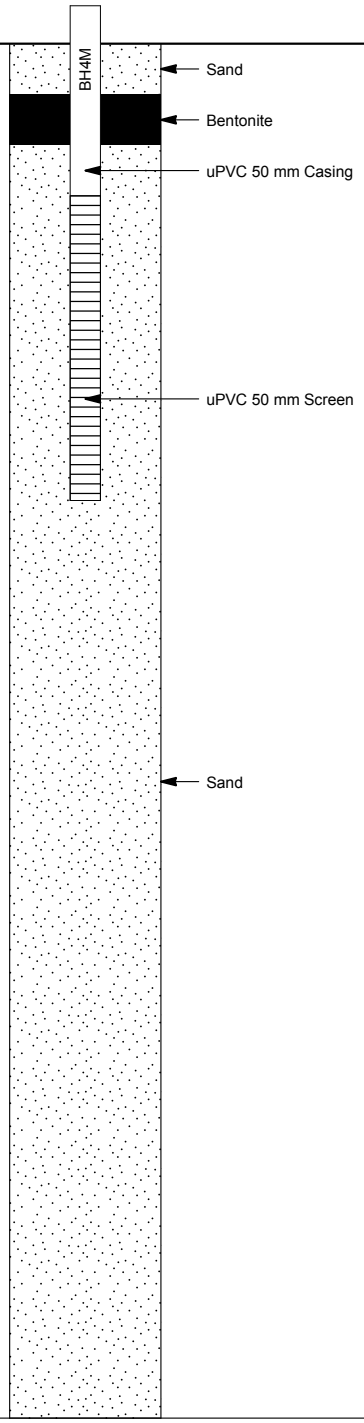
Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈49.00 m AHD

Drill Rig Auger Drill **Inclination** -90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
		0			
AD/T	GWNE		48		FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-angular to sub-rounded gravel and some rootlet.
					Silty CLAY; high plasticity, pale grey to orange-red.
		2			From 1.5 m, grading to pale grey extremely weathered shale.
					SHALE; grey, very low strength, distinctly weathered.
			46		
NMLC	100% RETURN				SHALE; dark grey to brown-orange, thinly to medium bedded, with occasional fine grained pale grey brown sandstone lamination and interbeds.
		4			
			44		
	100% RETURN	6			
			42		
	100% RETURN				CORELOSS: 620 mm.
		8			
	100% RETURN				SHALE; dark grey to brown-orange, thinly to medium bedded, with occasional fine grained pale grey brown sandstone lamination and interbeds.
			40		From 8.4 m, pale grey sandstone laminations.
		10			
	100% RETURN		38		
		12			
			36		
					Hole Terminated at 13.54 m
		14			

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH4M	Standpipe	0.20 m 44.70 m	4.50 m 44.50 m		



This well log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE LOG

BH NO. BH5M

Project	Proposed Development	**Sheet**	1 of 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	05/08/2020
Position	Refer to Figure 2	**Date Completed**	05/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 05/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor	Rockwell Drilling Services Pty Ltd	**Surface RL**	≈47.40 m AHD
Drill Rig	Auger Drill	**Inclination**	-90°

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY REL. DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	L	GWNE	0	47.40				-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-rounded to rounded gravels and some rootlets.	M (>PL)	-	FILL/TOPSOIL
				0.40								
				47.00	SPT 0.50-0.95 m 2,2,4 N=6			CH	Silty CLAY; high plasticity, pale grey to orange-red, trace rootlets.			RESIDUAL SOIL
			1								F	
					SPT 1.50-1.95 m 2,5,7 N=12					M (>PL)		
			2								St	
				2.80								
	M		3	44.60	SPT 3.00-3.41 m 13,15,16 N=31				From 2.8 m, grading to pale grey extremely weathered shale.	M (<PL)		
				3.41								
									Continued as Cored Borehole			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH5M

Project	Proposed Development	**Sheet**	2 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	05/08/2020
Position	Refer to Figure 2	**Date Completed**	05/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 05/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈47.40 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
					3.41		Continuation from non-cored borehole				
NMLC	100% RETURN	60	27	4	43.99		SHALE; dark grey to brown-orange, thinly to medium bedded with occasional fine grained pale grey brown sandstone laminations, with occasional layers of claystone.	DW		3.52-3.58: XWS, Silty clay 3.78-3.85: CS, fine to coarse, sub-angular to angular 3.93-3.97: CS, fine to coarse, sub-angular to angular 4.13-4.18: XWS, Silty clay 4.25-4.27: XWS, Silty clay 4.38: JT, 80°, CN, IR, SM 4.48-4.71: XWS, Silty clay	
				5				DW		4.84: JT, 80°, CN, IR, SM	
								SW		5.53: JT, 80°, CN, IR, SM 5.76: JT, 70°, CN, IR, SM 5.85: JT, 90°, CN, PR, SM	
	100% RETURN	100	68	6						6.17: JT, 80°, CN, PR, SM 6.20-6.24: XWS, Silty clay	
				7						6.81: JT, 45°, CN, PR, SM	
				8						7.85: JT, 60°, CN, IR, SM	
				9						8.73-8.78: CS, fine to medium, sub-rounded to sub-angular	
	100% RETURN	100	63		*9.50*			SW			
				10	37.90		SANDSTONE; pale grey, fine grained, medium bedded with shale laminations.				

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORED BOREHOLE LOG

BH NO. BH5M

Project	Proposed Development	**Sheet**	3 OF 3
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	05/08/2020
Position	Refer to Figure 2	**Date Completed**	05/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 05/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈47.40 m AHD

Drill Rig Auger Drill **Inclination** -90°

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	Average Defect Spacing (mm) (30, 100, 300, 1000, 3000)
NMLC	100% RETURN	100	63	10			SANDSTONE; pale grey, fine grained, medium bedded with shale laminations.	SW			
					10.40 37.00		SHALE; dark grey, with fine grained pale grey sandstone laminations.				
	100% RETURN	100	90	11							
				12							
				13	*13.33* 34.07		Hole Terminated at 13.33 m				
				14							
				15							
				16							
				17							
				18							
				19							
				20							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH5M

Project	Proposed Residential Development			**Depth Range**	3.41m to 7.00m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈ 47.4m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	05 / 08 / 2020
Client	Tony Owen Pty Ltd	**Box**	1 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

CORE PHOTOGRAPH OF BOREHOLE: BH5M

Project	Proposed Residential Development			**Depth Range**	7.00m to 13.33m BEGL		
Location	164-170 Croatia Avenue, Edmondson Park NSW			**Contractor**	Rockwell Drilling Services Pty Ltd		
Position	See Figure 2	**Surface RL**	≈ 47.4m	**Drill Rig**	Hanjin D&B 8D		
Job No.	E24744.G03	**Inclination**	-90°	**Logged**	JW	**Date**	05 / 08 / 2020
Client	Tony Owen Pty Ltd	**Box**	2-3 of 3	**Checked**	SK	**Date**	17 / 07 / 2020

MONITORING WELL LOG

MW NO. BH5M

Project	Proposed Development	**Sheet**	1 of 2
Location	164-170 Croatia Avenue, Edmondson Park, NSW	**Date Started**	05/08/2020
Position	Refer to Figure 2	**Date Completed**	05/08/2020
Job No.	E24744.G03	**Logged By** JW	**Date** 05/08/2020
Client	Super Star Holding Group Pty Ltd	**Reviewed By** SK	**Date** 17/09/2020

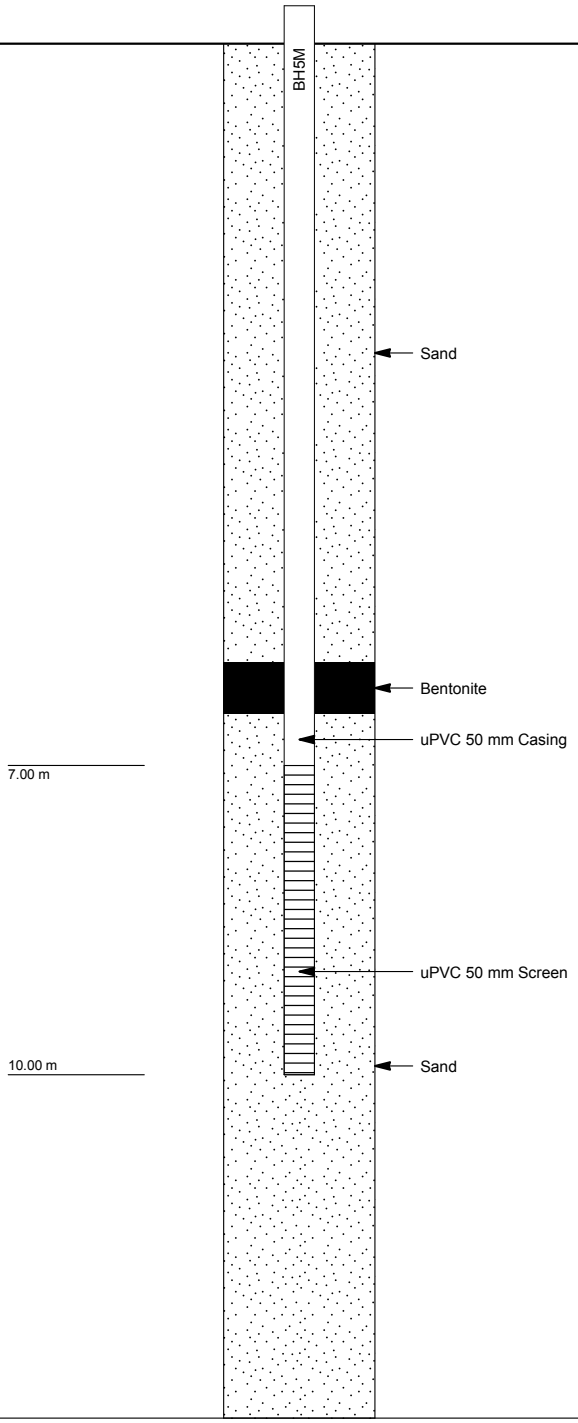
Drilling Contactor Rockwell Drilling Services Pty Ltd **Surface RL** ≈47.40 m AHD

Drill Rig Auger Drill **Inclination** -90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
AD/T	GWNE	0	48		FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-rounded to rounded gravels and some rootlets.
					Silty CLAY; high plasticity, pale grey to orange-red, trace rootlets.
		2	46		From 2.8 m, grading to pale grey extremely weathered shale.
NMLC	100% RETURN	4	44		SHALE; dark grey to brown-orange, thinly to medium bedded with occasional fine grained pale grey brown sandstone laminations, with occasional layers of claystone.
	100% RETURN	6	42		
		8	40		
	100% RETURN	10	38		SANDSTONE; pale grey, fine grained, medium bedded with shale laminations.
					SHALE; dark grey, with fine grained pale grey sandstone laminations.
	100% RETURN	12	36		
			34		Hole Terminated at 13.33 m

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date Static Water Level
BH5M	Standpipe	0.55 m 37.95 m	10.00 m 37.40 m	



This well log should be read in conjunction with EI Australia's accompanying standard notes.

TEST PIT: TP1

Project	Proposed Development			Sheet	1 OF 1
Location	164-170 Croatia Avenue, Edmondson Park, NSW				
Position	Refer to Figure 2	Surface RL	48.40 m AHD		
Job No.	E24744.G03	Contractor	-	Date	05/08/2020
Client	Super Star Holding Group Pty Ltd	Machine	Excavator	Logged	JW
		Bucket Size			

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	L	GWNE	0	48.40	DS 0.10-0.30 m			-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-angular to sub-rounded gravel and some rootlets.	M (<PL)	-	FILL/TOPSOIL
				0.40								
				48.00				CH	Silty CLAY; high plasticity, pale grey to orange-red.			RESIDUAL SOIL
			1		DS 0.90-1.20 m					M (>PL)	-	
			2	*2.10*								
				46.30					From 2.1 m, bands of ironstone.	M (<PL)		
				2.40								
	M			*2.55*				-	SHALE; grey, very low strength, distinctly weathered.	-	-	BEDROCK
									Hole Terminated at 2.55 m Refusal on shale bedrock			
			3									
			4									

Sketch & Other Observations

Comments
Refusal on shale bedrock

Checked SK
Date 17/09/2020

TEST PIT: TP2

Project	Proposed Development			Sheet	1 OF 1
Location	164-170 Croatia Avenue, Edmondson Park, NSW				
Position	Refer to Figure 2	Surface RL	47.10 m AHD		
Job No.	E24744.G03	Contractor	-	Date	05/08/2020
Client	Super Star Holding Group Pty Ltd	Machine	Excavator	Logged	JW
		Bucket Size			

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	L	GWNE	0	47.10	DS 0.10-0.30 m			-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-round to round gravel and some rootlets.	M (<PL)	-	FILL/TOPSOIL
				0.30								
				46.80				CH	Silty CLAY; high plasticity, pale grey to orange-red, trace rootlets.			RESIDUAL SOIL
			1		DS 0.80-1.10 m					M (>PL)	-	
			2							M (<PL)		
				2.30								
	M			*2.40*				-	SHALE; grey, very low strength, distinctly weathered.	-	-	BEDROCK
									Hole Terminated at 2.40 m Refusal on shale bedrock			
			3									
			4									

Sketch & Other Observations

Comments
Refusal on shale bedrock

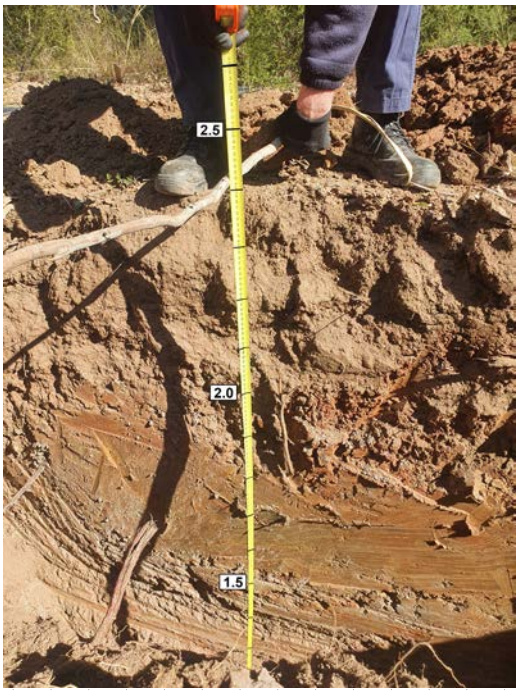
Checked SK
Date 17/09/2020

TEST PIT: TP3

Project	Proposed Development			Sheet	1 OF 1
Location	164-170 Croatia Avenue, Edmondson Park, NSW				
Position	Refer to Figure 2	Surface RL	53.40 m AHD		
Job No.	E24744.G03	Contractor	-	Date	05/08/2020
Client	Super Star Holding Group Pty Ltd	Machine	Excavator	Logged	JW
		Bucket Size			

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	L	GWNE	0	53.40	DS 0.10-0.30 m			-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-angular to sub-rounded gravel.	M (<PL)	-	FILL/TOPSOIL
				0.35 53.05				Cl	Silty CLAY; medium plasticity, pale grey to orange-red, trace rootlets.			RESIDUAL SOIL
			1		DS 0.60-0.90 m							
				1.10 52.30					From 1.1 m, pale grey.	M (<PL)	-	
				1.80 51.60					From 1.8 m, bands of ironstone.			
			2	*2.40*								
									Hole Terminated at 2.40 m Target Depth Reached.			
			3									
			4									

Sketch & Other Observations



Comments
Target Depth Reached.

Checked SK
Date 17/09/2020

TEST PIT: TP4

Project	Proposed Development			Sheet	1 OF 1
Location	164-170 Croatia Avenue, Edmondson Park, NSW				
Position	Refer to Figure 2	Surface RL	49.40 m AHD		
Job No.	E24744.G03	Contractor	-	Date	05/08/2020
Client	Super Star Holding Group Pty Ltd	Machine	Excavator	Logged	JW
		Bucket Size			

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0	49.40				-	FILL: Silty CLAY; medium plasticity, brown, trace of fine grained sub-rounded to rounded gravel and some rootlets.	M (>PL)	-	FILL/TOPSOIL
				0.30	DS 0.10-0.30 m							
				49.10				CI	Silty CLAY; medium plasticity, pale grey to orange.			RESIDUAL SOIL
			1		DS 0.60-0.90 m							
	-	GWNE		*1.20*						M (>PL)		
				48.20					From 1.2 m, pale grey only.		-	
				1.90								
			2	47.50					From 1.9 m, bands of ironstone.	M (<PL)		
				2.30								
	M			*2.40*				-	SHALE; grey, very low strength, distinctly weathered.	-	-	BEDROCK
									Hole Terminated at 2.40 m Refusal on shale bedrock			
			3									
			4									

Sketch & Other Observations

Comments
Refusal on shale bedrock

Checked SK
Date 17/09/2020

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT LOGS

DRILLING/EXCAVATION METHOD

HA	Hand Auger	**ADH**	Hollow Auger	**NQ**	Diamond Core - 47 mm
DT	Diatube Coring	**RT**	Rotary Tricone bit	**NMLC**	Diamond Core - 52 mm
NDD	Non-destructive digging	**RAB**	Rotary Air Blast	**HQ**	Diamond Core - 63 mm
AD*	Auger Drilling	**RC**	Reverse Circulation	**HMLC**	Diamond Core - 63 mm
***V**	V-Bit	**PT**	Push Tube	**EX**	Tracked Hydraulic Excavator
***T**	TC-Bit, e.g. AD/T	**WB**	Washbore	**HAND**	Excavated by Hand Methods

PENETRATION RESISTANCE

L	**Low Resistance**	Rapid penetration/ excavation possible with little effort from equipment used.
M	**Medium Resistance**	Penetration/ excavation possible at an acceptable rate with moderate effort from equipment used.
H	**High Resistance**	Penetration/ excavation is possible but at a slow rate and requires significant effort from equipment used.
R	**Refusal/Practical Refusal**	No further progress possible without risk of damage or unacceptable wear to equipment used.

These assessments are subjective and are dependent on many factors, including equipment power and weight, condition of excavation or drilling tools and experience of the operator.

WATER

Standing Water Level **Partial water loss**

Water Seepage **Complete Water Loss**

GWNO	GROUNDWATER NOT OBSERVED - Observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave-in of the borehole/ test pit.
GWNE	GROUNDWATER NOT ENCOUNTERED - Borehole/ test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/ test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following a 150mm seating drive
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported, N is not reported
RW	Penetration occurred under the rod weight only, N<1
HW	Penetration occurred under the hammer and rod weight only, N<1
HB	Hammer double bouncing on anvil, N is not reported
Sampling	
DS	Disturbed Sample
ES	Sample for environmental testing
BDS	Bulk disturbed Sample
GS	Gas Sample
WS	Water Sample
U50	Thin walled tube sample - number indicates nominal sample diameter in millimetres
Testing	
FP	Field Permeability test over section noted
FVS	Field Vane Shear test expressed as uncorrected shear strength (sv= peak value, sr= residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket Penetrometer test expressed as instrument reading in kPa
WPT	Water Pressure tests
DCP	Dynamic Cone Penetrometer test
CPT	Static Cone Penetration test
CPTu	Static Cone Penetration test with pore pressure (u) measurement

GEOLOGICAL BOUNDARIES

———— = Observed Boundary (position known)

– – – – – – – – – – = Observed Boundary (position approximate)

– –?– –?– –?– – = Boundary (interpreted or inferred)

ROCK CORE RECOVERY

TCR=Total Core Recovery (%)

$$= \frac{Length\ of\ core\ recovered}{Length\ of\ core\ run} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum Axial\ lengths\ of\ core > 100mm}{Length\ of\ core\ run} \times 100$$

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT LOGS

	FILL		ORGANIC SOILS (OL, OH or Pt)		CLAY (CL, CI or CH)
	COUBLES or BOULDERS		SILT (ML or MH)		SAND (SP or SW)
	GRAVEL (GP or GW)	Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay			

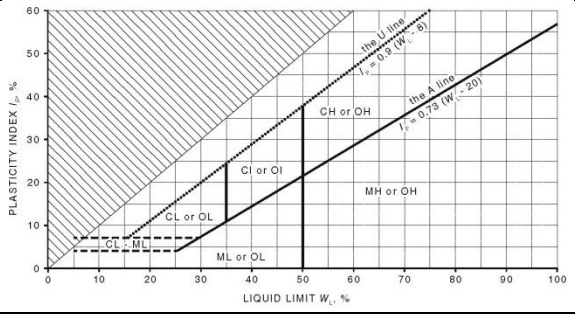
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS 1726:2017, Section 6.1 – Soil description and classification.

PARTICLE SIZE CHARACTERISTICS

Fraction	Components	Sub Division	Size mm
Oversize	BOULDERS		>200
	COBBLES		63 to 200
Coarse grained soil	GRAVEL	Coarse	19 to 63
		Medium	6.7 to 19
		Fine	2.36 to 6.7
	SAND	Coarse	0.6 to 2.36
		Medium	0.21 to 0.6
		Fine	0.075 to 0.21
Fine grained soil	SILT		0.002 to 0.075
	CLAY		<0.002

PLASTICITY PROPERTIES



GROUP SYMBOLS

Major Divisions		Symbol	Description
COARSE GRAINED SOILS More than 65% of soil excluding oversize fraction is greater than 0.075mm	GRAVEL More than 50% of coarse fraction is >2.36mm	GW	Well graded gravel and gravel-sand mixtures, little or no fines, no dry strength.
		GP	Poorly graded gravel and gravel-sand mixtures, little or no fines, no dry strength.
		GM	Silty gravel, gravel-sand-silt mixtures, zero to medium dry strength.
		GC	Clayey gravel, gravel-sand-clay mixtures, medium to high dry strength.
	SAND More than 50% of coarse fraction is <2.36 mm	SW	Well graded sand and gravelly sand, little or no fines, no dry strength.
		SP	Poorly graded sand and gravelly sand, little or no fines, no dry strength.
		SM	Silty sand, sand-silt mixtures, zero to medium dry strength.
		SC	Clayey sand, sandy-clay mixtures, medium to high dry strength.
FINE GRAINED SOILS More than 35% of soil excluding oversized fraction is less than 0.075mm	Liquid Limit less < 50%	ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands, zero to medium dry strength.
		CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, medium to high dry strength.
		OL	Organic silts and organic silty clays of low plasticity, low to medium dry strength.
	Liquid Limit > than 50%	MH	Inorganic silts of high plasticity, high to very high dry strength.
		CH	Inorganic clays of high plasticity, high to very high dry strength.
		OH	Organic clays of medium to high plasticity, medium to high dry strength.
Highly Organic soil		PT	Peat muck and other highly organic soils.

MOISTURE CONDITION

Symbol	Term	Description
D	Dry	Non- cohesive and free-running.
M	Moist	Soils feel cool, darkened in colour. Soil tends to stick together.
W	Wet	Soils feel cool, darkened in colour. Soil tends to stick together, free water forms when handling.

Moisture content of cohesive soils shall be described in relation to plastic limit (PL) or liquid limit (LL) for soils with higher moisture content as follows: Moist, dry of plastic limit (w < PL); Moist, near plastic limit (w ≈ PL); Moist, wet of plastic limit (w < PL); Wet, near liquid limit (w ≈ LL), Wet, wet of liquid limit (w > LL),

CONSISTENCY

Symbol	Term	Undrained Shear Strength (kPa)	SPT "N" #
VS	Very Soft	≤ 12	≤ 2
S	Soft	>12 to ≤ 25	>2 to ≤ 4
F	Firm	>25 to ≤ 50	>4 to 8
St	Stiff	>50 to ≤ 100	>8 to 15
VSt	Very Stiff	>100 to ≤ 200	>15 to 30
H	Hard	>200	>30
Fr	Friable	-	

DENSITY

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	≤ 15	0 to 4
L	Loose	>15 to ≤ 35	4 to 10
MD	Medium Dense	>35 to ≤ 65	10 to 30
D	Dense	>65 to ≤ 85	30 to 50
VD	Very Dense	>85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material. # SPT correlations are not stated in AS1726:2017, and may be subject to corrections for overburden pressure, moisture content of the soil, and equipment type.

MINOR COMPONENTS

Term	Assessment Guide	Proportion by Mass
Add 'Trace'	Presence just detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: ≤ 5% Fine grained soil: ≤ 15%
Add 'With'	Presence easily detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: 5 - 12% Fine grained soil: 15 - 30%
Prefix soil name	Presence easily detectable by feel or eye in conjunction with the general properties of primary component	Coarse grained soils: >12% Fine grained soil: >30%

TERMS FOR ROCK MATERIAL STRENGTH AND WEATHERING

CLASSIFICATION AND INFERRED STRATIGRAPHY
Rock is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 2017, Section 6.2 – Rock identification, description and classification.

ROCK MATERIAL STRENGTH CLASSIFICATION

Symbol	Term	Point Load Index, $Is_{(50)}$ (MPa) #	Field Guide
VL	Very Low	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

 # Rock Strength Test Results

▼ Point Load Strength Index, $Is_{(50)}$, Axial test (MPa)

● Point Load Strength Index, $Is_{(50)}$, Diametral test (MPa)

Relationship between rock strength test result ($Is_{(50)}$) and unconfined compressive strength (UCS) will vary with rock type and strength, and should be determined on a site-specific basis. However UCS is typically 20 x $Is_{(50)}$.

ROCK MATERIAL WEATHERING CLASSIFICATION

Symbol		Term	Field Guide
RS		Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
XW		Extremely Weathered	Rock is weathered to such an extent that it has soil properties - i.e. it either disintegrates or can be remoulded, in water.
DW	HW	Distinctly Weathered	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 weathering products in pores. In some environments it is convenient to subdivide into Highly Weathered and Moderately Weathered, with the degree of alteration typically less for MW.
	MW		
SW		Slightly Weathered	Rock slightly discoloured but shows little or no change of strength relative to fresh rock.
FR		Fresh	Rock shows no sign of decomposition or staining.

ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

CLASSIFICATION AND INFERRED STRATIGRAPHY
Rock is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 2017, Section 6.2 – Rock identification, description and classification.

DETAILED ROCK DEFECT SPACING

Defect Spacing	
Term	**Description**
Massive	No layering apparent
Indistinct	Layering just visible; little effect on properties
Distinct	Layering (bedding, foliation, cleavage) distinct; rock breaks more easily parallel to layering

Bedding Thickness (Stratification)	
Term	**Spacing (mm)**
Thinly laminated	<6
Laminated	6 – 20
Very thinly bedded	20 – 60
Thinly bedded	60 – 200
Medium bedded	200 – 600
Thickly bedded	600 – 2,000
Very thickly bedded	> 2,000

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

Defect Type	Abbr.	Description
Joint	JT	Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water or soil or rock substance, which acts as cement.
Bedding Parting	BP	Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/ bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material.
Contact	CO	The surface between two types or ages of rock.
Sheared Surface	SSU	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.
Sheared Seam/ Zone (Fault)	SS/SZ	Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50 mm) parallel and usually smooth or slickensided joints or cleavage planes.
Crushed Seam/ Zone (Fault)	CS/CZ	Seam or zone composed of disoriented usually angular fragments of the host rock substance, with roughly parallel near-planar boundaries. The brecciated fragments may be of clay, silt, sand or gravel sizes or mixtures of these.
Extremely Weathered Seam/ Zone	XWS/XWZ	Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places.
Infilled Seam	IS	Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity.
Vein	VN	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

NOTE: Defects size of <100mm SS, CS and XWS. Defects size of >100mm SZ, CZ and XWZ.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	PR	Consistent orientation	Polished	POL	Shiny smooth surface
Curved	CU	Gradual change in orientation	Slickensided	SL	Grooved or striated surface, usually polished
Undulating	UN	Wavy surface	Smooth	SM	Smooth to touch. Few or no surface irregularities
Stepped	ST	One or more well defined steps	Rough	RO	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper
Irregular	IR	Many sharp changes in orientation	Very Rough	VR	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper

Orientation: **Vertical Boreholes –** The dip (inclination from horizontal) of the defect.
Inclined Boreholes – The inclination is measured as the acute angle to the core axis.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

Coating	Abbr.	Description
Clean	CN	No visible coating or infilling
Stain	SN	No visible coating but surfaces are discoloured by staining, often limonite (orange-brown)
Veneer	VNR	A visible coating of soil or mineral substance, usually too thin to measure (< 1 mm); may be patchy

DEFECT APERTURE

Aperture	Abbr.	Description
Closed	CL	Closed.
Open	OP	Without any infill material.
Infilled	-	Soil or rock i.e. clay, silt, talc, pyrite, quartz, etc.

Appendix B - Laboratory Certificates

MOISTURE CONTENT TEST REPORT

Client:	EI Australia	**Job No:**	S20329
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Report No:**	S62302-MC
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)		

Test Procedure:

- [x] AS 1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (Standard method).
- [ ] AS4133 1.1.1 Rock moisture content tests - Determination of the moisture content of rock - Oven drying method (standard method)
- [ ] RMS T120 Moisture content of road construction materials (Standard method)
- [ ] RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	22/07/2020
Preparation:	Prepared in accordance with the test method		

Sample No.	Source	Sample Description	Moisture Content %
S62302	BH1	Silty CLAY	**15.9**

Notes:

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Authorised Signatory:

Chris Lloyd

28/07/2020

Date:

MACQUARIE GEOTECH

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U7/8 10 Bradford Street
Alexandria NSW 2015

MOISTURE CONTENT TEST REPORT

Client:	EI Australia	**Job No:**	S20329-2
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Report No:**	S62756-MC
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)		

Test Procedure:

- [x] AS 1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (Standard method).
- [ ] AS4133 1.1.1 Rock moisture content tests - Determination of the moisture content of rock - Oven drying method (standard method)
- [ ] RMS T120 Moisture content of road construction materials (Standard method)
- [ ] RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Sample No.	Source	Sample Description	Moisture Content %
S62756	BH4M_0.5-0.9m	Silty CLAY	**23.1**
S62757	BH5M_1.5-1.95m	Silty CLAY	**23.0**

Notes:

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17/08/2020

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SOIL CLASSIFICATION REPORT

Client	EI Australia	**Source**	BH1
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No**	S62302-PI
Job No	S20329	**Lab No**	S62302

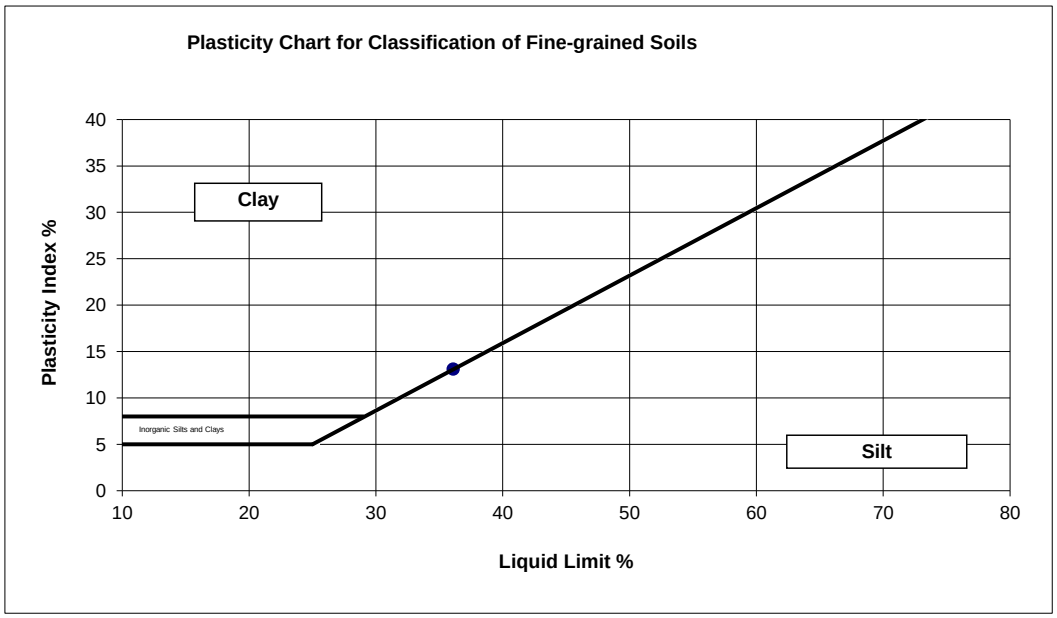
Test Procedure:

- ☐ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☑ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☐ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 22/07/2020

Preparation: Prepared in accordance with the test method

Liquid Limit (%)	36	**Linear Shrinkage (%)**	8.0
Plastic Limit (%)	23	**Plasticity Index**	13



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: Linear

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4/08/2020

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SOIL CLASSIFICATION REPORT

Client	EI Australia	**Source**	BH4M_0.50 - 0.90m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No**	S62756-PI
Job No	S20329-2	**Lab No**	S62756

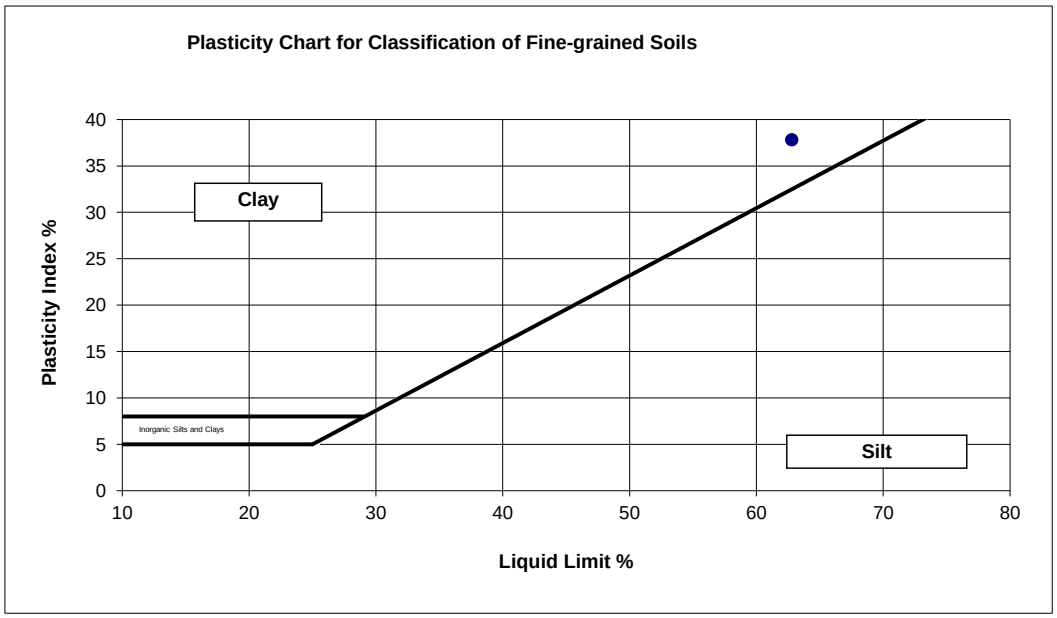
Test Procedure:

- ☐ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☑ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☐ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Liquid Limit (%)	63	**Linear Shrinkage (%)**	16.5
Plastic Limit (%)	25	**Plasticity Index**	38



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: Linear

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SOIL CLASSIFICATION REPORT

Client	EI Australia	**Source**	BH5M_1.50 - 1.95m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No**	S62757-PI
Job No	S20329-2	**Lab No**	S62757

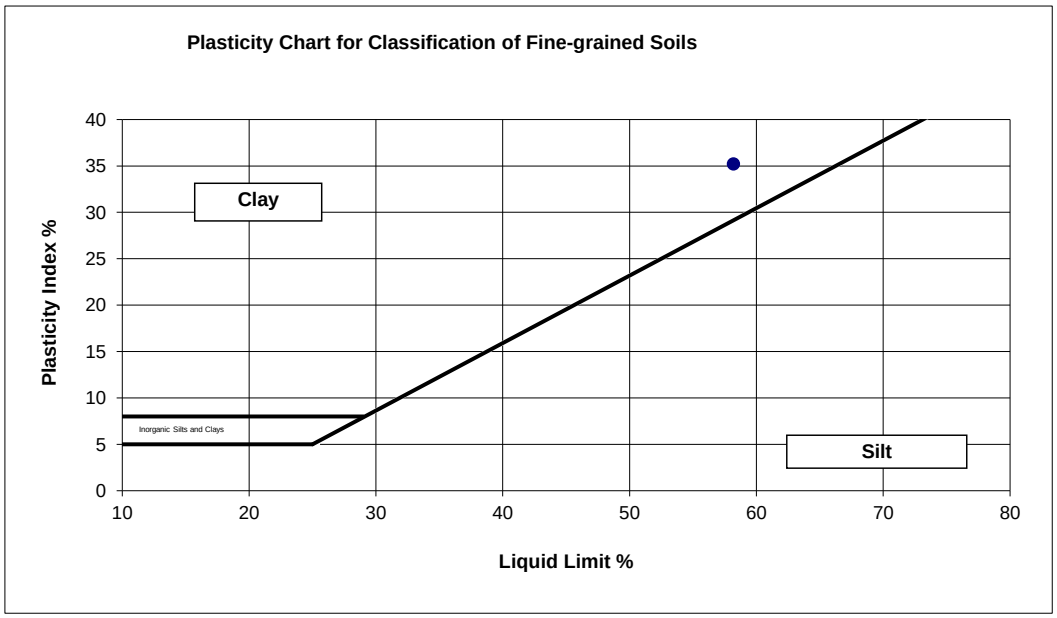
Test Procedure:

- ☐ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☑ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☐ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Liquid Limit (%)	58	**Linear Shrinkage (%)**	15.5
Plastic Limit (%)	23	**Plasticity Index**	35



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: Curling Occuring

Notes

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No:**	S62303-PL
Job No:	S20329	**Date Tested:**	27/07/2020

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 22/07/2020

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S62303	BH1 3.58 - 3.61m	Shale							
			Axial	51.7	32.0	0.45	0.21	0.21	1
S62304	BH1 4.64 - 4.71m	Shale							
			Axial	51.9	34.0	5.01	2.23	2.18	1
S62305	BH1 5.60 - 5.70m	Shale							
			Axial	52.2	35.0	4.00	1.72	1.69	1
S62306	BH1 6.19 - 6.28m	Shale							
			Axial	52.3	30.0	4.58	2.29	2.18	1
S62307	BH1 8.20 - 8.30m	Shale							
			Axial	51.8	39.0	6.87	2.67	2.69	1
S62308	BH1 8.82 - 8.92m	Shale							
			Axial	51.6	34.0	1.12	0.50	0.49	1
S62309	BH1 9.67 - 9.77m	Sandstone							
			Axial	51.8	34.0	10.86	4.84	4.72	1
S62310	BH1 11.60 - 11.70m	Sandstone							
			Axial	51.7	36.0	9.90	4.17	4.13	1
S62311	BH1 12.44 - 12.56m	Shale							
			Axial	52.2	42.0	6.71	2.41	2.47	1
S62312	BH2 14.10 - 14.20m	Sandstone							
			Axial	51.8	31.0	4.47	2.19	2.09	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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30/07/2020

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No:**	S62313-PL
Job No:	S20329	**Date Tested:**	27/07/2020

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** 22/07/2020

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S62313	BH2 3.12 - 3.19m	Shale							
			Axial	51.6	32.0	1.00	0.48	0.46	1
S62314	BH2 4.10 - 4.20m	Shale							
			Axial	51.7	34.0	1.33	0.59	0.58	1
S62315	BH2 6.19 - 6.28m	Shale							
			Axial	51.8	32.0	0.87	0.41	0.40	1
S62316	BH2 7.88 - 7.98m	Sandstone							
			Axial	52.0	37.0	4.54	1.85	1.84	1
S62317	BH2 9.66 - 9.74m	Sandstone							
			Axial	51.7	32.0	4.62	2.19	2.11	1
S62318	BH2 11.29 - 11.38m	Shale							
			Axial	52.1	40.0	4.92	1.86	1.88	1
S62319	BH2 13.32 - 13.42m	Sandstone							
			Axial	51.9	35.0	3.38	1.46	1.44	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No:**	S62761-PL
Job No:	S20329-2	**Date Tested:**	11/08/2020

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S62761	BH3M 2.88 - 2.92m	Shale							
			Axial	51.8	35.0	0.44	0.19	0.19	1
S62762	BH3M 3.91 - 3.96m	Shale							
			Axial	51.9	36.0	0.70	0.29	0.29	1
S62763	BH3M 4.47 - 4.51m	Shale							
			Axial	51.9	41.0	0.25	0.09	0.09	1
S62764	BH3M 5.08 - 5.18m	Shale							
			Axial	51.8	45.0	0.05	0.02	0.02	3
S62765	BH3M 5.82 - 5.92m	Shale							
			Axial	52.0	38.0	1.85	0.74	0.74	1
S62766	BH3M 6.51 - 6.61m	Shale							
			Axial	51.9	42.0	1.80	0.65	0.66	1
S62767	BH3M 7.04 - 7.11m	Shale							
			Axial	52.0	35.0	2.61	1.13	1.11	1
S62768	BH3M 7.80 - 7.90m	Shale							
			Axial	52.2	34.0	1.76	0.78	0.76	1
S62769	BH3M 8.80 - 8.88m	Shale							
			Axial	52.1	35.0	6.86	2.96	2.91	1
S62770	BH3M 9.63 - 9.73m	Shale							
			Axial	52.3	35.0	2.75	1.18	1.16	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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12/08/2020

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No:**	S62771-PL
Job No:	S20329-2	**Date Tested:**	11/08/2020

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S62771	BH3M 10.73 - 10.83m	Shale							
			Axial	52.3	35.0	7.40	3.18	3.13	1
S62772	BH3M 11.75 - 11.84m	Sandstone							
			Axial	52.3	45.0	7.21	2.41	2.51	1
S62773	BH3M 12.84 - 12.94m	Sandstone							
			Axial	52.3	32.0	13.99	6.56	6.33	1
S62774	BH4M 3.31 - 3.41m	Shale							
			Axial	51.9	33.0	1.75	0.80	0.78	1
S62775	BH4M 4.04 - 4.10m	Shale							
			Axial	52.1	31.0	5.40	2.62	2.51	1
S62776	BH4M 4.65 - 4.70m	Shale							
			Axial	52.2	32.0	0.28	0.13	0.13	3
S62777	BH4M 6.08 - 6.12m	Shale							
			Axial	52.0	32.0	1.06	0.50	0.48	1
S62778	BH4M 6.76 - 6.86m	Shale							
			Axial	52.0	34.0	1.68	0.75	0.73	1
S62779	BH4M 7.06 - 7.11m	Shale							
			Axial	50.7	33.0	0.03	0.01	0.01	3
S62780	BH4M 8.47 - 8.56m	Shale							
			Axial	52.3	41.0	4.48	1.64	1.67	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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Chris Lloyd

12/08/2020

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U7/8 10 Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No:**	S62781-PL
Job No:	S20329-2	**Date Tested:**	11/08/2020

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S62781	BH4M 9.39 - 9.49m	Shale							
			Axial	52.1	36.0	6.85	2.87	2.84	1
S62782	BH4M 10.26 - 10.36m	Shale							
			Axial	52.2	36.0	6.91	2.89	2.86	1
S62783	BH4M 11.48 - 11.57m	Shale							
			Axial	52.0	45.0	6.95	2.33	2.43	1
S62784	BH4M 12.51 - 12.61m	Shale							
			Axial	52.0	35.0	5.39	2.33	2.29	1
S62785	BH4M 13.23 - 13.32m	Shale							
			Axial	52.1	34.0	7.48	3.31	3.24	1
S62786	BH5M 3.60 - 3.70m	Claystone							
			Axial	52.7	30.0	0.06	0.03	0.03	1
S62787	BH5M 4.09 - 4.13m	Shale							
			Axial	52.2	31.0	0.32	0.16	0.15	1
S62788	BH5M 5.25 - 5.30m	Shale							
			Axial	51.7	34.0	0.69	0.31	0.30	1
S62789	BH5M 6.42 - 6.50m	Shale							
			Axial	52.1	34.0	6.59	2.92	2.85	1
S62790	BH5M 7.28 - 7.35m	Shale							
			Axial	52.0	33.0	1.54	0.71	0.68	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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Authorised Signatory:

Chris Lloyd

12/08/2020

Date

MACQUARIE GEOTECH

Macquarie Geotech
U7/8 10 Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No:**	S62791-PL
Job No:	S20329-2	**Date Tested:**	11/08/2020

Test Procedure: ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S62791	BH5M 8.40 - 8.50m	Shale							
			Axial	52.0	30.0	6.24	3.14	2.98	1
S62792	BH5M 9.22 - 9.32m	Shale							
			Axial	52.1	31.0	7.40	3.60	3.44	1
S62793	BH5M 9.85 - 9.94m	Sandstone							
			Axial	52.1	33.0	14.40	6.58	6.39	1
S62794	BH5M 10.71 - 10.81m	Shale							
			Axial	52.1	36.0	7.20	3.01	2.98	1
S62795	BH5M 11.31 - 11.40m	Sandstone							
			Axial	52.3	34.0	10.48	4.63	4.53	1
S62796	BH5M 12.24 - 12.33m	Shale							
			Axial	52.0	41.0	6.07	2.24	2.28	1
S62797	BH5M 13.11 - 13.21m	Shale							
			Axial	52.3	40.0	4.46	1.68	1.70	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

12/08/2020

Date

MACQUARIE GEOTECH

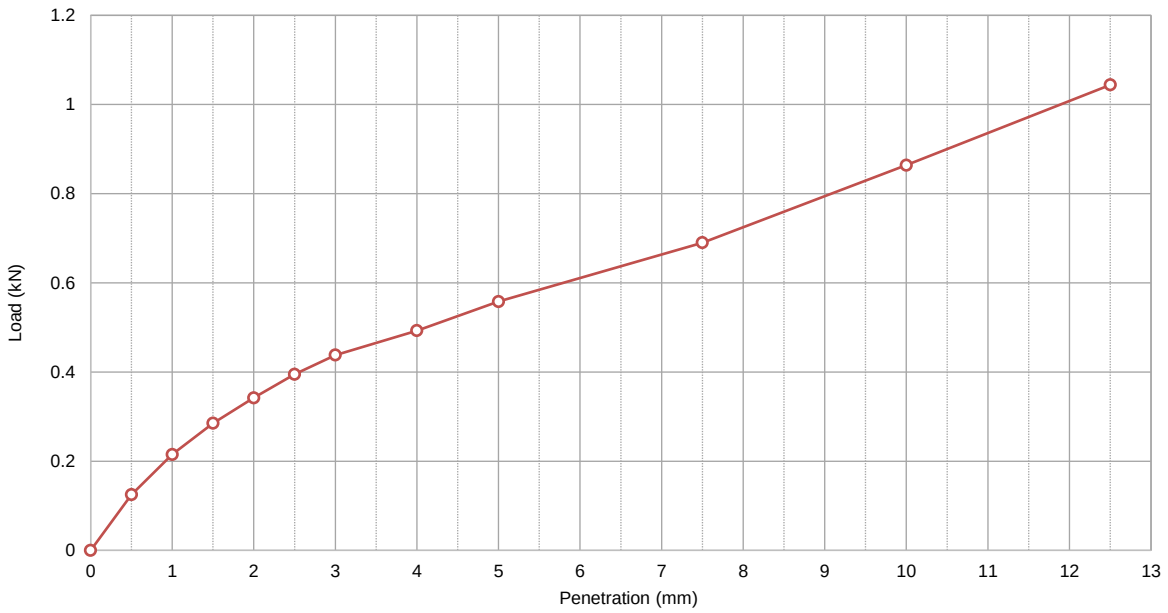
Macquarie Geotech
U7/8 10 Bradford Street
Alexandria NSW

CALIFORNIA BEARING RATIO REPORT

Client	EI Australia	**Source**	TP1 0.9-1.2m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No.**	S62758-CBR
Job No.	S20329-2	**Sample No.**	S62758

Test Procedure:	☑ AS 1289.6.1.1	☐ RMS T117	California Bearing Ratio
	☑ AS 1289.5.1.1	☐ RMS T111	Dry Density / Moisture Content Relationship - Standard Compaction
	☐ AS 1289.5.2.1	☐ RMS T112	Dry Density / Moisture Content Relationship - Modified Compaction
	☑ AS 1289.2.1.1	☐ RMS T120	Moisture Content - Oven Drying Method (Standard Method)

Sampling:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Preparation & Specification		Density & Moisture	Achieved	Target
Retained on 19.0mm Sieve (%)	0	Lab Moisture Ratio - LMR (%)	99.5	100.0
Method of Establishing Plasticity Level	Technician Assessment	Lab Density Ratio - LDR (%)	99.5	100.0
Sample Curing Time (hrs)	148 hrs	Dry Density - At Compaction (t/m³)	1.78	1.79
Compaction Hammer Used	Standard	Dry Density - After Soaking (t/m³)	1.74	
Surcharge Mass Applied (kg)	9.0	Specimen Swell (%)	2.6	
Period of Soaking (Days)	4	Moisture Content - At Compaction (%)	17.6	
Maximum Dry Density - MDD (t/m³)	1.79	Moisture Content - Top 30mm (%)	26.1	
Optimum Moisture Content - OMC (%)	17.7	Moisture Content - Remainder (%)	18.1	

Material CBR Value (%): **3** **at a penetration of** **2.5** **mm**

Notes:

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

31/08/2020

Chris Lloyd Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

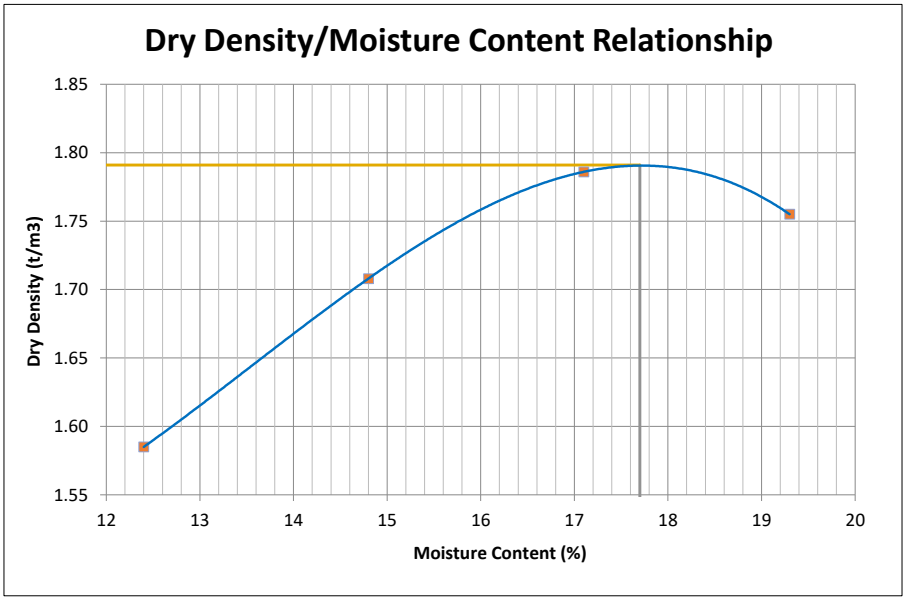
Client	EI Australia	**Source**	TP1 0.9-1.2m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No**	S62758-MDD
Job No	S20329-2	**Sample No**	S62758

Test Procedure:

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Maximum Dry Density (t/m^3)	1.791
Optimum Moisture Content (%)	17.7
Oversize Retained on 19mm sieve (%)	0.0
Oversize Retained on 37.5mm sieve (%)	0.0
Curing Time	124 hrs
Liquid Limit Determination	Technician Assessment

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Authorised Signatory:

Chris Lloyd

31/08/2020

Date:

MACQUARIE GEOTECH

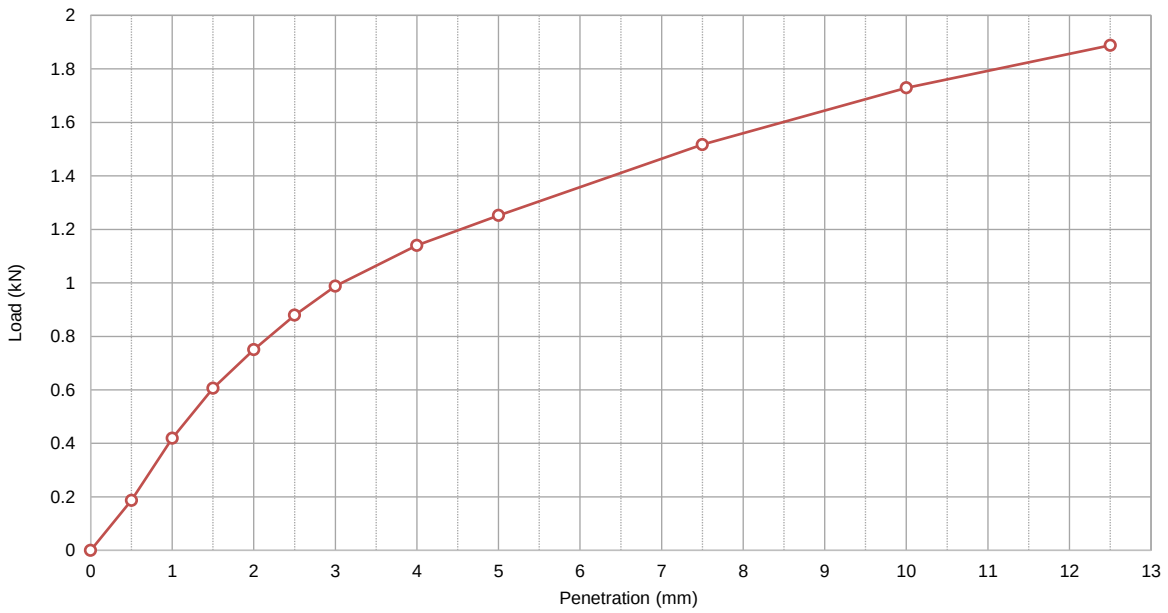
Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

CALIFORNIA BEARING RATIO REPORT

Client	EI Australia	**Source**	TP2 0.8-1.1m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No.**	S62759-CBR
Job No.	S20329-2	**Sample No.**	S62759

Test Procedure:				
☑	AS 1289.6.1.1	☐	RMS T117	California Bearing Ratio
☑	AS 1289.5.1.1	☐	RMS T111	Dry Density / Moisture Content Relationship - Standard Compaction
☐	AS 1289.5.2.1	☐	RMS T112	Dry Density / Moisture Content Relationship - Modified Compaction
☑	AS 1289.2.1.1	☐	RMS T120	Moisture Content - Oven Drying Method (Standard Method)

Sampling:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Preparation & Specification		Density & Moisture	Achieved	Target
Retained on 19.0mm Sieve (%)	0	Lab Moisture Ratio - LMR (%)	100.5	100.0
Method of Establishing Plasticity Level	Technician Assessment	Lab Density Ratio - LDR (%)	100.0	100.0
Sample Curing Time (hrs)	150 hrs	Dry Density - At Compaction (t/m³)	1.78	1.78
Compaction Hammer Used	Standard	Dry Density - After Soaking (t/m³)	1.76	
Surcharge Mass Applied (kg)	9.0	Specimen Swell (%)	1.2	
Period of Soaking (Days)	4	Moisture Content - At Compaction (%)	17.6	
Maximum Dry Density - MDD (t/m³)	1.78	Moisture Content - Top 30mm (%)	21.2	
Optimum Moisture Content - OMC (%)	17.5	Moisture Content - Remainder (%)	17.4	

Material CBR Value (%): **7** **at a penetration of** **2.5** **mm**

Notes:

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

31/08/2020

Chris Lloyd Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
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Alexandria NSW 2015

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

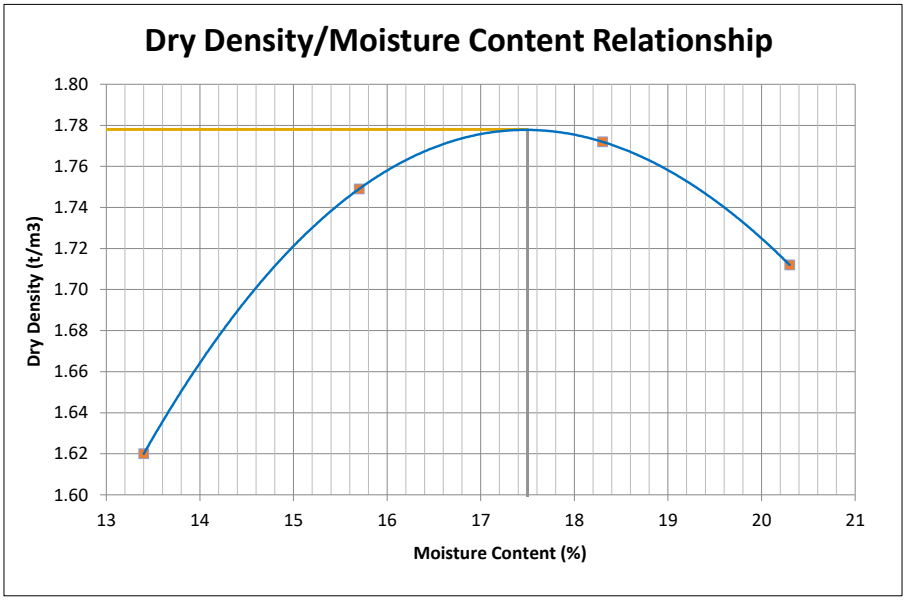
Client	EI Australia	**Source**	TP2 0.8-1.1m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No**	S62759-MDD
Job No	S20329-2	**Sample No**	S62759

Test Procedure:

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Maximum Dry Density (t/m^3)	1.778
Optimum Moisture Content (%)	17.5
Oversize Retained on 19mm sieve (%)	0.0
Oversize Retained on 37.5mm sieve (%)	0.0
Curing Time	122 hrs
Liquid Limit Determination	Technician Assessment

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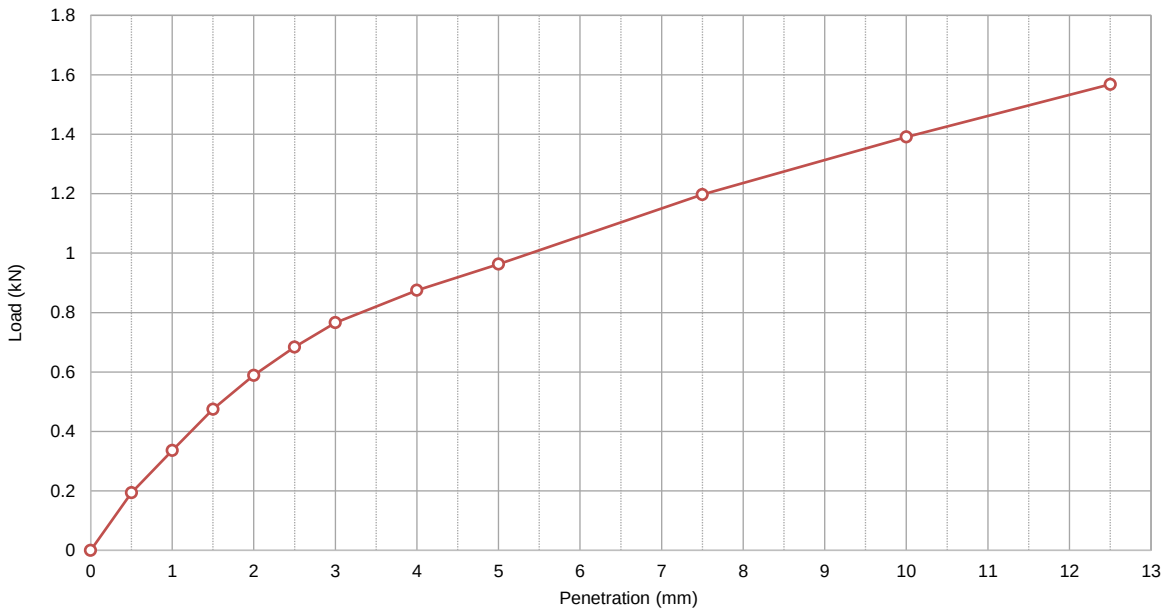
CALIFORNIA BEARING RATIO REPORT

Client	EI Australia	**Source**	TP3 0.6-0.9m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No.**	S62760-CBR
Job No.	S20329-2	**Sample No.**	S62760

Test Procedure:				
☑	AS 1289.6.1.1	☐	RMS T117	California Bearing Ratio
☑	AS 1289.5.1.1	☐	RMS T111	Dry Density / Moisture Content Relationship - Standard Compaction
☐	AS 1289.5.2.1	☐	RMS T112	Dry Density / Moisture Content Relationship - Modified Compaction
☑	AS 1289.2.1.1	☐	RMS T120	Moisture Content - Oven Drying Method (Standard Method)

Sampling:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Preparation & Specification		Density & Moisture	Achieved	Target
Retained on 19.0mm Sieve (%)	0	Lab Moisture Ratio - LMR (%)	100.5	100.0
Method of Establishing Plasticity Level	Technician Assessment	Lab Density Ratio - LDR (%)	99.5	100.0
Sample Curing Time (hrs)	149 hrs	Dry Density - At Compaction (t/m³)	1.60	1.61
Compaction Hammer Used	Standard	Dry Density - After Soaking (t/m³)	1.58	
Surcharge Mass Applied (kg)	9.0	Specimen Swell (%)	1.6	
Period of Soaking (Days)	4	Moisture Content - At Compaction (%)	23.1	
Maximum Dry Density - MDD (t/m³)	1.61	Moisture Content - Top 30mm (%)	29.3	
Optimum Moisture Content - OMC (%)	23.0	Moisture Content - Remainder (%)	23.9	

Material CBR Value (%): **5** **at a penetration of** **2.5** **mm**

Notes:

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Authorised Signatory:

31/08/2020

Chris Lloyd Date:

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Alexandria NSW 2015

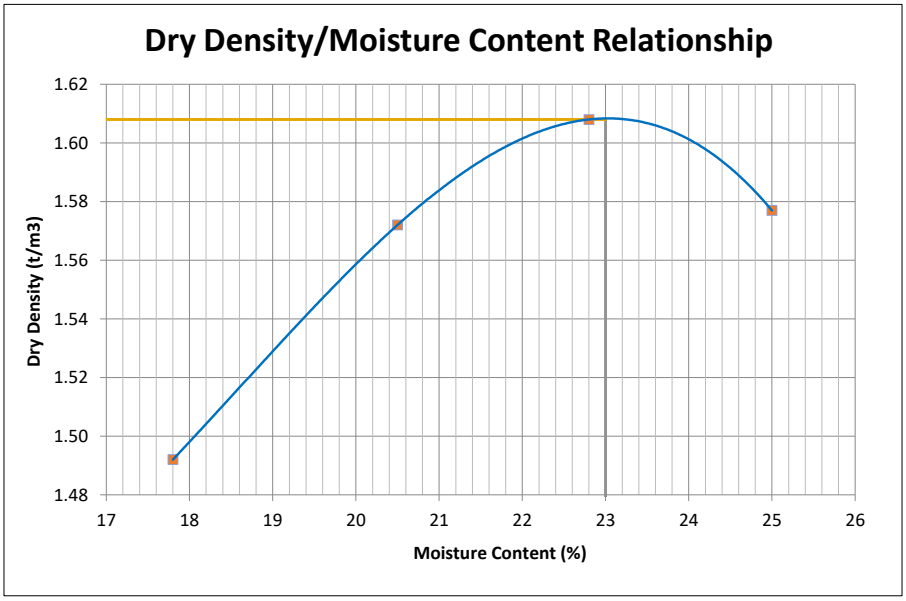
DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client	EI Australia	**Source**	TP3 0.6-0.9m
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description**	Silty CLAY
Project	164-170 Croatia Avenue Edmondson Park (E24744 G03)	**Report No**	S62760-MDD
Job No	S20329-2	**Sample No**	S62760

Test Procedure:
- ☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction
- ☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling: Sampled by Client - results apply to the sample as received **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method



Maximum Dry Density (t/m^3)	1.608
Optimum Moisture Content (%)	23.0
Oversize Retained on 19mm sieve (%)	0.0
Oversize Retained on 37.5mm sieve (%)	0.0
Curing Time	126 hrs
Liquid Limit Determination	Technician Assessment

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

31/08/2020

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	James Wei Wang
Client	EI AUSTRALIA
Address	SUITE 6.01 55 MILLER STREET PYRMONT NSW 2009
Telephone	61 2 95160722
Facsimile	(Not specified)
Email	James.wang@eiaustralia.com.au
Project	**E24744.G03 164-170 Croatia Ave Edmondson**
Order Number	**E24744.G03**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE209783 R0**
Date Received	10/8/2020
Date Reported	17/8/2020

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Dong LIANG
Metals/Inorganics Team Leader

Shane MCDERMOTT
Inorganic/Metals Chemist

pH in soil (1:5) [AN101] Tested: 13/8/2020

PARAMETER	UOM	LOR	BH3M_1.5-1.79 SOIL - 6/8/2020 SE209783.001	BH4M_1.5-1.95 SOIL - 5/8/2020 SE209783.002	BH5M_3.0-3.45 SOIL - 5/8/2020 SE209783.003
pH	pH Units	0.1	**5.8**	**5.4**	**8.3**

Conductivity and TDS by Calculation - Soil [AN106] Tested: 13/8/2020

PARAMETER	UOM	LOR	BH3M_1.5-1.79 SOIL - 6/8/2020 SE209783.001	BH4M_1.5-1.95 SOIL - 5/8/2020 SE209783.002	BH5M_3.0-3.45 SOIL - 5/8/2020 SE209783.003
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	**280**	**800**	**300**

Soluble Anions (1:5) in Soil by Ion Chromatography [AN245] Tested: 13/8/2020

PARAMETER	UOM	LOR	BH3M_1.5-1.79 SOIL - 6/8/2020 SE209783.001	BH4M_1.5-1.95 SOIL - 5/8/2020 SE209783.002	BH5M_3.0-3.45 SOIL - 5/8/2020 SE209783.003
Chloride	mg/kg	0.25	280	960	280
Sulfate	mg/kg	5	130	320	81

Moisture Content [AN002] Tested: 11/8/2020

PARAMETER	UOM	LOR	BH3M_1.5-1.79 SOIL - 6/8/2020 SE209783.001	BH4M_1.5-1.95 SOIL - 5/8/2020 SE209783.002	BH5M_3.0-3.45 SOIL - 5/8/2020 SE209783.003
% Moisture	%w/w	1	**6.4**	**16.9**	**8.5**

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	James Wei Wang
Client	EI AUSTRALIA
Address	SUITE 6.01 55 MILLER STREET PYRMONT NSW 2009
Telephone	61 2 95160722
Facsimile	(Not specified)
Email	James.wang@eiaustralia.com.au
Project	**E24744.G03 164-170 Croatia Ave,Edmondson**
Order Number	**E24744.G03**
Samples	2

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE209155 R0**
Date Received	24/7/2020
Date Reported	3/8/2020

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Dong LIANG
Metals/Inorganics Team Leader

Shane MCDERMOTT
Inorganic/Metals Chemist

Soluble Anions (1:5) in Soil by Ion Chromatography [AN245] Tested: 31/7/2020

PARAMETER	UOM	LOR	BH1_0.5-0.95 SOIL - 22/7/2020 SE209155.001	BH2_1.5-1.95 SOIL - 22/7/2020 SE209155.002
Chloride	mg/kg	0.25	180	1200
Sulfate	mg/kg	5	140	160

pH in soil (1:5) [AN101] Tested: 30/7/2020

PARAMETER	UOM	LOR	BH1_0.5-0.95 SOIL - 22/7/2020 SE209155.001	BH2_1.5-1.95 SOIL - 22/7/2020 SE209155.002
pH	pH Units	0.1	**4.8**	**8.1**

Conductivity and TDS by Calculation - Soil [AN106] Tested: 30/7/2020

PARAMETER	UOM	LOR	BH1_0.5-0.95 SOIL - 22/7/2020 SE209155.001	BH2_1.5-1.95 SOIL - 22/7/2020 SE209155.002
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	**250**	**770**

Moisture Content [AN002] Tested: 29/7/2020

PARAMETER	UOM	LOR	BH1_0.5-0.95 SOIL - 22/7/2020 SE209155.001	BH2_1.5-1.95 SOIL - 22/7/2020 SE209155.002
% Moisture	%w/w	1	**17.0**	**19.4**

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

Appendix C – Vibration Limits

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally considered to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) directions, in the plane of the uppermost floor), are summarised in **Table A** below.

It should be noted that peak vibration velocities higher than the minimum figures in **Table A** for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual conditions of the structures.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table A DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity (mm/s)			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note: For frequencies above 100 Hz, the higher values in the 50 Hz to 100 Hz column should be used.

Appendix D – Important Information

Important Information

SCOPE OF SERVICES

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client And EI Australia ("EI"). The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

EI has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. EI has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, EI will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to EI.

GEOTECHNICAL ENGINEERING

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

LIMITATIONS OF SITE INVESTIGATION

The investigation programme undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation programme and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. EI should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

VERIFICATION OF SITE CONDITIONS

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that EI be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

REPRODUCTION OF REPORTS

 Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the Client and no other party. EI assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of EI or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

OTHER LIMITATIONS

EI will not be liable to update or revise the report to take into account any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.