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PACIFIC DRIVE PTY LTD

Geotechnical Investigation

10-16 Pacific Drive, Port Macquarie, NSW

E24947.G03_Rev1
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Revision	Details	Date	Amended By
	Original	14 January 2021	
1	Updated architectural drawings	22 April 2022	KX
1	Groundwater Responses	31 May 2022	NJ

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1. Introduction

1.1 Background

At the request of Pacific Drive Pty Ltd (the Client), EI Australia (EI) has carried out a Geotechnical Investigation (GI) for the proposed development at 10-16 Pacific Drive, Port Macquarie, 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 P18820.1_Rev1, dated 19 November 2020, and with the Client's signed authorisation to proceed, dated 20 November 2020.

1.2 Proposed Development

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

- Pre-lodgement Meeting Advice for Application by Port Macquarie Hastings Council, Reference 210.2020.69, dated 11 November 2020;
- Architectural drawings prepared by D.R. Design (NSW) Pty Ltd – Project No. 22-020, Drawing Nos. DA-0-001 (Rev B), DA-0-002 (Rev C), DA-0-104 (Rev B), DA-0-210 to DA-0-214 (Rev B), DA-0-215 to DA-0-218 (Rev C), DA-0-302 (Rev B), DA-0-303 (Rev C), DA-0-401 (Rev B) and DA-0-402 (Rev B), dated 20 April 2022;
- Site survey plan prepared by LandDynamics Australia – Job No. 5115, Drawing No. 0001, Revision E, dated 23 June 2021. The datum in the survey plan is in Australian Height Datum (AHD), hence all Reduced Levels (RL) mentioned in this report are in AHD;
- Preliminary Review of Stormwater and Groundwater Issues Letter prepared by Bewsher Consulting Pty Ltd, Reference J2416L_1.docx dated 30 April 2022.

Based on the provided documents, EI understands that the proposed development involves the demolition of the existing site structures and the construction of a six-storey (Building A) and a five-storey (Building B) residential development overlying a common stepped basement carpark. Building A is located at northern portion of the site at a higher elevation overlies a two-level basement carpark and Building B is located at southern portion of the site at a lower elevation overlies a single-level basement carpark. The lowest basement level is proposed to have a Finished Floor Level (FFL) between RL 28.25m (Building A) and RL 26.95m (Building B). A Bulk Excavation Level (BEL) between RL 28.0m (Building A) and RL 26.7m (Building B) is assumed, which includes allowance for the construction of the basement slab. To achieve the BEL, excavation depths varying from 4.3m to 8.8m Below Existing Ground Level (BEGL) along the eastern excavation perimeter and from 2.4m to 8.1m along the western perimeter are expected. Locally deeper excavations may be required for footings, lift overrun pits, crane pads, and service trenches. The proposed basement has a minimum setback of 6.0m from the northern boundary, 1.5m from the western boundary, 6.0m from the southern boundary, and 1.3m from the eastern boundary.

As per pre-lodgement advice referred above, Planning Item 15, states the following:

15) Potential for ground water/aquifer interference and need to determine whether dewatering required with basement excavation. Geotechnical investigation required. Depending on the

findings the proposal may also be integrated development under the Water Management Act 2000 and referral to NSW Natural Resource Access Regulator would be undertaken.

1.3 Objectives

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

- Dilapidation Surveys;
- 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.
- 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 four boreholes (BH1M, BH2M, BH3 and BH4) by a track-mounted drill rig using solid flight augers equipped with a 'Tungsten-Carbide' (T-C) bit. Boreholes, BH1M and BH2M, were continued using wash boring methods to depth of about 20.20m, RL 17.80m and RL7.30m, respectively. The boreholes were auger/wash bored to depths as shown in **Table1-1** below:

Table 1-1 Augering/Wash Boring Depths

Borehole ID	Augering/ Wash Boring	
	Depth (m)	RL (m AHD)
BH1M	20.20	17.80
BH2M	20.20	7.30
BH3	14.50	19.00
BH4	9.50	26.60

  - 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 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**;
- Boreholes BH1M and BH2M were converted into two groundwater monitoring wells with depth of 11.20m BEGL (RL 26.80m) and 2.50m BEGL (RL 27.00m) respectively to allow for long-term groundwater monitoring;
- Boreholes BH3 and BH4 were backfilled with drilling spoils upon completion;
- Soil samples were sent to STS Geotechnics Pty Ltd (STS) 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 and the presence of existing site structures. The discussions and advice presented in this report are preliminary and intended to assist in the preparation of designs for the proposed development. Further geotechnical inspections should be carried out during construction to confirm the geotechnical and groundwater models, and the preliminary 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	10-16 Pacific Drive, Port Macquarie, NSW
Lot and Deposited Plan (DP) Identification	Lot 1 and 2 in DP 538077 and Lot A in DP441800.
Brief Site Description	At the time of our investigation, the site was occupied by a two-storey brick residential building located within the north-western portion. The building structure appeared to be in fair condition based on a cursory inspection of the exterior walls. The areas towards the south of the residential building were concrete paved and connected with the Pacific Drive by a driveway. The concrete pavement was in fair condition. The remaining area of the site was vacant and covered with grass.
Site Area	The site area is approximately 2990m^2 (based on the provided survey plan referenced above).

Plate 1: Aerial photograph of the site (source: SIX Maps, accessed 14/12/2020)

2.2 Local Land Use

The site is situated within an area of residential use. 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	Properties at No. 9 Pacific Drive, Nos. 2 and 6 Windmill Street. No. 9 Pacific Drive is a two-storey brick residential building with tile roof, grassy areas and a concrete driveway. No. 2 Windmill Street is a three-storey residential building with a concrete driveway. No. 6 Windmill Street is a three-storey residential building with one level basement. The buildings have offset of about 2-6m from the northern site boundary and appeared to be in good condition based on inspection of the external walls. The three properties are slightly on higher elevation than the site.
East	Lot 101 in DP 1244390, grassy vacant land. Beyond this is Pacific Drive, a two lane, asphalt-paved road, followed by a cliff face along the shoreline of the Pacific Ocean.
South	Property at No. 17 Pacific Drive, a two-storey residential house with a concrete driveway. The building has an offset of about 1-2m from the southern site boundary and appeared to be in good condition based on inspection of the external walls. The house is slightly lower than the site.
West	Properties at Nos. 6 and 8 Macquarie Place and No. 3 Home Street. No. 6 Macquarie Place is a two-storey residential building with a concrete driveway. No. 8 Macquarie Place is a two-storey brick residential building with a concrete driveway. No. 3 Home Street is a single storey brick residential building with concrete driveway. The buildings have an offset of about 2-5m from the western site boundary and appeared to be in good condition based on inspection of the external walls. The three properties are slightly lower in elevation than the site due to naturally sloping ground.

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 lower west side of the road within gently (<10°) southwest dipping topography with site levels varying from RL 39.65m at the north-eastern site corner to RL 28.55m at the south-western site corner.
Regional Geology	Information on regional sub-surface conditions, referenced from the NSW Department of Primary Industries, Hastings 1:250,000 Geological Series Sheet, reference SH56-14 (1970) indicates the site to be underlain by Serpentinite, ultrabasic intrusives (Ps). Based on geological map, an approximately located fault is extending in a North-South direction through the site.

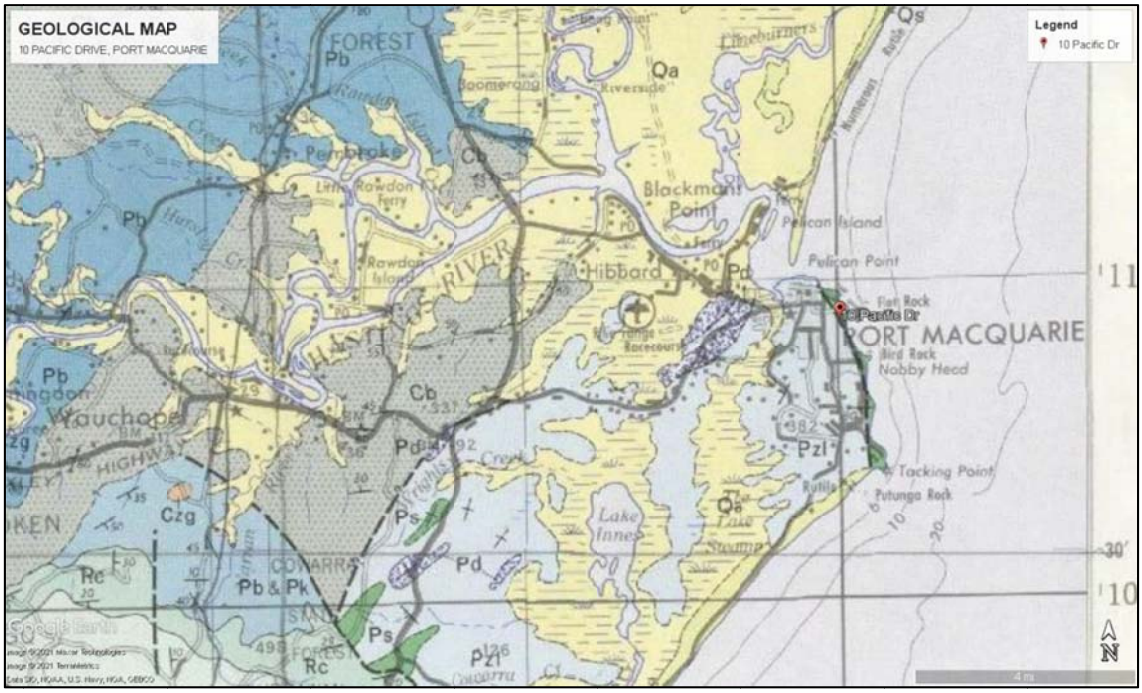

Plate 2: Excerpt of geological map showing location of site.

3. Investigation Results

3.1 Stratigraphy

For the development of a site-specific geotechnical model, the stratigraphy observed in the GI has been grouped into three 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	**Fill** [4]	Surface to 0.50	36.10 to 38.00	0.30 to 0.50	Fill consisting of silty clay, low plasticity with igneous gravels observed in BH1M and silty sand with traces of rootlets observed in BH4. No Fill was observed in BH2M and BH3
2	**Stiff to Very Stiff Silty Clay**	Surface to 0.50	29.50 to 37.50	1.20 to 2.50 [3]	High plasticity, stiff to very stiff silty clay with igneous gravels. SPT values ranged from 13 to 30.
3	**Hard Silty Clay**	1.50 to 3.00	34.90 to 35.00	- [4]	High plasticity, hard silty clay with igneous gravels. SPT values are 30 and refusal indicated by hammer bounced.

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 BH2 and BH3. Thickness of this unit is based on BH1M and BH4.
Note 4 Observed with in BH1M and BH4 only.

3.2 Groundwater Observations

Following completion of auger drilling, the boreholes were left open and groundwater levels were measured within the boreholes during the fieldwork. We note that no free standing groundwater in the boreholes was observed after drilling of the boreholes.

A further inspection of the monitoring wells was carried out on 12th May 2022 after recent heavy rainfall. No standing groundwater was recorded in the installed wells. It is highly likely that the groundwater may not be present due to low permeable deep silty clay across the site.

No long term groundwater monitoring was carried out.

3.3 Test Results

Five soil 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).

A summary of the soil test results is provided in **Table 3-2** below. Laboratory test certificates are presented in **Appendix B**.

Table 3-2 Summary of Soil Laboratory Test Results

Test/ Sample ID		BH1M 10.5-10.95	BH2M 6.0-6.45	BH3 1.5-1.95	BH3 3.0-3.45	BH4 1.5-1.95
Unit		2	2	2	2	2
Material Description [1]		Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY
Aggressivity	Chloride Cl (ppm)	69	26	12	-	-
	Sulfate SO_4 (ppm)	41	170	50	-	-
	pH	3.8	3.9	4.1	-	-
	Electrical Conductivity (µS/cm)	110	140	53	-	-
	Moisture Content (%)	19.9	25.2	23.7	22.6	13.2
Atterberg Limits	Liquid Limit (%)	-	-	-	72	59
	Plastic Limit (%)	-	-	-	28	26
	Plasticity Index (%)	-	-	-	44	33
	Linear Shrinkage (%)	-	-	-	14	13

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 high plasticity and of 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:

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

4. Recommendations

4.1 Geotechnical Issues

Based on the results of the investigation, 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;
- Reactivity of the underlying natural clays; and
- 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 the proposed development will require a BEL between RL 28.00m (Building A) and RL 26.70m (Building B) for the basement, or excavation depths from 4.3m to 8.8m BEGL along the eastern excavation perimeter and 2.4m to 8.1m BEGL along the western perimeter are anticipated. 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 therefore extend through all units as outlined in **Table 3-1** above. As such, an engineered retention system to retain the residual soils must be installed prior to excavation commencing.

Excavation can be carried out using buckets of conventional earthmoving Hydraulic Excavators, particularly if fitted with 'Tiger Teeth'.

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 a depth of 1.5m, and every 1.5m interval thereafter;
- 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

Free standing groundwater or seepage was not observed within the augered sections of all boreholes. Two piezometers were installed in BH1M and BH2M to depth 1.00m below BEL and the two wells were found to be dry one day after completion of fieldwork. Hence, groundwater is not likely to be encountered during excavation. No long term groundwater measurement was undertaken as it was beyond the scope of the investigation.

4.4.1 Further Investigation of Ground Water and EI Responses

EI has completed further investigation of groundwater and prepared the following response to hydrological advice provided by the panel dated 30th April 2022.

In relation to item 6 of the Groundwater items, within the letter provided by the panel further investigation was requested in terms of the groundwater assessment. EI Australia attended the site on the 12th May 2022 following heavy rainfall, and it was found that there was no standing ground water recorded in existing boreholes (BH1M and BH2M). This can be attributed to the ground condition on the site which have a low permeability and therefore limit the flow of groundwater.

It is however important to note that there was minimal seepage detected on the shallow fill soil and there was shallow groundwater detected. This however can be treated through the onsite stormwater drainage system and EI's understanding is that the Stormwater design and report "5115 SWMP Rev G" prepared by Land Dynamics has adequately addressed the shallow

groundwater issues which the properties on Macquarie Place and Home Street are experiencing.

In response to item 9 the groundwater which is currently being naturally drained as shallow groundwater and surface water into the affected properties is now being captured through the inclusion of agg line drainage (SSD) on the south western perimeter, and being directed to an additional pump out pit, limiting water from spilling into the neighbouring properties, therefore providing a positive benefit to the downslope properties- refer to page 2 of 5 of the Ground Floor Stormwater Concept Plan.

Further to the above, and as per the recommendations outlined in this report, the basement perimeter retaining walls will be designed as wet walls/drained walls, further intercepting any ground water which resides on the edges of the basement, where this water is then directed to a pump out pit within the basement and into the Onsite Detention Tank. This recommendation will further enable the groundwater and surface water which is currently naturally draining to the down slope properties to be intercepted on site and treated as required. While the stormwater drawings provided to date reflect that the basement will be fully tanked, however, the recommendation drained walls recommended by EI Australia should be adhered to and the stormwater design for the basement will likely need minor amendments to capture the drainage methods of the water entering the basement through the wet wall (drained wall) system. This can be implemented during construction and will not affect the current basement design in terms of layout and spatial requirements.

In completing further investigations and reviewing the amended stormwater design following the provision of the Panel's Hydrological advice in the letter dated 30th April 2022, it is EI Australia's recommendation that the groundwater spillage being experienced by the South and Western neighbouring properties, will be mostly intercepted and treated on site, providing a positive benefit to the neighbouring properties.

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 provided architectural plans, the proposed basement has a minimum setback of 6.0m from the northern boundary, 1.5m from the western boundary, 6.0m from the southern boundary, and 1.3m from the eastern boundary. Considering the setbacks from the site boundaries and depth of excavation, temporary batters with safe angle of 1 vertical to 1 horizontal may be adopted at south-western portion of Building B basement excavation. However, a suitable retaining structure is required for the remaining excavation perimeters.

A suitable retention system, such as an anchored/propped soldier pile wall, with concrete infill panels, will be required for the support of the excavation. Anchors/props and shotcrete must be installed progressively as excavation proceeds. The use of a more closely spaced shoring system (such as semi-contiguous or contiguous) is recommended adjacent to neighbouring buildings/infrastructures, so as to reduce the lateral movements and the risk of potential damage.

Bored piles are considered to be the most suitable for this site. The proposed pile locations should take into account the presence of buried services. Further advice should be sought from prospective piling contractors who should be provided with a copy of this report.

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:

- Conventional free-standing cantilever walls which support areas where movement is of little concern (i.e. where only gardens or open areas are to be retained), may be designed using a triangular lateral earth pressure distribution and an 'active' earth pressure coefficient, K_a, as shown in **Table 4-1**;
- Cantilevered walls, where the tops of which are restrained by the floor slabs of the permanent structure or which support movement sensitive elements, should be designed using a triangular lateral earth pressure distribution and an 'at rest' earth pressure coefficient, K_o, as shown in **Table 4-1** below;
- 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 6H 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 lateral toe resistance of the retention system can be achieved by sufficient embedment below the ground in front of the wall. For embedment depth design, a triangular lateral earth pressure distribution should be adopted, with a 'passive' earth pressure coefficient, Kp, as shown in **Table 4-1** below, assuming horizontal ground in front of the wall. We note that significant deflection is required in order to mobilise the full 'passive' pressure of a soil, and therefore a factor of safety of at least 2 should be adopted. The 'passive' pressure due to the upper 0.5m below bulk excavation level should be ignored in the analysis to take excavation tolerances into account. All localised excavations in front of the wall (such as pile rig working platform, buried services, footings, lift overrun pits, etc.) should also be taken into account in the wall design;
- 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 neighbouring basements and/or services and their levels must be confirmed prior to finalising anchor design;
- Anchors should have their bond length within Unit 2 or better. For the design of anchors bonded into Unit 2 or better, the geotechnical parameters outlined in **Table 4-1** 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 4-1 Geotechnical Design Parameters

Material [1]		Unit 1 Fill	Unit 2 Stiff to Very Stiff Silty Clay	Unit 3 Hard Clay
RL of Top of Unit (m AHD) [2]		36.10 to 38.00	29.50 to 37.50	34.60 to 35.00
Bulk Unit Weight (kN/m^3)		18	20	22
Friction Angle, ϕ' (°)		25	25	30
Effective Cohesion, c (kPa)		-	5	15
Elastic Modulus, E (MPa)		2	10	40
Earth Pressure Coefficients	At rest, K_o [3]	0.58	0.53	0.50
	Active, K_a [3]	0.41	0.36	0.33
	Passive, K_p [3]	-	2.77	3.00
Allowable Bearing Pressure (kPa) [4]		-	150	400
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 Port Macquarie is 0.06.		

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 To adopt these parameters we have assumed that:
- Footings have a nominal socket of at least 0.3m, into the relevant founding material;
- 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

Based on the encountered stratigraphy at the proposed BEL (RL 28.0m to 26.7m), very stiff to hard clays are expected to be exposed. It is recommended that all footings for the building to be founded on similar strength material to provide uniform support and reduce the potential for differential settlements. Based on the size of the development, we recommend that building is supported on pile footings founded into at least hard clays (Unit 3). However, the option of placing the structure on raft slab is also provided.

4.6.1 Raft Slab

Raft slabs are well suited to uniform slab conditions and building loads. Further detailed evaluation of expected performance including the evaluation of allowable bearing pressures and settlements would be required once design loads, founding level, and column layout are better known.

In the case of a piled stiffened raft slab, the piles are designed to their ultimate capacity and act as settlement reducers to the stiffened raft slab.

The subgrade preparation below any raft slabs will be important in the final performance of the raft. Detailed analysis of a piled raft would be required to estimate the settlements and the contact pressures below the raft. Further discussion regarding sub-grade preparation is provided in **Section 4.8** below. It is also recommended that a 150mm thick layer of good quality granular material such as recycled concrete or crushed rock be placed and compacted over the prepared surface, particularly at heavily loaded areas. This layer helps confine the gravelly soils from disturbances and improve the compaction and density of the surface soils.

4.6.2 Pile Footings

Alternatively, the proposed development may be supported on deep footings, such as piles, founded into hard clays.

The piles founded within hard clays can be designed for a maximum allowable bearing pressure of 400kPa.

At least the initial drilling of piles should be completed in the presence of a geotechnical engineer to verify that ground conditions meet design assumptions.

No groundwater was encountered during our geotechnical investigation. However, if 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. Concrete must be poured on the same day as drilling, inspection and drilling.

The aggressivity of natural soils and groundwater (if encountered) should be taken into consideration in the design.

Footings founded at or near a crest of an excavation (such as the building located to the south outside of the basement outline) should be founded below the zone of influence of the basement retaining walls, which may be taken as founding below a line drawn at 1 Vertical to 1 Horizontal from the base of the retaining walls. It is recommended to use piles.

4.7 Basement Floor Slab

Following the removal of all loose and softened materials, we recommend that underfloor drainage be provided and should comprise a strong, durable, single sized washed aggregate such as ‘blue metal gravel’. Joints in the concrete floor slab should be designed to accommodate shear forces but not bending moments by using dowelled and keyed joints. The basement floor slab should be isolated from columns. The completed excavation should be inspected by the hydraulic engineer to confirm the extent of the drainage required.

In addition, a system of sub-soil drains comprising a durable single sized aggregate with perforated drains/pipes leading to sumps should be provided. The basement floor slab should be isolated from columns.

Permission may need to be obtained from the NSW Department of Primary Industries (DPI) and possibly Council for any permanent discharge of seepage into the drainage system. Given the subsurface conditions, we expect that seepage volumes would be low and within the DPI limits. However, if permission for discharge is not obtained, the basement may need to be designed as a tanked basement.

4.8 Subgrade Preparation and Engineered Fill

4.8.1 Subgrade Preparation

Earthworks recommendations provided in this report should be complemented by reference to AS3798.

1 Fill should be fully excavated down to surface of the residual soils, and stockpiled separately since these materials are not suitable for re-use as engineered fill. Such excavation may need to be carried out with the excavation sides battered at an angle of no steeper than 1 Vertical to 1 Horizontal. The new fill must be 'keyed-in' the sides of these batters.

2 The exposed subgrade at the base of the excavation should be proof rolled with a smooth drum roller (say 12 tonne) used in static or non-vibratory mode of operation. Caution is required when proof rolling near existing infrastructures and utilities (where present). The purpose of the proof rolling is to detect any soft or heaving areas, and to allow for some further improvement in strength or compaction.

3 The final pass should be undertaken in the presence of an experienced geotechnician or geotechnical engineer, to detect any unstable or soft subgrade areas, and to allow for some further improvement in strength/compaction.

4 If dry conditions prevail at the time of construction then any exposed residual clay subgrade may become desiccated or have shrinkage cracks prior to pouring any concrete slabs. If this occurs, the subgrade must be watered and rolled until the cracks disappear.

5 Unstable subgrade detected during proof rolling should be locally excavated down to a sound base and replaced with engineered fill or further advice should be sought. Any fill placed to raise site levels should also be engineered fill, as per the specifications below.

If suspended floor slabs and pavement are designed, then it would be unnecessary to complete any particular subgrade preparation other than stripping of root affected soils from the footprint of the proposed building structures and replaced with surface levelling compacted fill for the floor slab formwork.

4.8.2 Engineered Fill Specifications

Any fill used to backfill unstable subgrade areas, raise surface levels or backfill service trenches should be engineered fill. Materials preferred for use as engineered fill are well-graded granular materials, such as ripped or crushed sandstone, free of deleterious substances and having a maximum particle size not exceeding 75 mm. such fill should be compacted in layers not greater than 200 mm loose thickness, to a minimum density of 98% of SMDD.

Density tests should be regularly carried out on the fill to confirm the above specifications are achieved. The frequency of density testing should be at least one test per layer per material type per 2500 m^2 or 1 test per 500m^3 distributed reasonably evenly throughout full depth and area or 3 tests per lot, whichever requires the most tests. We recommend that at least Level 2 control of fill compaction, as defined in AS3798-2007, be adhered to on this Site. Preferably, the geotechnical testing authority (GTA) should be engaged directly on behalf of the client and not by the earthworks subcontractor.

We recommend that the engineered fill layers extend a horizontal distance of at least 1m beyond the design geometry. The roller must extend over the edge of each placed layer in order to seal the batter surface. On completion of filling, the excess under-compacted edge fill should be trimmed back to the design geometry.

The 'tying in' of engineered fill to temporary cut batter slopes can be achieved by locally benching the cut slopes in no greater than 0.4m high steps. This can be carried out progressively as the height of engineered fill increases.

For backfilling confined excavations such as service trenches, a similar compaction to engineered fill should be adhered to, but if light compaction equipment is used then the layer thickness should be limited to 100mm loose thickness.

During construction of the fill, platform runoff should be enhanced by providing suitable falls to reduce ponding of water on the surface of the fill. Ponding of water may lead to softening of the fill and subsequent delays in the earthworks program. A poorly drained subgrade may become un-trafficable when wet. We recommend that if soil softening occurs, the subgrade be over-excavated to below the affected soil, and then replaced with engineered fill as specified above..

5. Further Geotechnical Inputs

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

- 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); and
- 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.

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 Brian Hood and Pacific Drive 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 Brian Hood and Pacific Drive 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 C** 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 October 2018 – WorkCover NSW

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

HASHIMOTO T.R. & TROEDSON A.L. 2007. *Port Macquarie 1:100,000 and 1:25,000, coastal Quaternary geology map series.* Geological Survey of New South Wales, Maitland.

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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Suite 6.01, 55 Miller Street, PYRMONT 2009
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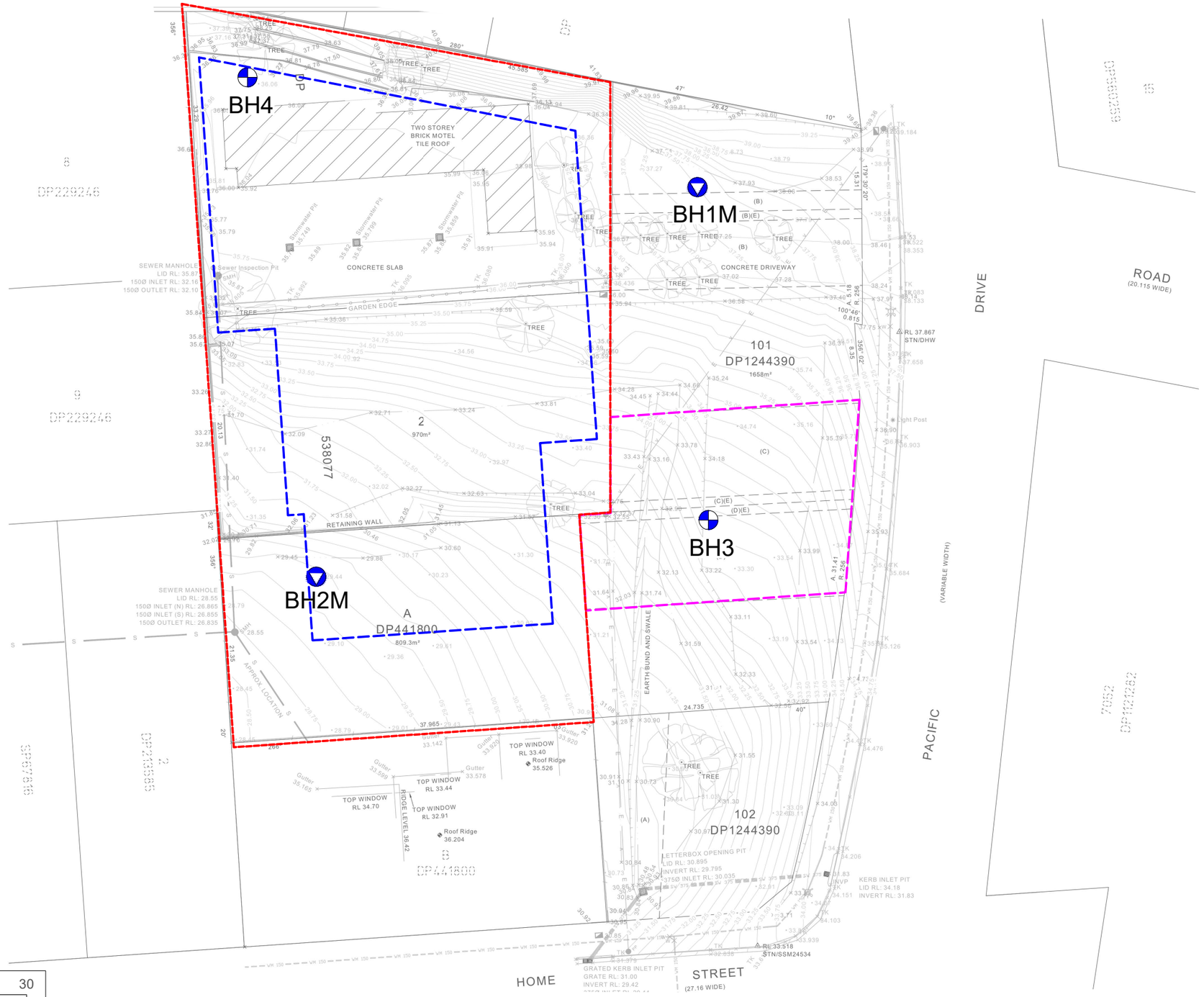
Drawn:	M.C.
Approved:	K.X.
Date:	20-04-22
Scale:	Not To Scale

Pacific Drive Pty Ltd
Geotechnical Investigation
10-16 Pacific Drive, Port Macquarie NSW
Site Locality Plan

Figure:
1

Project: E24947.G03



0 5 10 20 30

Approx. Scale (m)

Map Source: LandDynamics Australia, Job No: 5115, DWG No: 0001, Dated on: 14-09-2020

LEGEND (All Locations are Approximate)

- Site boundary
- Basement boundary
- Access easement boundary
- Approximate borehole location
- Approximate borehole/monitoring well location

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Pacific Drive Pty Ltd
Geotechnical Investigation
10-16 Pacific Drive, Port Macquarie NSW
Borehole Location Plan

Figure: 2

Project: E24947.G03

Appendix A – Borehole Logs And Explanatory Notes

BOREHOLE LOG

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BH NO. BH1M

Project	Proposed Residential Development	**Sheet**	1 of 3
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
Position	Refer to Figure 2	**Date Completed**	08/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 08/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈38.00 m AHD
Drill Rig	Hanjin DB8	**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	-	GWNE	0	38.00				-	FILL: Silty CLAY; low plasticity, orange-brown, with angular igneous gravel.	M	-	FILL
				0.50								
				37.50	SPT 0.50-0.95 m 12,9,10 N=19			CH	Silty CLAY; high plasticity, light grey and orange-brown, angular igneous gravel.			RESIDUAL SOIL
			1									
					SPT 1.50-1.95 m 11,14,13 N=27						VSt	
			2									
			3		SPT 3.00-3.45 m 11,14,17 N=31							
			4								H	
					SPT 4.50-4.80 m 17,21/150mm HB					M (<PL)		
			5									
			6		SPT 6.00-6.45 m 18,12,15 N=27						VSt	
			7	*7.50*								
				30.50	SPT 7.50-7.93 m 9,17,28/130mm HB				From 7.50m, purple and orange-brown.			
			8								H	
			9		SPT 9.00-9.45 m 11,21,27 N=48							
			10									

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

BOREHOLE LOG

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BH NO. BH1M

Project	Proposed Residential Development	**Sheet**	2 of 3
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
Position	Refer to Figure 2	**Date Completed**	08/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 08/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈38.00 m AHD
Drill Rig	Hanjin DB8	**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			10		SPT 10.50-10.95 m 13,26,30 N=56			CH	Silty CLAY; high plasticity, light grey and orange-brown, angular igneous gravel.		H	RESIDUAL SOIL
			11									
			12									
			13									
			14									
WB	-	GWNE	15							M (<PL)	-	
			16									
			17									
			18									
			19									
			20									

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BOREHOLE LOG

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BH NO. BH1M

Project	Proposed Residential Development	**Sheet**	3 of 3
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
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Drilling Contactor	Total Drilling	**Surface RL**	≈38.00 m AHD
Drill Rig	Hanjin DB8	**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
WB	-		20	*20.20*				CH			-	RESIDUAL SOIL
									Hole Terminated at 20.20 m Target Depth Reached.			
			21									
			22									
			23									
			24									
			25									
			26									
			27									
			28									
			29									
			30									

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

MONITORING WELL LOG

MW NO. BH1M

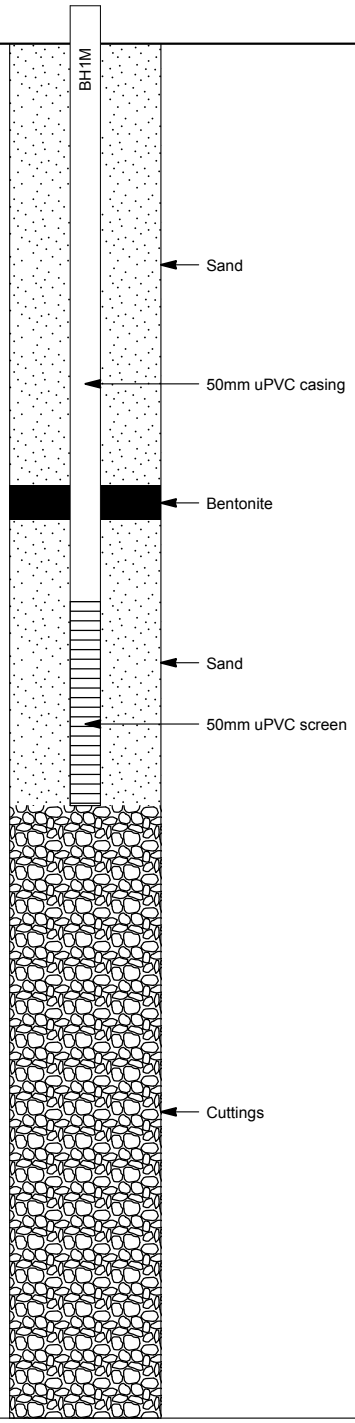
Project	Proposed Residential Development	**Sheet**	1 of 1
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
Position	Refer to Figure 2	**Date Completed**	08/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 08/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈38.00 m AHD
Drill Rig	Hanjin DB8	**Inclination**	-90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
AD/T	GWNE	0	38		FILL: Silty CLAY; low plasticity, orange-brown, with angular igneous gravel.
					Silty CLAY; high plasticity, light grey and orange-brown, angular igneous gravel.
		2	36		
		4	34		
		6	32		
					From 7.50m, purple and orange-brown.
		8	30		
		10	28		
		12	26		
		14	24		
WB		16	22		
		18	20		
		20	18		Hole Terminated at 20.20 m Target Depth Reached.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH1M	Standpipe		11.20 m 26.80 m		



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

BOREHOLE LOG

BH NO. BH2M

Project	Proposed Residential Development	**Sheet**	1 of 3
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
Position	Refer to Figure 2	**Date Completed**	09/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 08/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈29.50 m AHD
Drill Rig	Hanjin DB8	**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	-	GWNE	0	29.50				CH	Silty CLAY; high plasticity, dark brown, with subangular igneous gravel.			RESIDUAL SOIL
				0.50								
				29.00	SPT 0.50-0.95 m 7,9,13 N=22				From 0.5m, high plasticity, light grey and orange-brown.			
			1		SPT 1.00-1.45 m 8,8,10 N=18							
			2									
					SPT 2.50-2.95 m 5,9,15 N=24							
			3									
				4.00								
			4	25.50					From 4.0m, pale grey.			
											VSt	
				5.00						M		
			5	24.50					From 5.0m, pale grey and orange-brown.	(<PL)		
			6		SPT 6.00-6.45 m 6,7,10 N=17							
			7									
			8									
			9		SPT 9.00-9.45 m 5,7,6 N=13						St	
											-	
			10	*10.00*								

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

BOREHOLE LOG

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BH NO. BH2M

Project	Proposed Residential Development	**Sheet**	2 of 3
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
Position	Refer to Figure 2	**Date Completed**	09/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 08/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈29.50 m AHD
Drill Rig	Hanjin DB8	**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
WB	-	GWNE	10					CH	Silty CLAY; high plasticity, dark brown, with subangular igneous gravel.	M (<PL)	-	RESIDUAL SOIL
			11									
			12									
			13									
			14									
			15									
			16									
			17									
			18									
			19									
			20									

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

BOREHOLE LOG

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Practical Solutions for Built Environments

BH NO. BH2M

Project	Proposed Residential Development	**Sheet**	3 of 3
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
Position	Refer to Figure 2	**Date Completed**	09/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 08/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈29.50 m AHD
Drill Rig	Hanjin DB8	**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
WB	-		20	*20.20*				CH			-	RESIDUAL SOIL
									Hole Terminated at 20.20 m Target Depth Reached.			
			21									
			22									
			23									
			24									
			25									
			26									
			27									
			28									
			29									
			30									

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

MONITORING WELL LOG

MW NO. BH2M

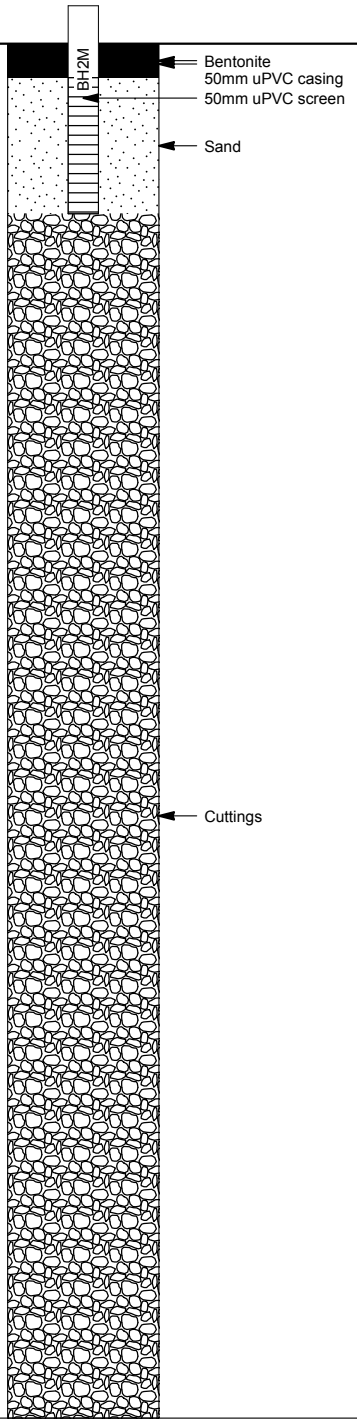
Project	Proposed Residential Development	**Sheet**	1 of 1
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	08/12/2020
Position	Refer to Figure 2	**Date Completed**	09/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 08/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈29.50 m AHD
Drill Rig	Hanjin DB8	**Inclination**	-90°

METHOD	WATER	DEPTH (m)	RL (m AHD)	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION
AD/T	GWNE	0	30		Silty CLAY; high plasticity, dark brown, with subangular igneous gravel.
		2	28		From 0.5m, high plasticity, light grey and orange-brown.
		4	26		From 4.0m, pale grey.
		6	24		From 5.0m, pale grey and orange-brown.
		8	22		
		10	20		
WB		12	18		
		14	16		
		16	14		
		18	12		
		20	10		Hole Terminated at 20.20 m Target Depth Reached.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH2M	Standpipe		2.50 m 27.00 m		



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

BOREHOLE LOG

BH NO. BH3

Project	Proposed Residential Development	**Sheet**	1 of 2
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	09/12/2020
Position	Refer to Figure 2	**Date Completed**	09/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 09/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈33.50 m AHD
Drill Rig	Hanjin DB8	**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	-	GWNE	0	33.50				CH	Silty CLAY; high plasticity, orange-brown, with angular igneous gravel.			RESIDUAL SOIL
			1		SPT 1.50-1.95 m 4,10,10 N=20							
			2									
				3.00								
			3	30.50	SPT 3.00-3.45 m 5,9,14 N=23				From 3.0m, very high plasticity, pale grey and orange-brown, with subangular ironstone gravel.			
			4									
				4.80	SPT 4.50-4.95 m 7,10,14 N=24						VSt	
			5	28.70				CH	Gravelly CLAY; high plasticity, coarse grained, pale grey and orange-brown.			RESIDUAL SOIL
				5.50								
				28.00				CH	Silty CLAY; high plasticity, pale grey and orange-brown, with subangular ironstone gravel.			
			6		SPT 6.00-6.45 m 5,9,11 N=20							
			7									
			8									
			9		SPT 9.00-9.45 m 7,11,15 N=26							
			10								-	

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

BOREHOLE LOG

BH NO. BH3

Project	Proposed Residential Development	**Sheet**	2 of 2
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	09/12/2020
Position	Refer to Figure 2	**Date Completed**	09/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 09/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈33.50 m AHD
Drill Rig	Hanjin DB8	**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	-	GWNE	10					CH	Silty CLAY; high plasticity, pale grey and orange-brown, with subangular ironstone gravel.		-	RESIDUAL SOIL
			11									
			12									
			13									
			14	*14.50*								
									Hole Terminated at 14.50 m Target Depth Reached.			
			15									
			16									
			17									
			18									
			19									
			20									

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

BOREHOLE LOG

BH NO. BH4

Project	Proposed Residential Development	**Sheet**	1 of 1
Location	10-16 Pacific Drive, Port Macquarie NSW	**Date Started**	09/12/2020
Position	Refer to Figure 2	**Date Completed**	09/12/2020
Job No.	E24947.G03	**Logged By** KX	**Date** 09/12/2020
Client	Pacific Drive Pty Ltd	**Reviewed By** NJ	**Date** 21/12/2020

Drilling Contactor	Total Drilling	**Surface RL**	≈36.10 m AHD
Drill Rig	Hanjin DB8	**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	-	GWNE	0	36.10				-	FILL: Silty SAND; fine to medium grained, dark brown, trace rootlets	M	-	FILL
				0.30								
				35.80				CH	Silty CLAY; high plasticity, brown, with subangular igneous gravel.			RESIDUAL SOIL
			1								VSt	
					1.50-1.95 m SPT 1.50-1.95 m 12,14,16 N=30							
			2								H	
					3.00-3.23 m SPT 3.00-3.23 m 13,19/80mm HB							
			3									
			4									
			5							M (<PL)		
			6								-	
			7									
			8									
			9									
				9.50								
			10						Hole Terminated at 9.50 m Target Depth Reached.			

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

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 (%)

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

RQD = Rock Quality Designation (%)

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

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			

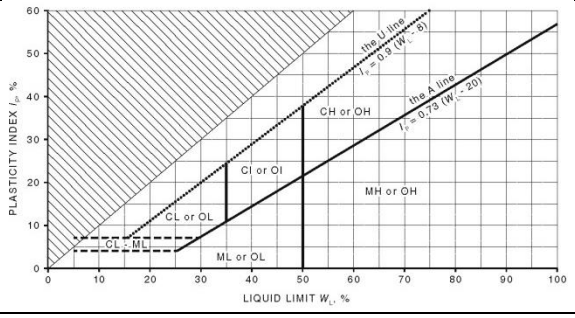
CLASSIFICATION AND INFERRED STRATIGRAPHY

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

Spacing/width (mm)	Descriptor	Symbol
<20	Extremely Close	EC
20-60	Very Close	VC
60-200	Close	C
200-600	Medium	M
600-2000	Wide	W
2000-6000	Very Wide	VW

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

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Kaiyu Xu
Client	EI AUSTRALIA
Address	SUITE 6.01 55 MILLER STREET PYRMONT NSW 2009
Telephone	61 2 9516 0722
Facsimile	(Not specified)
Email	kaiyu.xu@eiaustralia.com.au
Project	**E24947.G03 10-16 Pacific Dr,Port Macquar**
Order Number	**E24947.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	**SE214895 R0**
Date Received	11/12/2020
Date Reported	18/12/2020

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: 17/12/2020

PARAMETER	UOM	LOR	BH1M 10.5-10.95m SOIL - 8/12/20 11:30 SE214895.001	BH2M 6.0-6.45m SOIL - 8/12/20 15:30 SE214895.002	BH3 1.5-1.95m SOIL - 9/12/20 10:00 SE214895.003
Chloride	mg/kg	0.25	**69**	**26**	**12**
Sulfate	mg/kg	5	**41**	**170**	**50**

pH in soil (1:5) [AN101] Tested: 17/12/2020

PARAMETER	UOM	LOR	BH1M 10.5-10.95m SOIL - 8/12/20 11:30 SE214895.001	BH2M 6.0-6.45m SOIL - 8/12/20 15:30 SE214895.002	BH3 1.5-1.95m SOIL - 9/12/20 10:00 SE214895.003
pH	pH Units	0.1	**3.8**	**3.9**	**4.1**

Conductivity and TDS by Calculation - Soil [AN106] Tested: 17/12/2020

PARAMETER	UOM	LOR	BH1M 10.5-10.95m SOIL - 8/12/20 11:30 SE214895.001	BH2M 6.0-6.45m SOIL - 8/12/20 15:30 SE214895.002	BH3 1.5-1.95m SOIL - 9/12/20 10:00 SE214895.003
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	110	140	53

Moisture Content [AN002] Tested: 16/12/2020

PARAMETER	UOM	LOR	BH1M 10.5-10.95m SOIL - 8/12/20 11:30 SE214895.001	BH2M 6.0-6.45m SOIL - 8/12/20 15:30 SE214895.002	BH3 1.5-1.95m SOIL - 9/12/20 10:00 SE214895.003
% Moisture	%w/w	1	**19.9**	**25.2**	**23.7**

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.		
***	Indicates that both * and ** apply.				

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.

STS Geotechnics Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au

GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

Atterberg Limits and Linear Shrinkage Report

Project: E24947: 10-16 Pacific Drive, Port Macquarie — Project No.: 30951

Client: EI Australia Pty Ltd — Report No.: 20/4390

Address: Suite 6.01, 55 Miller Street, Pyrmont NSW 2009 — Report Date: 22/12/2020

Test Method: AS1289.3.1.2, 3.2.1, 3.1.1, 3.4.1, 2.1.1 — Page: 1 of 1

Sampling Procedure: Samples Supplied By Client (Not covered under NATA Scope of Accreditation)

STS / Sample No.	4718D-L/1	4718D-L/2				
Sample Location	Borehole 3	Borehole 4				
Material Description	Silty Clay, red brown grey, trace of gravel	Silty Gravelly Clay, red brown grey, trace of gravel				
Depth (m)	3.0-3.45	1.5-1.95				
Sample Date	9/12/2020	9/12/2020				
Sample History	Oven Dried	Oven Dried				
Method of Preparation	Dry Sieved	Dry Sieved				
Liquid Limit (%)	**72**	**59**				
Plastic Limit (%)	**28**	**26**				
Plasticity Index	**44**	**33**				
Linear Shrinkage (%)	**14**	**13**				
Mould Size (mm)	250	254				
Crumbing	N	N				
Curling	N	N				

Remarks:

NATA **Accredited for compliance with ISO/IEC 17025 - Testing**
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards
NATA Accreditation Number 2750

Approved Signatory.....

Technician: DH

Orlando Mendoza - Laboratory Manager

STS Geotechnics Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au

GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

Moisture Content of Soil and Aggregate Samples

Project: E24947: 10-16 Pacific Drive, Port Macquarie — Project No.: 30951

Client: EI Australia Pty Ltd — Report No.: 20/4390

Address: Suite 6.01, 55 Miller Street, Pyrmont NSW 2009 — Report Date: 22/12/2020

Test Method: AS1289.3.1.2, 3.2.1, 3.1.1, 3.4.1, 2.1.1 — Page: 1 of 1

Sampling Procedure: Samples Supplied By Client (Not covered under NATA Scope of Accreditation)

STS / Sample No.	4718D-L/1	4718D-L/2				
Sample Location	Borehole 3	Borehole 4				
Material Description	Silty Clay, red brown grey, trace of gravel	Silty Gravelly Clay, red brown grey, trace of gravel				
Depth (mm)	3.0-3.45	1.5-1.95				
Sample Date	9/12/2020	9/12/2020				
Moisture Content (%)	**22.6**	**13.2**				

Remarks:

NATA
Accredited for compliance with ISO/IEC 17025 - Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards
NATA Accreditation Number 2750

Approved Signatory.....

Technician: DH — Orlando Mendoza - Laboratory Manager

Appendix C – 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.