

Area 23 St Leonards Development SYDGE219558-GET-RPT-02

Geotechnical Assessment Report

30 August 2022



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Area 23: St Leonards Development

Prepared for Berry Road Development Pty Ltd

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1. Introduction

This report presents the results of a geotechnical investigation carried out for the proposed Area 23 St Leonards residential development in Sydney. The geotechnical investigation was commissioned by Berry Road Development Pty Ltd and was carried out in general accordance with Coffey fee proposal (Ref: SYDGE219558AA dated 14 June 2018). The objective of this investigation was to provide geotechnical information to support planning and design of the proposed development.

It is understood that the proposed development involves the construction of multi-unit residential buildings up to 13-storey high and residential amenities with underground car parking. At the time when this report was prepared the architectural design is still under development and with no firm details of the intended development.

2. Site Description

The site currently comprises 19 individual houses with several sheds, swimming pools and large trees within an area of 6,318 m² in the St Leonards South Precinct. The site is bounded by Berry Road to the West, River Road to the South, Park Road the East, houses to the north, with Berry Lane running north-south through the middle. The general topography of the site slopes south towards River Road, steepening into outcropping sandstone (approximately 5m high) at the southern end of Berry Road. Figure 1 illustrates the site locality and boundaries.

Figure 1: Site location plan



3. Desktop Study Information

3.1. Local Geology

Review of the 1:100,000 Sydney Geological Sheet indicates the site is situated near the boundary of:

- Ashfield Shale: Dark-grey to black claystone-siltstone and fine sandstone-siltstone laminite of the Wianamatta Group.
- Hawkesbury Sandstone: Medium to very coarse-grained quartz sandstone, very minor shale and laminite lenses. Typically bedded between 1 m and 3 m thickness; and

These units are typically separated by the Mittagong Formation comprising interbedded shale and sandstone of variable strength, generally less than 8m thick.

The Prospect/Parramatta River Acid Sulphate Soil Risk Map indicates that the site is in an area of no known occurrences of acid sulphate soils, consistent with the geology and site elevation.

3.2. Soil landscape and erodibility

The Sydney Soils Landscape Sheet indicates that the majority of site is within the Glenorie soil landscape with the southern boundary underlain by the Gymea soil landscape. Glenorie landscapes are characterised by undulating to rolling low hills on Wianamatta group shales. The soil horizons are typically friable to hardsetting topsoil, underlain by grey to brown, plastic clays with shale gravel. Clays within the lower horizons are typically moderately reactive, with potential for erodibility.

Gymea soil landscapes are characterised by undulating to rolling rises and low hills on benched Hawkesbury sandstone. Soil horizons below the topsoil are typically clayey sand, slightly reactive with very low erodibility, transitioning to moderately reactive, highly erodible clay.

3.3. Groundwater

Reference to the WaterNSW All Groundwater Map indicates there are no registered groundwater bores within 500 m of site. Groundwater is expected to follow regional topography, flowing south-east to Berry's Creek, towards Balls Head Bay and Sydney Harbour.

3.4. Local Coffey investigations

During an early stage of the project development, Coffey completed a geotechnical walkover of part of the site (48-54 River Rd, 47 Berry Rd and 42-50 Park Rd). The outcomes were reported in Coffey report GEOTLCOV25696AA-AC. The walkover identified sandstone outcropping in the southern portion of site at residences bounding River Road.

Coffey has conducted geotechnical investigations to the north of the Pacific Highway in this locality (about 20m higher in elevation). Those investigations have encountered ground conditions consistent with the geology, with deeply weathered Ashfield Shale over Hawkesbury Sandstone. These investigations encountered some groundwater seepage but were generally not sufficiently deep to encounter the permanent groundwater table.

3.5. Underground Services

Coffey completed a Dial Before You Dig (DBYD) request on 10/08/2018 (Attachment A) and received a response indicating the following authorities' own assets within the vicinity of the site:

- *Ausgrid*: Assets run along the site boundary with Berry Rd, as well as further west within Berry Road. Assets also run along River Rd to the south and appear to enter 50 River Road;
- *Jemena*: A 50 mm line runs along the Park Rd boundary of site and a 200 mm line runs along the Berry Rd and River Rd boundaries, with a connection entering 50 River Road. An additional 32 mm line runs parallel on the western side of Berry Rd;
- *NBN*: Fibre optic lines run along Berry, River and Park Roads on both sides of the roads, connecting to all properties;
- Sydney Water: Water mains run within Berry, River and Park Roads. A sewer main runs down Berry Lane, entering 38 Park Road from the west until about halfway within the property, continuing north into the abutting houses. At the intersection of Berry Lane and River Road, the sewer main heads East-North-East, traversing across 52 Park Road;
- *Telstra*: Utilities run along Park, River and Berry Roads on both side of the road, entering each property from the street. Minor connections are mapped from 40B to 40A and 48 to 46, Park Road and 43A to 43 Berry Road;
- *PIPE Networks*: A letter confirms that these utilities are within Telstra ducts and as such, a separate plan is not included.

No plans were available at the time of this report for services within the residential property bounds.

4. Fieldwork Summary

4.1. Ground Investigation

Prior to starting the intrusive investigation, Coffey cross-referenced the DBYD plans with the proposed boreholes, and engaged Geotrace Pty Ltd (Geotrace) to conduct service locating at every exploratory hole location.

Coffey commissioned Terratest Pty Ltd (Terratest) as the drilling subcontractor. The ground investigation was carried out between 20 and 24 August (Boreholes 4 to 9) and between 27 and 29 August 2018.

Each borehole was initially advanced using a hand auger to either 1.5 m below existing ground level (bgl) or refusal in case of unmapped or hard to detect underground services. After hand augering, Terratest utilised a track mounted drill rigs (Geoprobe 7822DT or Hinowa HP9503) drill rig with solid stem augers and tungsten-carbide (TC) drill bit to advance the borehole until encountering rock. Standard Penetration Tests were conducted in soils between 1.0 to 1.5 m bgl and every subsequent 1.5 m until refusal. When rock was encountered boreholes were continued by NMLC coring to target depth.

Upon reaching the target depth of 10.0 m bgl, monitoring wells were installed in boreholes BH 1, 3, 5, 7A and 9. Typically, 6 m of 50 mm slotted PVC with an end cap was installed from 10.0 m bgl to 4.0 m bgl with non-slotted PVC was installed to the surface. The wells were filled with well-graded sand to approximately 0.5 m above the top of the slotted PVC, topped by approximately 0.5 m of bentonite plug seal. The wells were finished with grout from the top of bentonite to the surface, with a roadbox cover installed flush with the existing ground level.

Boreholes BH 2, 4, 6, 7 and 8 were backfilled with soil cuttings and sand.

Refer to the Exploratory Hole Location plan in Appendix B for the locations of boreholes and groundwater monitoring wells.

4.2. Exploratory boreholes

Table 1 provides a summary of the geotechnical boreholes.

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Туре	Quantity	Maximum Depth (m)	Remarks	Groundwater monitoring standpipe	Rig Type
Rotary Core Drilling	10	10.48	BH1 (10.02m) BH2 (10.11m) BH3 (10.08m)	Yes (10m deep) No (backfilled) Yes (10m deep)	Hinowa HP9503
			BH4 (10.42m) BH5 (10.00m) BH6 (10.07m) BH7 (1.60m) BH7A (10.26m) BH8 (10.00m) BH9 (10.48m)	No (backfilled) Yes (10m deep) No (backfilled) No (backfilled/obstruction) Yes (10m deep) No (backfilled) Yes (10m deep)	Geoprobe 7822dt

Exploratory borehole logs are presented in Appendix B. These provide information including the methods used, samples taken, tests carried out and descriptions of the strata encountered.

4.3. Groundwater Monitoring

Details of the instrumentation installed in the exploratory holes for groundwater monitoring are shown with the relevant logs in Appendix B. Records of groundwater monitoring carried out by Coffey after the fieldwork period are presented in Appendix D.

5. Results of Investigation

5.1. Encountered Geology

The encountered subsurface ground profile at the site was consistent with the published and anticipated geology. A layer of varying thickness fill/topsoil overlying mainly residual soils derived from the underlying sandstone that increased in strength with depth.

5.2. Geotechnical Model

Using the subsurface information from the geotechnical investigation, the encountered ground conditions have been characterised into the geotechnical units presented in Table 2 below.

Table 2:	Summarv	of aeo	logical uni	ts encoun	tered
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Unit	Material	Description	Approximate Depth to Top of unit m bgl	Range of Unit Thickness (m)
1	Fill/Topsoil	Gravelly Clayey SAND / Clayey SAND / Sandy CLAY	0.0 (Ground level)	0.15 – 3.20
2	Residual soil	Silty/clayey/gravelly SAND / Sandy CLAY / CLAY	0.15	0.15 – 3.00
3а	Hawkesbury Sandstone	Class V Sandstone – mainly highly weathered	0.57 – 3.0	3.20 – 5.80
		Class IV Sandstone – moderately to slightly weathered	0.8 - 3.2	0.5 – 4.9
3b	Hawkesbury Sandstone	Class III Sandstone – Slightly (with some moderately) weathered	2.2 -6.2	Thickness not proven, but >3.4m
		Class II Sandstone – Slightly weathered to Fresh	4.5 – 9.6	Thickness not proven, but >4.1m

Notes:

- 1. The depths and unit thicknesses are based on the boreholes and may not represent the stratigraphy or the maximum or minimum depths and thicknesses of stratigraphic units across the entire site.
- 2. Rock classification is based on the system presented in "Foundations on Sandstone and Shale in the Sydney Region" Aust. Geomech. Jnl, Dec 1998, Pells et al (1998).

Interpreted Geological cross sections (refer to Figures 3, 4 and 5 in Appendix B) illustrate the varying thicknesses of the different geological units from north to south and east to west.

5.3. Groundwater Conditions

Groundwater monitoring standpipes were installed after drilling in boreholes BH1, BH3, BH5, BH7A and BH9. Details of the installations can be found in the engineering logs (refer to Appendix C).

Groundwater levels monitored during the intrusive investigation, however as water is used in the coring process, a more reliable method of obtaining a true groundwater level is to return to the site approximately one week later, once an equilibrium has been reached.

Groundwater levels were recorded on 4 September 2018 and are tabulated in Appendix D. These groundwater levels may not have stabilised, and a further round of groundwater monitoring is recommended.

5.4. Laboratory Test Results

Geotechnical laboratory testing of soil and rock samples were carried out in accordance with:

- AS 4133 Methods of Testing Rocks for Engineering Purposes
- AS 1289 Methods of Testing Soils for Engineering Purposes

Soil tests were conducted in NATA accredited laboratories of Coffey Testing and Eurofins | MGT and rock point load tests were carried out by Coffey Services in our Chatswood core storage facility. Results are summarised in Tables 3, 4 and 5.

Table 3: Soil Index test results

Sample ID		Moisture Content		Atterberg		
BH	Depth (m)	%	LL	PL	PI	LS
BH1	1.0 - 1.45	8.7	28	17	11	4.0
BH2	2.5 - 2.8	11.2	28	16	12	4.5
BH3	1.0 – 1.45	15.2	41	19	22	8.0
BH4	2.5 – 2.95	10.6	31	19	12	5.0

The results of Soil Aggressivity testing were assessed in accordance with Australian Standards AS3600-2018 Concrete Structures and AS2159-2009 Piling – "Design and Installation". Chemical test results indicated the following expected ground conditions for buried steel and concrete structural elements.

Table 4: Soil Aggressivity results

:	Sample ID	Moisture Content	Aggre	ssivity
BH	Depth (m)	%	Sulphates (SO4)	рН
BH4	1.0	17	<30	8.2
BH7	1.0	15	<30	8.7
BH8	0.8	18	46	8.5

Table 5: Laboratory test results - Rock Point Load tests

вн	Depth (m)	ls (50) MPA	BH	Depth (m)	ls (50) MPA	BH	Depth (m)	ls (50) MPA
BH1	1.83	0.06	BH2	9.04	1.48	BH4	5.76	1.39
BH1	2.36	0.13	BH2	10.00	1.57	BH4	5.90	0.97
BH1	3.42	0.53	BH3	2.27	0.17	BH4	6.22	1.42
BH1	4.49	0.68	BH3	3.17	0.27	BH4	6.44	0.70
BH1	5.33	0.57	BH3	4.72	0.33	BH4	7.30	0.90
BH1	6.44	0.21	BH3	5.50	0.75	BH4	8.24	0.33
BH1	7.42	0.82	BH3	6.63	0.48	BH4	9.44	1.46
BH1	8.48	0.64	BH3	7.70	1.29	BH4	10.31	2.06
BH1	9.47	0.53	BH3	8.21	0.90	BH5	1.90	0.11
BH2	3.18	0.27	BH3	9.63	0.86	BH5	2.75	1.20
BH2	4.26	1.66	BH3	10.00	0.99	BH5	3.90	0.93

BH2	5.39	2.65	BH4	3.06	0.93	BH5	4.91	1.04
BH2	5.69	0.62	BH4	3.45	0.89	BH5	5.12	0.94
BH2	7.00	1.13	BH4	4.00	1.03	BH5	5.38	1.04
BH2	8.00	1.44	BH4	4.76	1.34	BH5	6.10	1.39
BH5	6.30	1.10	BH6	9.45	0.72	BH8	6.32	1.42
BH5	7.10	1.10	BH6	10.00	1.53	BH8	7.32	0.87
BH5	7.62	0.74	BH7A	3.55	0.52	BH8	8.32	0.71
BH5	8.09	0.94	BH7A	4.60	0.62	BH8	9.30	1.09
BH5	8.89	1.30	BH7A	5.54	0.21	BH9	1.39	1.71
BH5	9.09	1.16	BH7A	6.58	1.14	BH9	2.02	0.45
BH5	9.20	1.13	BH7A	7.74	0.96	BH9	3.56	0.54
BH6	1.04	0.71	BH7A	8.00	1.02	BH9	4.43	0.77
BH6	2.07	0.28	BH7A	9.00	0.21	BH9	5.72	0.34
BH6	3.00	1.06	BH7A	10.00	0.60	BH9	6.55	0.26
BH6	4.13	0.75	BH8	1.65	0.76	BH9	7.27	0.75
BH6	5.13	0.59	BH8	2.36	0.70	BH9	8.24	0.58
BH6	6.45	0.86	BH8	2.49	1.30	BH9	9.00	1.23
BH6	7.45	0.80	BH8	3.13	1.16	BH9	10.00	0.92
BH6	8.44	0.38	BH8	5.00	1.13	BH8	6.32	1.42
BH5	7.62	0.74	BH6	9.45	0.72	BH8	7.32	0.87
BH5	8.09	0.94	BH6	10.00	1.53	BH8	8.32	0.71
BH5	8.89	1.30	BH7A	3.55	0.52	BH8	9.30	1.09
BH5	9.09	1.16	BH7A	4.60	0.62	BH9	1.39	1.71
BH5	9.20	1.13	BH7A	5.54	0.21	BH9	2.02	0.45
BH6	1.04	0.71	BH7A	6.58	1.14	BH9	3.56	0.54
BH6	2.07	0.28	BH7A	7.74	0.96	BH9	4.43	0.77
BH6	3.00	1.06	BH7A	8.00	1.02			

Point load tests were carried out at approximately 1m intervals in suitable rock core samples recovered from each of the boreholes. Tests were carried out by a suitably trained geotechnical engineer after all core samples had been transported to the Coffey storage facility in Chatswood. Axial test results have only been shown in Table 5, whereas both axial and diametrical are displayed on the engineering logs that can be found in Appendix B.

6. Geotechnical Discussion & Recommendations

6.1. Excavation

6.1.1. Excavatability

When this report was prepared, details of likely basement depths were not provided.

Excavation of Geotechnical Units 1, 2 and some 3a (mainly Class V Sandstone) should be able to be excavated using conventional earthmoving equipment such as a tracked excavator with toothed bucket or a tracked excavator. Light ripping may be necessary to assist where stronger rock bands occur. Where moderately weathered or better sandstone is present, hard rock excavation techniques such as large dozers fitted with rippers, or large excavators fitted with rock saws, rock grinders and rock hammers may be used. The use of hard rock excavation techniques will cause vibrations that could damage vibration sensitive structures, infrastructure and underground services. Assessment of the potential impacts of excavation induced vibrations should be considered as part of the detailed design and excavation planning.

6.1.2. Unsupported excavations

Batter slopes or bench excavation may be possible where excavations can be set back sufficiently from adjacent structures and roads. The batter slopes or benches should be scaled following excavation to remove all loose material which could slide or topple from the face during construction and hence pose a risk to construction personnel.

Table 5 below provides a summary of the recommended batter slopes for each geotechnical unit likely expected within the depth of excavation. It should be noted that the proposed batters in rock are subject to assessment by a geotechnical engineer during construction. If adverse joints or other defects are present, flatter batters or slope stabilisation may be required.

Table 6: Recommended batter slopes for unsupported excavations up to 3m deep Material	Maximum short-term ^{Note 1} batter slope	Maximum long-term batter slope
Fill	2H:1V	3H:1V
Residual Soil	1.5H:1V	2.5H:1V
Class V Sandstone	1H:1V	1.5H:1V
Class IV Sandstone	0.5H:1V	1H:1V
Class III Sandstone or better	Near vertical	0.5H:1V

Note 1: Up to 3 months maximum

6.1.3. Temporary excavation supports

Where unsupported, open excavations are impracticable, a shoring wall should be required during construction. Sheet pile walls are considered impractical for the proposed excavation due to the shallow depth of rock level.

Typically, in these geological conditions a drained basement would be constructed at this site. This could comprise either anchored soldier pile retaining walls with shotcrete infill or anchored contiguous pile retaining walls as excavation support depending on wall stiffness requirements. For preliminary design Coffey recommends the piles be drilled and socketed into rock below the bulk excavation (BE) level. Where it is important to minimise adjacent ground movements due to the presence of sensitive structures or services, internal bracing and/or tie-back anchors may also be required during construction.

Based on our experience, a slope batter for fill and natural soil steeper than 1V:1H during excavation is not recommended. As is recommended in the table above, class V sandstone can be formed in a 1H:1V slope batter during construction. However, if adverse joints or other defects are present, flatter batters or slope stabilisation (such as shotcrete) may be required. Subject to the assessment of actual site conditions by an experienced geotechnical engineer or geologist during excavation, a near vertical cut in class IV sandstone can be achieved with the possibility of geotechnical stabilisation.

Table 7 presents recommended design parameters for the design of the temporary retaining wall where there is a level retained ground surface. The K_0 values in Table 2 assume that some wall movement and relaxation of horizontal stress will occur due to the excavation. Actual in-situ K_0 values may be higher, particularly in the rock units. Retaining wall analyses will need to consider surcharges, footing loads from adjacent structures and hydrostatic pressure. These values should be reconsidered when the nature and depth of excavation is known.

Table 7: Recomm ended paramete rs for temporar y retaining wall designMa terial	Bulk Density γ (kN/m3)	Effective Cohesion c' (kPa)	Effective Friction Angle Φ' (degrees)	Coefficient of Active Earth pressure, Ka	Coefficient of Earth pressure at rest, Ko	Coefficient of Passive Earth pressure, Kp	Elastic modulus E _H (MPa)
Fill	19	0	25	0.4	0.50	2.5	10
Residual Soils	20	5	25	0.4	0.5	2.5	20
Class V Sandstone	22	10	30	0.3	0.5	3.5	40
Class IV Sandstone	23	30	35	0.27	0.5	3.7	100

Table 7: Preliminary parameters for site retention

Ground anchor design should be based on allowing effective anchorage to be developed by locating the bond length behind an 'active zone', determined by drawing a line at 45° from the base of the wall to intersect the ground surface behind the excavated face. The following ultimate bond stresses presented in Table 8 below can be adopted for ground anchor design with the provision that bond lengths are between 3 m to 5 m and anchors are to be proof loaded to at least 1.5 times their design working load.

Table 8 - Recommended bond stresses for ground anchor design

Unit / Material Description	Ultimate Bond Stress (kPa)
Class V sandstone	200
Class IV sandstone	500
Class III sandstone	800
Class II sandstone	1500

6.1.4. Excavation-induced ground movements

Excavation will cause some ground movements adjacent to the excavation site. The magnitude of the movements that will be experienced by a retaining wall will depend on various factors including the earth pressures that exist, groundwater conditions and construction sequence. Documented data has shown that for well-designed and constructed shoring, vertical and lateral movements can be about 0.1% to 0.3% of the retained height at the excavation face. Lateral ground movements can occur at distances up to twice the basement depth from the edge of excavations.

It shall be noted that the assessment of excavation-induced ground movements involves detailed soil structure interaction analysis. The accuracy of the assessment results plays an important role in determining the impact of the excavation on the adjacent structures and roads as well as evaluating the effectiveness of the proposed retaining wall. If this assessment is required, Coffey can provide the assessment (by numerical analyses) during the detailed design when more design information becomes available.

It is recommended that dilapidation surveys be carried out prior to the commencement of the excavation to assess the condition of the buildings within the zone of influence of the excavation. Potential risk of damage to buildings from ground movements during excavation should be considered during the development of the excavation methodology. Ground movements of the buildings should be monitored during excavation to reduce the risk of damage from excessive ground movements.

6.1.5. Groundwater control during excavation

Groundwater seepages in this geological setting typically occur at soil/rock interfaces, through joint swarms and in bedrock joints and partings. Bedrock seepage in sandstone bedrock could be assumed as typically flowing toward local drainage lines or the regional water table, along horizontal bedding planes and sub-vertical joints. Sandstone is not typically a highly permeable material; therefore, the rock mass permeability will be governed by joints, bedding planes, and other defects within the rock mass.

Groundwater levels recorded to date suggest basement excavation could encounter groundwater inflow. In this geology groundwater inflows into the basement can generally be controlled using conventional sump and pump techniques for discharge into stormwater or sewer systems networks, subject to regulatory approvals. For a drained basement, permanent floor and wall drainage will need to be maintained to dispose of groundwater inflows throughout the life of the structure. It is expected that such a drainage system would include a sub-floor drainage blanket with slotted drainage pipes and a sump and pump system with the ability to effectively back flush the system for long-term maintenance.

6.1.6. Excavation-induced vibrations

The use of excavation plant such as impact hammers will generate vibrations that may affect any surrounding sensitive structures and buried services. Measures to mitigate the risks associated with construction vibration such as the use of jack hammer and excavator during construction should be considered. It is recommended that vibration monitoring be undertaken on the existing structures and on the ground adjacent to the structures. The vibration limits in Table 8 are commonly recommended to reduce the risk of vibration damage to sensitive receptors.

Table 8: Recommended ground vibration limits for structures

Type of Structure	Peak Particle Velocity (mm/s)
Residential or low-rise buildings in good condition	10
Reinforced concrete commercial and industrial buildings in good condition	25

6.2. Foundations

It is understood that the foundations for the proposed development include both shallow and deep foundations.

Conventional bored piles or Continuous Flight Auger (CFA) piles are expected to be appropriate for the proposed development. Table 10 presents preliminary geotechnical parameters for pile design.

Table 9:Recommended design parameters for foundation design

Material	Ultimate End Bearing Value (MPa)	Ultimate Shaft Adhesion (kPa)	Vertical Elastic Modulus Ev (MPa)
Class V Sandstone	3	150	80
Class IV Sandstone	8	400	400
Class III Sandstone	30	1000	750
Class II Sandstone	60	1500	1000

Notes:

- a) Assumes a minimum embedment depth of at least 0.5 m into the relevant bearing stratum or one pile dimeter, whichever is deeper.
- b) Shaft adhesion assumes a rough socket (at least grooves of depth 1 mm to 4 mm and width greater than 5 mm at spacing of 50 mm to 200 mm)
- c) Foundation unit extends to a depth of at least 5 times of pile diameter below pile toe.

A geotechnical strength reduction factor (Φ_g) of 0.5 can be adopted in limit state design of pad or strip footings. The recommended ultimate bearing pressures are contingent upon successful 'spoon testing' in drilled holes to a minimum depth of 1.5 times the footing width.

For limit state design of piles, the design ultimate geotechnical pile capacity is derived by applying a geotechnical strength reduction factor (Φ_g) to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 9. In accordance with AS2159-2009, Φ_g is dependent on an Average Risk Rating (ARR) which considers various geotechnical uncertainties, foundation system redundancy, construction supervision, quantity and type of pile testing. To assist you with preliminary design we suggest Φ_g of 0.5 could be adopted assuming some pile testing will be specified.

The use of limit state design also requires assessment of the serviceability performance of the foundation system, including pile group interaction effects. This should be carried out by an experienced geotechnical professional using well-established and soundly based methods. The elastic modulus value given in Table 10 may be adopted but it should be noted that the accuracy of settlement prediction is dependent on construction methods as well as material stiffness, both of which can involve degree of uncertainty.

6.3. Soil Aggressivity

Based on laboratory test results summarised in Table 4, the soil has an exposure classification of *'Mild'* and *'Non-aggressive'* as according to AS2159-2009 for concrete and steel.

6.4. Earthworks

6.4.1. Subgrade preparation

Prior to the construction of subgrade layers by engineered fill, the pavement layer and the underlying fill should be removed and stockpiled separately for appropriate reuse. The exposed material should be proof rolled with at least four passes of a non-vibratory smooth drum roller of minimum 12 tonne dead weight. Any soft or heaving areas should be excavated and replaced with engineered fill.

It is expected that trafficability in silty and clayey materials for wheeled vehicles can be difficult during and following rainfall due to surface heaving and / or rutting.

6.4.2. Engineered Fill compaction

For bulk earthworks using modern purpose-built earthmoving plant, fill material should be placed in layers not exceeding 300mm loose thickness and moisture conditioned to Standard Optimum Moisture Content (SOMC) \pm 2%.

All engineered fill should be compacted to achieve a minimum dry density ratio of 98% SMDD (Standard Maximum Dry Density and moisture conditioned to SOMC ± 2% at the time of compaction.

Earthworks construction should be constructed under Level 1 geotechnical inspection and testing as defined in AS3798-2007.

6.4.3. Re-use of material

The following comments are made regarding the suitability of site soils for re-use in areas requiring filling:

- Where excavation or site regrade is proposed, all existing asphalt, topsoil, fill, vegetation or other
 potentially deleterious material should be removed to spoil or stockpiled for re-use as landscaping
 material only.
- If existing fill encountered, it should be carefully stripped and if suitable stockpiled for re-use as general site fill, or replacement subgrade for proposed pavement areas;
- The underlying natural soils should be carefully stripped as necessary and stockpiled for re-use as general site fill.

7. Limitations

Subsurface conditions can be complex and may vary over relatively short distances – and over time. The inferred geotechnical model and recommendations in this report are based on limited subsurface investigations at discrete locations. The engineering logs describe subsurface conditions only at the investigation locations. Further investigations may be required to support detailed design if there are scope limitations or changes to the nature of the project. We can assist with detailed design and/or to review designs and verify that the conditions exposed are consistent with design assumptions during construction.

The attached document entitled "Important information about your Coffey report" forms an integral part of this report and presents additional information about its uses and limitations.

Appendix A – Desktop Study Information

- WaterNSW All Groundwater Map
- DBYD Plans





Coffey Services Australia Pty Ltd ABN 55 139 460 521



Job No 14735001

Platinum Sponsor:

DIAL BEFOR YOU DIG

www.1100.com.

The Essential First Step

Caller Details

Contact:	Mr Aidan McKenzie
Company:	Coffey
Address:	Level 18 799 Pacific Highway
	Chatswood NSW 2067

Caller Id: 1728091 Phone: 0294061217 Mobile: 0419490698 Fax: Not Supplied Email: aidan.mckenzie@coffey.com

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.



Your Responsibilities and Duty of Care

• If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.

• ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.

• Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.

• Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.

• If you damage an underground asset you MUST advise the asset owner immediately.

• By using this service, you agree to Privacy Policy and the terms and disclaimers set out at www.1100.com.au

• For more information on safe excavation practices, visit www.1100.com.au

Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days.

Additional time should be allowed for information issued by post. It is your responsibility to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, so it is your **responsibility** to identify and contact any asset owners not listed here directly. ****** Asset owners highlighted by asterisks ****** require that you visit their offices to collect plans.

Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
74378144	Ausgrid	0249510899	NOTIFIED
74378146	Jemena Gas North	1300880906	NOTIFIED
74378148	NBN Co, NswAct	1800626762	NOTIFIED
74378143	PIPE Networks, Nsw	1800201100	NOTIFIED
74378147	Sydney Water	132092	NOTIFIED
74378145	Telstra NSW, Central	1800653935	NOTIFIED

GOLD COAST CONVENTION &

EXHIBITION CENTRE

Queensland, Australia

August 20-23, 2018

END OF UTILITIES LIST





A3 MOCS_std_plot





Indicative Plans

Issue Date:	10/08/2018	DIAL BEFORE
Location:	Berry Road,St Leonards,NSW-2065	YOU DIG www.1100.com.au

	1		
W E	Type: Telco Technology: Coaxial/Fibre Assets IN-SERVICE: Cable/ Duct/Trench DesigneD/constructed: Cable/ Duct/Trench	Pit/Manhole	$_0$ S $_{20}$ a $_{40}$ $_{60}$ Meters 1:2000 1 cm equals 20 m





Emergency Contacts

You must immediately report any damage to **nbn**[™] network that you are/become aware of. Notification may be by telephone - 1800 626 329.





Telstra	For all Telstra DBYD plan enquiries - email - Telstra.Plans@team.telstra.com For urgent onsite contact only - ph 1800 653 935 (bus hrs)	Sequence Number: 74378145	
		CAUTION: Fibre optic and/ or major network present	
TELSTRA CORPORATION LIMITED A.C.N. 051 775 556		in plot area. Flease read the Duty of Care and	
Generated On 10/08/2018 20:16:51		any assistance.	

The above plan must be viewed in conjunction with the Mains Cable Plan on the following page

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.



Telstro	For all Telstra DBYD plan enquiries -	Sequence Number: 74378145
	For urgent onsite contact only - ph 1800 653 935 (bus hrs)	CAUTION: Fibre optic and/ or major network present
TELSTR	A CORPORATION LIMITED A.C.N. 051 775 556	approximate and the services about you require
G	enerated On 10/08/2018 20:16:54	any assistance.

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.

Appendix B – Figures

- Figure 1: Published Geological Map
- Figure 2: Exploratory Hole Location Plan
- Figures 3, 4 and 5: Geological Cross Sections







COUNTRY GAR	DEN AUSTRALIA	
ST LEONARDS DEVELOPMENT ST LEONARDS, NSW		
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^{D:} 754-SYDGE219558	figure no: FIGURE 3	^{rev:} A
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	SECTIO	N B-B'		
^{no:} 754-SYDGE21	9558	figure no:	FIGURE 4	^{rev:} A

NORTH

SITE



COUNTRY GAR	DEN AUSTRALIA	
ST LEONARDS ST LEONA	DEVELOPMENT RDS, NSW	
SECTIO	ON C-C'	
^{0:} 754-SYDGE219558	figure no: FIGURE 5	ev: A

Appendix C – Borehole Logs and Core Photographs



ATETR	A TECH	COMF	PANY						•	Boreł	nole ID.	RH1		
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Engineering Log - Borehole											ct no.	754-SYDGE219558		
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locat	tion:	St	Leonar	ds, I		check	ked by:	AB						
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client: Country Garden Australia Pty Ltd									date started: 28 Aug 2018		28 Aug 2018		
principal: date complete										mpleted:	leted: 28 Aug 2018		
project: St Leonards Development										logged	ogged by: AM		
location: St Leonards, NSW										checked	d by:	AB	
position: E: 332,593.14; N: 6,255,592.88 (MGA94) surface elevation: 66.20 m (AHD) angle from horizontal: 90°									ontal: 90°				
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drilling information material substance rock ma									mass defe	cts			
	material description								defect additional observations and				

					ß	material description		න estimated ල strength		samples, field tests		defect spacing	additional observations and defect descriptions	
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		-	-60							a=0.21 d=0.20	88%		P1, 8°, RO, CN PT, 2°, PL, RO, CN PT, 8°, PL, RO, CN JT, 6°, RO, CN JT, 13°, PL, RO, CN	-
		-	-59			SANDSTONE: fine to coarse grai orange-brown to pale grey, (Clas	ned, s III).			a=0.85 d=0.69	76%		JT, 10°, RO, Fe SN JT, 20°, RO, CN JT, 4°, RO, CN	-
H A A A C W R N H H	method & support AS auger screwing AD auger drilling CB claw or blade bit W washbore RR rock roller NMLCNMLC core (51.9 mm) NQ wireline core (47.6mm) HQ wireline core (85.0mm) PQ wireline core (85.0mm) HA hand auger			ort ewing ling ade bit re (51.9 ore (51.9 ore (63. ore (63. ore (85.	mm) 6mm) 5mm) 0mm)	support C casing M mud N none water In/10/12, water level on date shown water inflow complete driling fluid loss partial drilling fluid loss partial drilling fluid loss water pressure test result (lugeons) for depth interval shown	graphic log / core core rec (graphic sym no core core run & RQD barrel wi RQD = Rock Qu	e recove overed holos indicate recovere ithdrawn ality Des	ry material) ed ignation (%)	weathering RS residu XW extren HW highly MW moder SW slightly FR fresh VL very lov L low M mediun H high VH very hig EH extrem	& alter al soil hely weathe ately we y weathe ith A for a w n gh ely high	attion* athered red aathered ered alteration	defect type PT parting JT joint SS shear surface SZ shear surface SZ shear zone CO contact CS crushed seam SM seam roughness VR very rough RO rough SO smooth POL polished	planarity PL planar CU curved UN undulating ST stepped IR Irregular coating CN clean SN stained VN veneer CO coating


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BH1 6.00 - 10.02 m

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approved	AB		project:	St Leonards	Develop	ment	
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:	method & support	1 2 penetrati	water	samples & field tests	RL (m)	depth (m)	graphic loç	soil group symbol	SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency relative den	penetro- meter (kPa) କୁ ରୁ ରୁ ରୁ	additional observations
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				E SPT	-	1.0-			FILL: Sandy CLAY: fine to medium grained, low	>Wp			
				1, 1, 2 N*=3		-		CI	CLAY: medium plasticity, orange-brown, trace		St		ALLUVIUM?
					-63	-	$\langle / / /$		medium graineo sano.				
						-		CL	Sandy CLAY: medium to coarse grained, low plasticity, orange-brown mottled dark grey.				RESIDUAL SOIL
						2.0-					_,,_		
9:02				SDT	62	-							
)/2018 (11, 8, /0mm	_	-							Discontinued for fear of equipment - becoming unrecoverable.
 12/10 	• •		⊠	<u></u> /	+	3.0-	<i>\////</i>		Borehole BH2 continued as cored hole				
ngFile>:						-							
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GPJ <					_	-							
219558						4.0-]
SYDGE					-60	-							
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SEHOLI					-59	-	-						
OFBO					L	60-	1						
Log C							-						
rev:AU					-58	-	1						
3Y.GLB						-	-]
LIBRAF					-	7.0-	1						-
6 01					-57	-							
CDF_0					57	-	1						
Ļ				<u> </u>	┢──		1						<u> </u>
	method support AD auger drilling* M mud N nil AS auger screwing* C, casing							nil	samples & field tests s B bulk disturbed sample	soil grou soil de	ip symbo	n	Consistency / relative density VS very soft
	HA W	IS auger screwing* C casing IA hand auger V washbore penetration							D disturbed sample ba E environmental sample	ased on <i>i</i>	AS 1726:	2017	F firm
	HA	hand a	auger				no res	sistance ig to	U## undisturbed sample ##mm diameter mois HP hand penetrometer (kPa) D	ture cor dry	ndition		VSt very stiff H hard
	*	bit sho	own bv	suffix	wat	er	Oct-12 w	ıl ater	N standard penetration test (SPT) M N* SPT - sample recovered W	moist wet	mit		Fb friable VL very loose
	e.g. B	AD/T blank	bit			lev wa	el on date ter inflow	shown	Nc SPT with solid cone Wp VS vane shear; peak/remouded (kPa) WI R refixed	piastic li liquid lin	nit		L loose MD medium dense
	T V	TC bit V bit				-d wat	ter outflow	v	HB hammer bouncing				VD very dense



A TETRA TECH	I COMPANY	Borehole ID.	BH2
Enai	incoring Log Cored Porcholo	sheet:	2 of 3
Engi	ineering Log - Cored Borenole	project no.	754-SYDGE219558
client:	Country Garden Australia Pty Ltd	date started:	27 Jan 1900
principal:		date completed:	27 Jan 1900
project:	St Leonards Development	logged by:	АМ
location:	St Leonards, NSW	checked by:	AB
position: E:	: 332,633.74; N: 6,255,580.28 (MGA94) surface elevation: 64.47 m (AHD)	angle from horizontal: 90°	

d	rill n	node	el: Hino	owa HF	P9503,	Track mounted dri	lling fluid: Water				hole	diameter : '	125 mm	
C	Irilli	ng iı	nform	ation	mate	erial substance					rock	mass defe	cts	
method &	support	water	RL (m)	depth (m)	graphic log	material descriptio ROCK TYPE: grain charac colour, structure, minor con	n cterisics, nponents	weathering & alteration	estimated strength & Is50 X = axial; O = diametral	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm)	additional obs defect de (type, inclination, planar thicknes particular	ervations and scriptions ity, roughness, coating, s, other) general
			-64	- - - 1.0 —							-			
			-63	- - - 2.0 —										_
2018 09:03			-62	- - -30		started coring at 3.00m								
 UrawingFile>> 12/10/. 			-61			SANDSTONE: fine to medium gr orange-brown to pale grey, (Clas	ained, is V).	HW		a=0.27 d=0.10	42%		 JT, 10°, CU, RO, CN JT, 10°, ST, RO, CN JT, 7°, UN, RO, CN SM, Clay, 37 mm SM, Clay, 32 mm PT, 3°, PL. RO, Fe SI 	N
04-51 UGEZ 19998.GPJ <			-60	4.0 — - - -						a=1.63 d=0.81	070/		SM, Clay, 24 mm JT, 6°, PL, RO, CN JT, 5°°, PL, RO, CN SM, Sandy clay, 340 JT, 81°, UN, RO, CN PT, 3°, ST, RO, CN PT, 3°, ST, RO, CN	- mm
			-59	5.0 — - -		5.14 to 5.33 m: Shale laminae SANDSTONE : fine to coarse gra to pale grey, indistinctly bedded a	ined, dark grey at 5°-15° (Class	MW		a=2.56 d=1.29 a=0.61			→ SM, Clay, 42 mm → JT, 10°, PL, RO, Fe C → JT, 4°, UN, RO, CN	-
GEB LEV. AU LOG CUF BU			-58	6.0 — - -		6.00 to 6.50 m: Dark grey, fine grey and stone SANDSTONE: fine to coarse gragrey, distinctly bedded at 0°-25°	rained ined, pale (Class II).	SW FR		d=0.25	100%			-
CDF_0_9_0/_LIBRAR			-57	7.0 — - - -						a=1.15 d=1.15	100%		JT, 8°, UN, RO, CN	-
	met AS AD CB W RR NML NQ HQ PQ HA	hod a au cla va roc CNN wir wir wir wir	Supp ger scr ger dril wor bl shbore ck rolle ALC co reline c reline c reline c	ort ewing ling ade bit r re (51.9 ore (47. ore (63. ore (45. ore (85. ore (85.	9 mm) 6 mm) 5 mm) 0 mm)	support C casing M mud N none water I0/10/12, water level on date shown water inflow complete drilling fluid loss partial drilling fluid loss	graphic log / cor core red (graphic syn no core core run & RQD barrel w	re recover covered mbols indicate recover vithdrawn	e material)	weathering RS residu XW extren HW highly MW moder SW slightly FR fresh *W replaced strength VL very lov L low M medium H hinh	& altera al soil hely wea weather ately we weather weather w	ation* atiened red aathered ered ilteration	defect type PT parting JT joint SS shear surface SZ shear surface CO contact CS crushed seam SM seam roughness VR very rough RO rough	planarity PL planar CU curved UN undulating ST stepped IR Irregular coating CN clean SN stained
	-					(lugeons) for depth interval shown	RQD = Rock Qu	ality Des	signation (%)	VH very hig EH extrem	gh ely high		SO smooth POL polished SL slickensided	VN veneer CO coating



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	ΙĆ	JIII	ee	rm	g Log - Cored Borer	101	9			project i	no.	754-SYDGE219558
clier	nt:	C	Coun	try G	arden Australia Pty Ltd					date sta	irted:	27 Jan 1900
prine	cipa	I:								date co	mpleted:	27 Jan 1900
proje	ect:	S	St Le	onar	ds Development					logged l	by:	AM
loca	tion	: S	St Le	onar	ds, NSW					checked	d by:	AB
positi	ion:	E: 33	2,633.7	74; N: 6	,255,580.28 (MGA94) surface elevation: 64	4.47 m ((AHD)		angle	e from horiz	ontal: 90°	
drill n	node	el: Hino	owa HF	P9503,	Track mounted drilling fluid: Water				hole	diameter : 1	125 mm	
drilli	ng i	nform	ation	mate	rial substance				rock	mass defe	cts	
method & support	water	RL (m)	depth (m)	graphic log	material description ROCK TYPE: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral ⊃ ↓ ↓ ∐	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm)	ac (type, inclina particular	dditional observations and defect descriptions ation, planarity, roughness, coating, thickness, other) general
- NMLC		-56	- - - 9.0		SANDSTONE: fine to coarse grained, pale grey, distinctly bedded at 0°-25° (Class II). (continued)	FR		a=1.40 d=0.89 a=1.51 d=1.03	100%		— PT, 22°, (CU, RO, CN

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100% 11 111 -55 11 ii 111 10.0 a=1.58 d=1.06 Borehole BH2 terminated at 10.11 m Target depth 1111 ||||||||-54 1111 |||||||||||||||||||||||||| | | | | |11111 |||||||11.0 1111 | | | | | |1111 ||||||iiii | | | | | |-53 1111 |||||||1111 ||||||||1111 12.0 ||||||11111 |||||||||||||||||||-52 ||||||||||||||||||||||||||||||||11111 |||||||13.0 ||||||||||||||||||||||||||1111 |||||||-51 iiii 11111 |||||||+ + + + + + +1111 14.0 ||||||| | | | | |1111 ++++|||||||||||||-50 1111 |||||||| | | | | |11111 ||||||1111 ||||||15.0 11111 | | | | | ||||||||||||||11111 ||||||-49 11111 ||||||1111 ||||||İİİİİ |||||||planarity PL planar CU curved UN undulating ST stepped weathering & alteration* RS residual soil XW extremely weathered HW highly weathered MW moderately weathered SW slightly weathered FR fresh *W replaced with A for alteration strength VL very low L low weathering & alteration defect type method & support graphic log / core recovery PT parting JT joint SS shear sL SZ shear zC CO contact CS crushed SM seam support parting joint shear surface auger screwing auger drilling claw or blade bit AS C casing M mud N none AD CB W core recovered water ST stepped IR Irregular 10/10/12, water (graphic symbols indicate material) shear zone washbore rock roller CNMLC core (51.9 mm) T RR NML level on date shown crushed seam seam no core recovered water inflow wireline core (47.6mm) wireline core (63.5mm) wireline core (85.0mm) NQ complete drilling fluid loss very low low medium HQ PQ core run & RQD coating CN clean SN stained VN veneer CO coating partial drilling fluid loss roughness VR very rough RO rough SO smooth POL polished SL slickensided м Н barrel withdrawn HA hand auger water pressure test result (lugeons) for depth interval shown high 25uL RQD = Rock Quality Designation (%) VH very high EH extremely high







Biologic 101 103 257 Aug 2018 Inter: Country Garden Australia Pty Ltd date states: 27 Aug 2018 Inter: Silonards Development date states: 27 Aug 2018 Inter: Silonards Development kogod hor. AM Inter: Silonards Development date states: Interesting Horizonards (NS) Inter: Silonards Development date states: Interesting Horizonards (NS) Inter: Silonards Development date states: Interesting Horizonards (NS) Interesting Horizonards (NS) Marge Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Total Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonards (NS) Interesting Horizonar	ATET	RA TECH	COMF	PANY						·	Boreł	nole I	D.	BH3
Cited: Country Garden Australia Ply Ltd date standed 274 AUX 2018 principal: date standed 27 Aug 2018 principal: bigged by: AM tocation: St Leonards Development logged by: AM tocation: St Leonards NSW checked by: AB tocation: St Leonards New control difficial diff	E.	nai	n 0	orin	~		2	Da	robolo		sheet	:		1 of 3
teim: Country Garden Australia PPy Ltd principa: Calcenards Development to calcenards Development t		ngi	ne	enn	<u>g</u> ı	<u> </u>	<u>y -</u>	DU	renoie		proje	ct no.		754-SYDGE219558
pricipal: de condition de la d	clie	nt:	Со	untry G	Gard	en A	ustra	alia P	Pty Ltd		date s	starte	ed:	27 Aug 2018
program St. Lonards. Development bogs by AM torm st. Lonards. NEW c.e. and y AB Station 1: St. St. N. 226.07.81 (MRM) and the elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 69 (27 m (AH)) bit of elevation. 60 (27 m (AH)) bit of elevatio	prin	cipal:									date o	comp	leteo	d: 27 Aug 2018
bozie St. Londred, MSM posterie 1322.693.59, N. 24.253.57.14 (MAR4) infinitional characterization of the standard stan	proj	ect:	St	Leonar	ds E)evel	lopm	ent			logge	d by:		AM
Provider E: 332.603.81 N: 6.256.579 14 (MAR4) surface develop: 6620 m (AHD) angle from horizontal: 00° Infilme information diffing hief. Water bel sameter: 129 nm Infilme information Track mounted filme information Infilme information Track mounted filme information Infilme information Filme information Structure and structure an	loca	ation:	St	Leonar	ds, l	NSW	/				check	ked b	v:	AB
Net Hones IP 5003, Task muund inding fluid. Water Net diameter : 125 mm. Territoria material substance Territoria Statustic indication Territ	posit	tion: E:	332,6	63.83; N: 6	,255,5	79.14	(MGA9	4)	surface elevation: 66.20 m (AHD)	angle	from ho	orizont	tal: 9	0°
difficult number of automation number of automation method automation	drill r	model: H	linowa	a HP9503,	Track	mount	ted	,	drilling fluid: Water	hole d	liametei	: 125	5 mm	
organ matrix organ matrix organ matrix organ matrix	dril	ling info	ormati	ion			mate	erial sub	bstance					
Solit Solit <th< td=""><td>∞</td><td>ration</td><td></td><td>samples &</td><td></td><td>Ê</td><td>boj</td><td><u>e</u></td><td>material description</td><td>e ⊆</td><td>ncy / tensity</td><td>han pene</td><td>nd tro-</td><td>structure and additional observations</td></th<>	∞	ration		samples &		Ê	boj	<u>e</u>	material description	e ⊆	ncy / tensity	han pene	nd tro-	structure and additional observations
Plu: Plu: Plu: Plu: Plu: Plu: 10 </td <td>method support</td> <td>1 2 peneti</td> <td>water</td> <td>field tests</td> <td>RL (m)</td> <td>depth (r</td> <td>graphic</td> <td>soil grou symbol</td> <td>SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components</td> <td>moistur conditio</td> <td>consister relative c</td> <td>met (kPa ୁ ଛୁ ଛୁ</td> <td>er a) 000 000</td> <td></td>	method support	1 2 peneti	water	field tests	RL (m)	depth (r	graphic	soil grou symbol	SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	moistur conditio	consister relative c	met (kPa ୁ ଛୁ ଛୁ	er a) 000 000	
Image: series of a seri	HA –			E	-66	-			FILL: SILTY SAND: dark brown.	D				FILL -
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method	— AD			3,S67,113 N=€19	-65	-	V///						i i l	-
Image: State in the state]	-	$\langle / / /$					lii.		-
method -64 -	+		8			-	<i>[]]]]</i>		Develope DI 10 e estimat de constituent					
Notes All and ager of integration of the standard period based on SA 1728 2017 So of the standard period based on SA 1728 2017 Notes So of the standard period based					-64	2.0-	1		Borenole BH3 continued as cored hole					-
Abroad - </td <td>:02</td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td>	:02					-	-							-
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Note: 0 -61 -61 -60 - <t< td=""><td>CORE</td><td></td><td></td><td></td><td></td><td>5.0-</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td></t<>	CORE					5.0-	1							-
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method support samples & field tests soil group symbol & consistency / relative density Model 1111 1111 1111 1111 1111 1111 Model auger drilling* Support samples & field tests soil group symbol & consistency / relative density Model Minud N nil B buik disturbed sample soil group symbol & very soft AD auger drilling* Minud N nil B buik disturbed sample soil description based on AS 1726:2017 S soft HA hand auger firm standard penetration test (SPT) N'' SPT - sample recovered N'' SPT - sample recovered N'' N'' SPT - sample recovered N'' N'''''''''''''''''''''''''''''''''	WARY.C					70-	1							-
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method AD auger drilling* AS support auger drilling* AS support mud samples & field tests soil group symbol & soil description based on AS 1726:2017 consistency / relative density HA hand auger M mud N nil C casing B bulk disturbed sample based on AS 1726:2017 S soil description based on AS 1726:2017 * bit shown by suffix e.g. moresistance ranging to water no resistance ranging to water no resistance ranging to water N standard penetration test (SPT) N* M moist VS very soft S S soft S point * bit shown by suffix e.g. AD/T Image: Not the shown water inflow N standard penetration test (SPT) water inflow N* SPT with solid cone VS Value Wethout Value	G				-	-	1					i i		-
method AD suger drilling* auger screwing* HA support auger screwing* HA support have data auger samples & field tests soil group symbol & soil description consistency / relative density W washbore HA hand auger M N nil B bulk disturbed sample b soil description VS very soft W washbore HA hand auger penetration S system S soft F firm v washbore HA hand auger penetration S system S soft S soft v water ranging to ranging to e.g. AD/T no resistance resistance ranging to elvel on date shown water inflow N standard penetration test (SPT) N* N M moist S very life T T TC bit In-O-Crl 2 water N' SPT - sample recovered NC N' Wet VL very loose V VS vane shear; peak/remouded (kPa) R R refusal MD medium dense D dense VD very very dense VD very very dense									<u> </u>					-
As auger survey light C casing D disturbed sample based on AS 1726:2017 S soft HA hand auger washbore penetration S split spoon sample S split spoon sample S stiff S stiff HA hand auger moresistance ranging to no resistance ranging to N standard penetrometer (kPa) N moisture condition VSt very stiff * bit shown by suffix water if 0-Oct-12 water N SPT - sample recovered W W wet VL very light B blank bit if 0-W N standard penetration test (SPT) M MD medium dense V V bit water inflow water outflow NS vare shear; peak/remouded (kPa) Will liquid limit MD medium dense V V bit Water outflow HB hammer bouncing VD verv dense	AD	hod auger	drilling	*	sup M	port mud	N	nil	samples & field tests B bulk disturbed sample	soil grou soil de	p symbo	n n		consistency / relative density VS very soft
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A TETRA TECH	H COI	MPANY				Borehol	e ID.	BH3				
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Engi	Engineering Log - Cored Borenole											754-SYDGE219558
client:	С	oun	try G	Garden Australia P	ty Ltd					date sta	rted:	27 Aug 2018
principal:										date cor	mpleted:	27 Aug 2018
project:	S	t Le	onar	ds Development						logged l	oy:	AM
location:	S	t Le	onar	ds, NSW						checked	l by:	AB
position: E:	: 332	2,663.8	3; N: 6	,255,579.14 (MGA94)	surface elevation: 66	6.20 m (AHD)		angle	e from horiz	ontal: 90°	
drill model:	rill model: Hinowa HP9503, Track mounted drilling fluid: Water ho									diameter : 1	25 mm	
drilling information material substance room										rock mass defects		
od € € Color								un DD	defect spacing (mm)	ad (type, inclin	dditional observations and defect descriptions ation, planarity, roughness, coating, thickness, other)	

	method & support	water	RL (m)	depth (m)	graphic lo	Colour, structure, minor comp	terisics, iponents	weatherir alteration	& Is50 X = axial; O = diametra	& Is(50) (MPa) a = axial; d = diametral	core run & RQD	(mm) s e g g e g	(type, inclination, planarity thickness, particular	, roughness, coating, other) general
ľ			-66	_										-
			-65	- - 1.0 - - -		started coring at 1 90m								 - - - - - - - - -
	1			2.0 —	· · · · ·	SANDSTONE: medium grained, i pale grey, (Class V).	red-brown to	HW				╒╤┫┆┆┆	HAWKESBURY SANDS	TONE -
>> 12/10/2018 09:03			-64 -							a=0.16 d=0.12 a=0.27 d=0.24	85%		→ JT, 66°, CU, RO, CN JT, 64°, CU, RO, CN JT, 70°, CU, RO, CN → PT, 5°, PL, RO, CN → SM, Clay, 200 mm → SM, Clay, 8 mm → PT, 15°, PL, RO, CN	- - - - -
EHOLE: CORED 754-SYDGE219558.GPJ < <drawingfile>></drawingfile>		04/09/18	-62	- - 4.0 — -									- SM, Clay, 10 mm	- - - -
	NMLC		-61	- - 5.0 — - -		5.26 to 5.43 m: distinctly laminate	ed shale lens			a=0.32 d=0.32	77%		 SM, Clay, 16 mm SM, Sandy clay, 30 mm PT, 7°, UN, RO, Fe SN SM, Clay, 17 mm JT, 25°, CU, RO, CN JT, 16°, CU, RO, CN SM, Clay, 33 mm SM, Clay, 17 mm 	- - - - -
ARY.GLB rev:AU Log COF BORI			-60	6.0		SANDSTONE: fine to medium gragrey, distinctly cross bedded at 5 III). 6.61 to 6.91 m: fine sandstone in grey	ained, pale -15° (Class II to terbedding, dark	FR MW FR		a=0.48 d=0.06	100% 82%		PT, 11°, PL, RO, CN 	- - - - - -
CDF_0_9_07_LIBF			-59	-						a=1.32 d=0.38	100% 86%		PT, 18°, CU, RO, VN SM, Clay, 4 mm 	- - - -
	Me AS AD CB W RR NQ HQ PQ HA	thod & aug cla va roc LCNM wir wir wir har	supp ger sci ger dri w or b shbore k rolle ALC cc eline c eline c eline c aline c	port rewing llade bit r rore (51.9 core (63. core (63. core (85.)	mm) 6mm) 5mm) 0mm)	support C casing M mud N none water 10/10/12, water level on date shown water inflow complete drilling fluid loss partial drilling fluid loss partial drilling fluid loss	core rec (graphic syn no core core run & RQD barrel w RQD = Rock Qu	e recover overed hoos indicate recovere ithdrawn ality Des	e material) ed signation (%)	weathering RS residu XW extret HW highly MW mode SW slight FR fresh W replaced v strength VL very lo L low M mediu H high VH very h EH extrem	g & after Jal soil mely wei v weathe vrately w ly weath vith A for a w m igh hely high	atton" athered eathered ered alteration	uerecr type PT parting JT joint SS shear surface SZ shear zone CO contact CS crushed seam SM seam roughness VR very rough RO rough SO smooth POL polished SL slickensided	puanarity PL planar CU curved UN undulating ST stepped IR Irregular CO clean SN stained VN veneer CO coating



11.0

ATETR	RA TE	СН СО	MPANY					Borehole ID.	BH3		
с.	~ ~		~~	rin	a Loa Corod Borol		~			sheet:	3 of 3
	<u>nę</u>	jin	ee	rin	g Log - Cored Borel		e			project no.	754-SYDGE219558
clier	nt:	C	coun	try G	arden Australia Pty Ltd					date started:	27 Aug 2018
prin	cipa	I:								date completed:	27 Aug 2018
proj	ect:	S	t Le	onar	ds Development					logged by:	AM
loca	tion	: S	t Le	onar	ds, NSW		checked by:	AB			
posit	ion:	E: 33	2,663.8	33; N: 6	,255,579.14 (MGA94) surface elevation: 6	angl	e from horizontal: 90°				
drill r	node	el: Hino	owa HF	P9503,	Track mounted drilling fluid: Water				hole	diameter : 125 mm	
drill	ing i	nform	ation	mate	rial substance				rock	mass defects	
method & support	water	RL (m)	depth (m)	graphic log	material description ROCK TYPE: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral 弓 ∑ ⊥ 듯 표	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) (type, incli	additional observations and defect descriptions nation, planarity, roughness, coating, thickness, other) general
NMLC		-58 - -57 -	- - 9.0 — - - 10.0 —		SANDSTONE: fine to coarse grained, pale grey to orange-brown, distinctly bedded at 20-30° (Class II to III). SANDSTONE: fine to coarse grained, pale grey, indistinctly cross bedded at 10-20° (Class II).	MW FR		a=0.90 d=0.78 a=0.84 d=0.88 a=0.93	86% 87%	SM, Fe HAWKE J, I SM, Gr J, 11° J, 18° J, 10° PT, 23° PT, 23° PT, 23° PT, 25° I J J F, 10° I J J, 10° I J J, 10°	4 mm SBURY SANDSTONE aveily Clay, 14 mm CU, Ro, Fe VN CU, Fe CO, Very Narrow PL, Fe CO, Very Narrow PL, Fe CO, PL, RO, CN , PL, RO, CN , PL, RO, CN , PL, RO, CN PL, RO, CN PL, RO, CN PL, RO, CN PL, RO, CN PL, RO, SN
		-56	-		Borehole BH3 terminated at 10.08 m Target depth			d=0.78			

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11111

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CDF_0_9_07_LIBRARY.GLB rev:AU_Log_COF BOREHOLE: CORED_754-SYDGE219558.GPJ_<<DrawingFile>> 12/10/2018_09:03

||||||||||||||-55 1111 ||||||iiii | | | | | |1111 |||||||||||||||||||||11111 ||||||||12.0 -54 ||||||| | | | | |||||||||||||||||||||||||||1111 ||||||||||||||||||||13 0 ||||||||||||||-53 11111 ||||||1111 |||||||iiii 11111 |||||||||||||||||||||11111 14.0 ||||||| | | | | |1111 ++++-52 ||||||| | | | | |1111 |||||||| | | | | |11111 ||||||11111 ||||||15.0 11111 ||||||-51 |||||||| | | | | |11111 | | | | |iiii iiii 1111 ||||||iiiii |||||||planarity PL planar CU curved UN undulating ST stepped weathering & alteration* RS residual soil XW extremely weathered HW highly weathered MW moderately weathered SW slightly weathered FR fresh *W replaced with A for alteration strength VL very low L low weathering & alteration defect type method & support graphic log / core recovery support PT parting JT joint SS shear sL SZ shear zc CO contact CS crushed SM seam parting joint shear surface auger screwing auger drilling claw or blade bit AS C casing M mud N none AD CB W core recovered water 10/10/12, water level on date shown (graphic symbols indicate material) ST stepped IR Irregular washbore rock roller CNMLC core (51.9 mm) wireline core (47.6mm) wireline core (63.5mm) wireline core (85.0mm) shear zone T RR NML crushed seam seam no core recovered water inflow NQ HQ PQ complete drilling fluid loss very low low medium high core run & RQD coating CN clean SN stained VN veneer CO coating partial drilling fluid loss roughness VR very rough RO rough SO smooth POL polished SL slickensided L M H barrel withdrawn HA hand auger water pressure test result (lugeons) for depth interval shown 25uL RQD = Rock Quality Designation (%) VH very high EH extremely high







ATETR	A TEC		IPANY				Но	le ID.	BH3			
Di	~-	- ~ r	~~~	tar	Installation	1.00				sh	eet:	1 of 1
F I	ez	201	ne	ter	Installation	LUU				pro	oject no.	754-SYDGE219558
clien	t:	С	ount	ry G	arden Australia Pty I	Ltd				da	te started:	27 Aug 2018
princ	ipal	:								da	te completed:	27 Aug 2018
proje	ect:	S	t Lec	onarc	ls Development					log	iged by:	АМ
locat	tion:	S	t Lec	onard	ds, NSW					ch	ecked by:	AB
positio	on: I	E: 332	,663.8	3; N: 6,	255,579.14 (MGA94) s	urface ele	vation: 66.2	0 m (AHD)		angle from	n horizontal: 90°	
equip	men	t type:	Hinow	a HP95	503, Track mounted	Irilling fluid	: Water			hole diam	eter : 125 mm	
Irillin	g inf	ormat	ion	mater	ial substance		piezomete	r constructio	n details		bore construction lic	anco.
⊗ p t			٦. E	ic log	material name						drilling company:	
metho	water	RL (m	depth	graphi					3H3		driller: driller's permit no.:	
A L	-	-66	-		FILL							
F			-		RESIDUAL SOIL		-					
:			1-									
:		_	-							∭-	- Grout	
_			-				_					
		-64	-		HAWKESBURY SANDSTONE							
			-	· · · · ·								
			3-				2.96 m			×///	Dentenite	
		[-				3 48 m		····		- Bentonite	
			-				0.101					
	14/09/1	-62	4				4.08 m					
	0											
			5-									
		[-									
			-									
		-60	-0	· · · · ·								
			-							•	- Sand	
			7-								Calla	
			-	· · · · ·								
			8	· · · · ·								
		-58	-									
			-									
		L	9-									
			-									
							10.08 m					
		-56	-									
			-									
			11-									
			-									
			-		-	_						1
method & support graphic log / core recovery ID ID								type	installation date	stickup t (m)	ip depth water level (m) (m)	Relative Levels (AHD)
wate	r 10	-Oct-12	2, water		core recovered (graphic symbols	BH3		standpipe			10.08 m	56.12
	- wa	ter inflo	ate SNO W	vvī i	no core recovered							
	∎ co] pa	mplete rtial dril	drilling f ling fluic	iuid loss I loss								
water pressure test result												
25	(luge	ons) fo	r depth									



			,									
ATET	RA TECH	COMF	PANY							Borel	hole ID.	BH4
	nai	nc	orin	a 1		2	Bo	roholo		sheet	t:	1 of 3
	ngi	IIE	enn	<u>y</u> ı	LUį	<u>y -</u>	DU	Tenole		proje	ct no.	754-SYDGE219558
clie	nt:	Со	untry G	Gard	en A	ustra	alia P	ty Ltd		date	started:	23 Aug 2018
prin	icipal:									date	complet	ted: 23 Aug 2018
pro	ject:	St	Leonar	ds E)eve	lopm	ent			logge	ed by:	АМ
loca	ation [.]	St	Leonar	ds.	NSN	, /				check	ked bv [.]	4B
posi	tion: F	332.6	12 49' N' 6	255 5	61.93	(MGA9	4)	surface elevation: 63.02 m (AHD)	angle	from he	orizontal:	90°
drill	model:	Geopr	obe 7822dt	t, Trac	k mou	nted	. ,	drilling fluid: Water	hole d	liamete	r : 125 m	m
dri	lling inf	ormat	ion			mate	erial sul	ostance				
∞	ation		samples &		Ē	Бо	<u>e</u>	material description		icy / ensity	hand penetro-	structure and additional observations
method support	1 2 penetr	water	field tests	RL (m)	depth (n	graphic	soil grou symbol	SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	moisture conditio	consister relative d	meter (kPa) ୁ ରୁ ରୁ ରୁ	
►HA			E	-63	-			FILL: SILTY SAND: dark brown, with coarse gravels.	D			FILL PID: 0.5 ppm
				-				FILL: CLAY: high plasticity, some ash with gravels.	>Wp			Reworked Natural?
			E			\mathbb{W}						-
			SPT 2 年 1	-62	1.0-							
	z		N=2									PID: 0.5 ppm -
— AD/												
				-61	2.0-							- - -
							CL	CLAY: low plasticity, pale grey.	<wp< td=""><td>VSt</td><td>1111</td><td>RESIDUAL SOIL</td></wp<>	VSt	1111	RESIDUAL SOIL
09:02			SPT	+		V///						-
)/2018	,		12, 9, 30/65mm			$\mathbb{V}///$						-
12/10				-60	3.0-	-		SANDSTONE: orange-brown to pale grey,	D			
gFile>:								Borehole BH4 continued as cored hole			liii	
Drawir				-								
* ſď						-						
9558.0				-59	4.0-							
DGE21												-
754-SY				Γ								
KED				50	5.0-							-
S NO				-30		4						-
DLE: N	Ìİİ					-						-
OREH						1						
COFB				-57	6.0-	-						-
Log					.	1						-
rev:AL				F		1						
KY.GLB						-						
-IBRAF				-56	7.0-	1						-
<u> </u>						1						
DF 0				-		-						
o					.	1						
met	thod	drilling	*	sup	port	•		samples & field tests	soil grou	ıp symb	ol &	consistency / relative density
AS HA	auger auger hand	screw	ng*	C N	rnud casing	N	nii	в рик asturbed sample D disturbed sample bi E environmental sample	soil de ased on /	AS 1726	n :2017	S soft
W HA	washl hand	oore auger		per		1 1	istance	SS split spoon sample U## undisturbed sample ##mm diameter	eturo oc	dition		St stiff VSt verv stiff
		0			<u></u>	rangir refusa	isiance ig to il	HP hand penetrometer (kPa) D N standard penetration test (SPT) M	dry moist	anion		H hard Fb friable
*	bit sh	own by	suffix	wat	er ▼10-	-Oct-12 w	ater	N* SPT - sample recovered W Nc SPT with solid cone Wp	wet plastic li	mit		VL very loose L loose
е.g. В т	blank	bit			wa	ter inflow		VS vane shear; peak/remouded (kPa) WI R refusal	liquid lin	nit		MD medium dense D dense
v	V bit	t shown by suffix D/T ank bit 2 bit bit water outflow wat										VD very dense



A TETRA TECH	1 COMPANY	Borehole ID.	BH4
Ena	incoring Log Cored Porchala	sheet:	2 of 3
Eng	neering Log - Corea Dorenoie	project no.	754-SYDGE219558
client:	Country Garden Australia Pty Ltd	date started:	23 Aug 2018
principal:		date completed:	23 Aug 2018
project:	St Leonards Development	logged by:	АМ
location:	St Leonards, NSW	checked by:	AB
position: E	: 332,612.49; N: 6,255,561.93 (MGA94) surface elevation: 63.02 m (AHD)	angle from horizontal: 90°	

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Ŀ	drill n	model: Geoprobe 7822dt, Track mounted drilling fluid: Water											hole	diameter : '	125 mm	
I	drilli	ing i	nform	ation	mate	rial substance							rock	mass defe	cts	
	ernou & pport	ater	(m) -	pth (m)	aphic log	material descriptio ROCK TYPE: grain charac colour, structure, minor cor	n cterisics, nponents	eathering & eration	es s o	stimate trengt & Is50 × = axial = diamet	ed th) tral	samples, field tests & Is(50) (MPa) a = axial:	re run RQD	defect spacing (mm)	additional obser defect desc (type, inclination, planarity thickness,	vations and riptions /, roughness, coating, other)
┟	sul	Na	-63	de	gra			alte	≓ _	ΣI	∃ 뛰	d = diametral	<u>8</u> ∞	300 30 0 300 30 0 300 100 30	particular	general
			- -62	- - - 1.0 -												- - - - - - - - - -
03:00			-61		started coring at 2.87m										- - - - - - - -	
	≜		-60	3.0	\geq	NO CORE: 0.13 m				Π						
			-	-		SANDSTONE: fine to medium gr orange-brown, (Class IV to V).	ained,	MW				a=0.92 d=0.88 a=0.83 d=0.84			└── PT, 0°, PL, RO, CN └── PT, 0°, PL, RO, CN └── SM, Clay, 58 mm └── PT, 8°, PL, RO, CN	- - -
22 L19300.GFJ 2300			-59	4.0		SANDSTONE: fine to coarse gra red-brown, distinctly bedded at 1	ined, 5-30° (Class IV).			₩ ₩ ₩ ₩ ₩ ₩ ₩		a=0.98 d=0.68	83%		PT, 20°, PL, RO, CN SM, Sandy clay, 11 mn	
			-58	- 5.0 - -						× 		a=1.37 d=1.35				- - - -
			-57	- 6.0 — - - -		SANDSTONE: medium to coarse grey, distinctly cross bedded at 5	e grained, pale i-25° (Class II).	FR		× × × ×		a=1.35 d=0.81 a=0.99 d=0.46 a=1.39 d=0.80 a=0.70 d=0.36	96%		JT, 8°, PL, RO, CN	
			-56	7.0						→ →		a=0.87 d=0.40			PT, 10°, PL, RO, CN	 - - -
	AS AD CB W RR NM NQ HQ PQ HA	hod a au cla va roo CNN wir wir wir wir har	& supp ger scr ger dril w or bl shbore k rolle /ILC co reline c reline c reline c nd aug	ort ewing ade bit re (51.9 pre (47.6 pre (63.5 pre (85.0 er	mm) ômm) 5mm) 0mm)	support C casing M mud N none water 10/10/12, water level on date shown water inflow complete drilling fluid loss partial drilling fluid loss partial drilling fluid loss	graphic log / con core rec (graphic syn no core core run & RQD barrel w RQD = Rock Qu	e recover overed bols indicate recovere ithdrawn ality Des	ry e mater ed	tion (?	%)	weathering RS residu XW extren HW highly MW moder SW slightj FR fresh "Wreplaced w strength VL very lov L low M mediun H high VH very hig EH extrem	& alter al soil nely weathe rately we weathe ith A for a w n gh ely high	attion* atthered red atthered ered ilteration	defect type PT parting JT joint SS shear surface SZ shear zone CO contact CS crushed seam SM seam roughness VR very rough RO rough SO smooth POL polished SL slickensided	Planarity PL planar CU curved UN undulating ST stepped IR Irregular CO clean SN stained VN veneer CO coating



A TETRA TE	ECH CO	MPANY							Borehol	e ID.	BH4	
Ene				a Loa Corod Borok		•			sheet:		3 of 3	
Eng	jin	ee	rin	g Log - Corea Borer	101	e			project i	10.	754-SYDGE219558	
client:	C	Coun	try G	Garden Australia Pty Ltd					date sta	rted:	23 Aug 2018	
principa	al:								date cor	mpleted:	23 Aug 2018	
project:	S	St Lee	onar	ds Development		logged l	by:	АМ				
location	: S	St Lee	onar	ds, NSW		checked	d by:	AB				
position:	position: E: 332,612.49; N: 6,255,561.93 (MGA94) surface elevation: 63.02 m (AHD) angle from horizontal: 90°											
drill mode	el: Geo	probe [·]	7822dt	r, Track mounted drilling fluid: Water				hole	diameter : 1	125 mm		
drilling i	nform	ation	mate	erial substance				rock	mass defe	cts		
duilling information water (m) (m) (m) (m) (m) (m) (m) (m) (m) (m)			graphic log	material description ROCK TYPE: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm)	ad (type, inclina particular	dditional observations and defect descriptions ation, planarity, roughness, coating, thickness, other) general	
	∞ ≤ 1/2 ∞ ∞ 55 - - - - - - - - - - - - - - - - - - - - - - - - - - -			FR		a=0.32 d=0.87	-		── SM, Clay ── PT, 11°, I	, 10 mm		

-54 9.0 NMLC i i i 11 97% PT, 10°, PL, RO, Clay CO iπ 11 SM, Clay, 8 mm 11 a=1.48 d=1.02 11 11 ||-53 10.0 11 11 111 a=2.07 11 о× 1 1 d=1.15 Borehole BH4 terminated at 10.42 m Target depth 11111 | | | | |12/10/2018 09:03 |||||||||||||11111 ||||||11.0 -52 1111 ||||||1111 ||||||_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: CORED 754-SYDGE219558.GPJ <<DrawingFile>> iiii ||||||1111 ||||||1111 1111 1111 12.0 -51 ||||||11111 |||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||13.0 -50 ||||||||||||||||||||||||||1111 |||||||11111 |||||||11111 + + + + + + +1111 -49 14.0 ||||||| | | | | |1111 + + + + + + +1111 |||||||1111 |||||||| | | | | |11111 ||||||1111 ||||||15.0 -48 11111 | | | | | ||||||||||||||1111 | | | | |1111 ||||||E E 1111 ||||||İİİİİ |||||||planarity PL planar CU curved UN undulating ST stepped weathering & alteration defect type method & support graphic log / core recovery Active type PT parting JT joint SS shear surface SZ shear zone CO contact CS crushed seam SM seam support residual soil extremely weathered highly weathered moderately weathered RS auger screwing auger drilling claw or blade bit AS C casing M mud N none XW AD CB W HW MW SW core recovered w sightly weathered FR fresh W replaced with A for alteration strength VL very low water ST stepped IR Irregular 10/10/12, water (graphic symbols indicate material) washbore T RR NML rock roller CNMLC core (51.9 mm) level on date shown no core recovered water inflow wireline core (47.6mm) NQ complete drilling fluid loss very low low medium HQ PQ wireline core (63.5mm) wireline core (85.0mm) core run & RQD coating CN clean SN stained VN veneer CO coating partial drilling fluid loss roughness VR very rough RO rough SO smooth POL polished SL slickensided м Н barrel withdrawn HA hand auger high water pressure test result 25uL VH very high EH extremely high RQD = Rock Quality Designation (%) (lugeons) for depth interval shown







ATE	TRA T	TECH C	OMP	ANY							Borel	nole	ID.	BH5
-		~:.	• •	orio	~		~	Da	rahala		sheet	t:		1 of 3
	:N(<u>gir</u>	<u>ie</u>	erin	<u>g</u> I	<u> </u>	<u>y -</u>	D 0	prenoie		proje	ct n	0.	754-SYDGE219558
clie	ent:		Со	untry G	Gard	en A	ustra	alia P	Pty Ltd		date	star	ted:	21 Aug 2018
pri	ncip	al:									date	com	plet	ted: 21 Aug 2018
pro	oject	t:	St	Leonar	ds E)evel	lopm	ent			logge	d b	y:	AM
loc	atio	n:	St	Leonar	ds, I	NSW	/				checł	ked	by:	AB
pos	sition	: E: 3	32,6	31.96; N: 6	,255,5	44.25	(MGA94	4)	surface elevation: 60.15 m (AHD)	angle	from ho	orizo	ntal:	90°
dril	l moc	del: Ge	eopro	be 7822dt	, Trac	k mour	nted		drilling fluid: Water	hole o	diamete	r : 12	25 mi	m
dr	illing	infor	mati	on			mate	rial sub	bstance motorial description		L2	h	and	official and
& p	Ę	etratio		samples & field tests	-	(E	ic log	dno.	SOIL NAME: plasticity or particle characteristic,	ion	tency /	per m	and netro- eter	additional observations
methc	oddns	bene	water		RL (m	depth	graph	soil gr symbo	colour, secondary and minor components	moist	consis	(k 00 00	(Pa)	
A	1			E	-60	- -			FILL: SILTY SAND: dark brown, with coarse	D				FILL
Ĥ H ₩	ASING			F		-		CL	Sandy CLAY: low plasticity, pale orange-brown,	>Wp	F	1 i i		
AD					-	-			Borehole BH5 continued as cored hole					
						1.0-								-
					-59	-								-
						-								
					-	-								
	ļ	ii			-58	2.0-						ļii		-
02		ii												
018 09:					-	-								
12/10/2						30-								-
					-57	-								-
awingF	ļ	ii				-								-
J N N					-	-								-
558.GP						4.0-								
GE219					-50	-								
64-SYD					_	-								
2ED 75						-								-
N COF	ļ	11			-55	5.0-						l i i		-
ILE: NO	ļ	ii				-						ļ		-
OREHC					-	-								-
COFB						6.0-								-
Log					-54	-								-
3 rev:AL														
RY.GLE					[-								
LIBRA					-53	7.0-								
9 02						-								
CDF_0					-	-								
						-								
m Al	ethod	uger d	rilling	۰.	sup M	port mud	N	nil	samples & field tests B bulk disturbed sample	soil grou soil de	up symbo	ol& n		consistency / relative density VS very soft
AS HA	Sa Ah	uger so and au	crewin ger	ng*	C	casing			D disturbed sample E environmental sample	based on	AS 1726	2017	,	S soft F firm
H/	۱» ۱۹	and au	e ger				no res	istance	SS split spoon sample U## undisturbed sample ##mm diameter	moisture co	ndition			- St stiff VSt very stiff
					wat	er	rangin refusa	g to I	HP nand penetrometer (kPa) N standard penetration test (SPT) N* SPT - sample recovered	D dry M moist W wet				H hard Fb friable VI verv loose
e.g	b g.A	It show D/T	n by:	suttix		Lev	Oct-12 wa el on date	ater shown	Nc SPT with solid cone VS vane shear; peak/remouded (kPa)	Wp plastic li WI liquid lin	imit nit			L loose MD medium dense
Ч	a T V	idi ik Di C bit bit			│	wat	ter inflow	/	R refusal HB hammer bouncing					D dense VD very dense



AT	ETR	A TECH COMPANY Bore												le ID.	BH5	_
	. .,		-:	~~	-in	-lag Caro	Dorok	- alı	_				sheet:		2 of 3	
-		<u>19</u>]]]]]	ee		g Loy - Corec	J DOLEI	1016	3				project	no.	754-SYI)GE219558
С	lien	t:	C	;oun	try G	arden Australia Pty L	td						date sta	arted:	21 Aug	2018
р	rinc	ipa	I:										date co	mpleted:	21 Aug	2018
р	roje	ect:	S	t Le	onar	ds Development							logged	by:	АМ	
lc	ocat	lion	: S	t Le	onar	ds. NSW							checke	d by:	AB	
р	ositi	on:	E: 332	2,631.9	96; N: 6	,255,544.25 (MGA94) su	Inface elevation: 60).15 m (AHD)		angl	e from horiz	ontal: 90°		
dı	rill m	iode	I: Geo	probe	7822dt	, Track mounted dri	illing fluid: Water					hole	diameter :	125 mm		
d	rilli	ng ir	nform	ation	mate	rial substance material descriptic	n	~~~	est	imated	samples,	rock	defect	ects ad	Iditional observa	ations and
% pot	ort	- -	Ê	(ш) ч	hic log	ROCK TYPE: grain charac colour, structure, minor cor	cterisics, nponents	thering ation	str & ×	ength Is50 = axial;	field tests & Is(50) (MPa)	E G	spacing (mm)	(type, inclina	defect descrip ation, planarity, r thickness, of	oughness, coating,
meth	ddns.	wate	RL (r	depth	grapł			weat	=0 	diametral ≥ ⊥ ≯ i	a = axial; d = diametral	core & R(30 300 3000 3000	particular		general
			-60	-								Γ				
						started coring at 0.57m										
			F			SANDSTONE: fine to coarse gra	ined,	HW		+++	1			HAWKESI	BURY SANDST	ONE
]		1.0 —		NO CORE: 0.17 m	/	XW		İİİ	1	0%		SM, Sand	ly clay, 410 mm	_
]	-59			SANDSTONE: fine to coarse gra red-brown to pale grey, (Class IV	ined, /).					070		∦		-
]										<u> </u>		FZ, 320 m	m _, RO, CN	-
]	[1 1 1 1 1			0.11			PT, 5°, PL PT, 5°, PL SM. Sand	., RO, CN ., RO, CN lv clav. 35 mm	-
]	-58	2.0 —							d=0.11	65%		SM, Sand JT, 0°, PL	iy clay, 11 mm , RO, CN	_
						SANDSTONE: medium to coarse red-brown to pale orange brown	e grained, dark indistinctly	MW				00,0		Root jacki	ng 65° ng 65° W day: 35 mm	-
20-2]				bedded at 10-25° (Class IV).	maiourisay							JT, 2°, PL Root jacki	., RO, CN ng 0°	-
200]		30-						8°II 11	a=1.23 d=1.06					-
2017]	-57	3.0 -										01,0,00	J, NO, ON	-
]														-
awiig		3/18	-									94%				-
		27/06		4.0 —							a=0.94 d=0.81			IT 5°. PL	RO CN	_
19.00	ן ארר !	_ <u>₹</u> _	-56											01,0,12	., NO, ON	-
	ž	/09/18												I I── SM, Claye	ev sand, 8 mm	-
5		04		-		SANDSTONE: fine to coarse gra grey, distinctly bedded at 0-20° v	ined, pale vith	FR						JT, 5°, PL	., RO, CN	-
2]	-55	5.0 —		carbonaceous laminae (Class II)	1.				a=1.06 d=0.98			JT, 5°, PL	., RO, CN	
55]	- 55							() (*	d=0.84 a=1.01			PT, 5°, UI	N, RO, CN	-
L L L]	L I								d=0.74	97%		JT, 10°, C	U, RO, CN	_
]												JT, 5°, UN	N, RO, CN	4
-0- -0-]	-54	6.0 -						×	a=1.36 d=1.14				IN, RO, CN	-
				1							a=1.10 d=1.27			PT, 15°, 0	CU, RO, VN	-
PI I		ļ	-											IT 10° D		-
		ļ		7.0 —					i	i				PT, 5°, PL PT, 5°, PL PT, 5°, PL	_, RO, Fe VN _, RO, Fe VN	_
]	-53			SANDSTONE: medium to coarse	e grained nale	-			a=1.12 d=1.22	94%				-
]				grey, massive (Class II). 7.30 to 7.41 m: Minor shale brec	cia							∏— FZ		-
3			F	-		7.52 to 7.74 m: dark grey, lamina	ated at 12°				a=0.65 d=0.31			PT, 20°, F	²L, RO, CN	-
	met	ł hod	& supp	ort		support	graphic log / cor/	e recove	<u>⊥⊥</u> /ry	383 I	weathering	& altera	ation*	defect type	ļ.	lanarity
	As auger screwing C casing M mud N none XW extrem AD auger drilling C dasing W mud N none C dasing W mud N none XW extrem C claw childre bit W the core recovered HW highly										nely weathe	athered red	JT joint SS shears	surface l	CU curved JN undulating	
	CB claw or blade bit W washbore Rr rock roller level on date shown									MW moder SW slightly	rately we y weathe	eathered ered	SZ shear a CO contac	zone S t l'	T stepped R Irregular	
	NML NQ	CNN	/LC co eline c	re (51.9 ore (47.	(mm) .6mm)	water inflow		recovere)d		*W replaced w strength	vith A for a	alteration	SM seam	d seam	
	hq PQ	wir	eline o eline o	ore (63. ore (85.	5mm) .0mm)	partial drilling fluid loss	barrel w	vithdrawn			L low M mediur	w n		roughness VR very r	ough (:oating CN clean
	HA	a wireline core (85.0mm) Image: Interval shown Image: Interva										n gh Iely high		RO rough SO smoo POL polish	th \	N stained N veneer CO coating



ATETI	RA TE	CH CO	MPANY					Borehol	e ID.	BH5		
C.				, in	alaa Carad Barah		•			sheet:		3 of 3
	nĉ	JIN	ee	rin	g Log - Cored Borer	1016	J			project	no.	754-SYDGE219558
clie	nt:	C	Coun	try G	arden Australia Pty Ltd					date sta	rted:	21 Aug 2018
prin	principal:									date co	mpleted:	21 Aug 2018
proj	roject: St Leonards Development										by:	АМ
loca	cation: St Leonards, NSW										d by:	AB
posit	tion:	E: 33	2,631.9	6; N: 6	,255,544.25 (MGA94) surface elevation: 60).15 m (AHD)		angle	e from horiz	ontal: 90°	
drill r	node	el: Geo	probe	7822dt	, Track mounted drilling fluid: Water				hole	diameter : '	125 mm	
drill	ing i	nform	ation	mate	rial substance				rock	mass defe	cts	
method & support	water RL (m)			graphic log	material description ROCK TYPE: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral I → ∞ ± 5 ∰	samples, field tests & ls(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm)	ad (type, inclin particular	dditional observations and defect descriptions ation, planarity, roughness, coating, thickness, other) general
-52			-		SANDSTONE: medium to coarse grained, pale grey, massive (Class II). <i>(continued)</i>	FR		a=0.97 d=1.08	94%		HAWKES	BURY SANDSTONE -

12/10/2018 09:03 _0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: CORED 754-SYDGE219558.GPJ <<DrawingFile>> E E

NMLC -a=1.37 d=1.06 a=1.16 d=0.88 a=1.08 d=0.96 × × × 9.0 I T 1 -51 9.06 m: becoming indistinctly bedded at 5-10° ✓ SM, Sandy clay, 8 mm ✓ PT, 5°, PL, RO, CN PT, 10°, PL, RO, CN ᠮᠮ᠇ᡀ İ 93% I T T T 1 I T 1 1 ł 1 0.0 Borehole BH5 terminated at 10.00 m -50 ||Target depth 1111 1111 |||||||||||||||||||1111 | | | | | |11111 ||||||11.0 1111 | | | | |-49 1111 ||||||iiii ||||||1111 ||||||1111 1111 1111 12.0 ||||||||-48 11111 |||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||13 0 |||||||| | | | | |-47 |||||||||||||1111 |||||||11111 |||||||1111 ||+ + + + + + +1111 |||||||14.0 ||||||-46 1111 + + + + + + +1111 |||||||1111 ||||||| | | | | |11111 |||||||1111 ||||||15.0 11111 ||||||-45 |||||||||||||1111 ||||||1111 ||||||1111 ||||||İİİİİ |||||||planarity PL planar CU curved UN undulating ST stepped weathering & alteration defect type method & support graphic log / core recovery PT parting JT joint SS shear sL SZ shear zC CO contact CS crushed SM seam support residual soil extremely weathered highly weathered moderately weathered parting joint shear surface RS auger screwing auger drilling claw or blade bit AS C casing M mud N none XW AD CB W HW MW SW core recovered w sightly weathered FR fresh W replaced with A for alteration strength VL very low water ST stepped IR Irregular 10/10/12, water (graphic symbols indicate material) shear zone washbore T RR NML rock roller CNMLC core (51.9 mm) level on date shown crushed seam seam no core recovered water inflow wireline core (47.6mm) wireline core (63.5mm) wireline core (85.0mm) NQ complete drilling fluid loss very low low medium HQ PQ core run & RQD coating CN clean SN stained VN veneer CO coating roughness VR very rough RO rough SO smooth POL polished SL slickensided partial drilling fluid loss м Н barrel withdrawn HA hand auger high water pressure test result 25uL VH very high EH extremely high RQD = Rock Quality Designation (%) (lugeons) for depth interval shown



A4

original size

fig no:

FIGURE 1

rev:

project no:

754-SYDGE219558



drawn			client:	Country Garden A	Australia I	PTY LTD	
approved		ee 🂧	project:	Country Garden St Lo	eonards [Development	
date	22-08-2018	coffev 🗸	title:	St Lee	onards		
scale	N.T.S.	A TETRA TECH COMPANY	uue.	CORE PHC B	DTOGR/ H5	APH	
original size	A4		project no:	754-SYDGE219558	fig no:	FIGURE 2	rev:



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ה:	~ =			4 - 4	- lastallation				sheet:	1 of 1
۲ı	ez	<u>20</u>	ne	ter	Installation i	_og			project no.	754-SYDGE219558
clier	nt:	C	ount	try G	arden Australia Pty Lt	d			date started:	21 Aug 2018
prine	cipal	:							date completed:	21 Aug 2018
proje	ect:	St	t Leo	onare	ds Development				logged by:	AM
loca	tion:	S	t Leo	onare	ds, NSW				checked by:	AB
posit	ion: E	E: 332	,631.9	6; N: 6,	255,544.25 (MGA94) sur	face elev	vation: 60.15 m (AHD)		angle from horizontal: 90°	
equip	omen	t type:	Geopr	robe 78	322dt, Track mounted dril	ling fluid:	Water		hole diameter : 125 mm	
drillir	ng inf	ormat	ion	mate	rial substance		piezometer construction	details	hare construction li	
۲ کو م			Ê	bol o	material name				drilling company:	ense.
nethoc	/ater	sr (m)	epth (raphic				H5	driller: driller's permit no.:	
N A A O	\$	-60	P	⊸ XXX	FILL		0.30 m		Grout	
CASIN			-	<i>[]]]]</i>	RESIDUAL SOIL				Bentonite	-
<u>ـ [</u>]	-		- 1-		HAWKESBURY SANDSTONE		0.60 m			_
		F	-				1.00 m			
			-							-
		-58	2-							-
			-							-
			3-							-
	8	F	-							
	27/08/1		-							-
	-¥	-56	4-							_
p	18/18		-							-
	04/0		- 5							-
NMLC		F	-						Sand	
			-							-
		-54	6-							_
			-							-
			- 7							-
		-	-							
			-		•					
		-52	8-							-
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			- 9-							-
			-							_
			-				10.00 m			
 		-50	-10						•	
			-	-						-
1			- 11 —							-
		Γ	-	-						_
			-	-						
meth	nod &	suppo	rt 1 log for	r details	graphic log / core recovery	ID	type	installation date	stickup tip depth water level (m) (m) (m)	Relative Levels (AHD)
wate	e engi 9 r 10-	-Oct-12	water	uctalis	core recovered	0.15		uuto		stickup tip water level
	lev wa	el on da ter inflo	ate sho w	wn	(graphic symbols indicate material)	вн5	standpipe		10.00 m	50.15
		nplete	drilling f	fluid loss	s no core recovered					
'			uro toot	rocu ⁴						
25	(luge interv	ons) fo val shov	r depth vn	result						

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ATET	TETRA TECH COMPANY								Bore	nole ID.	BH6				
										sheet		1 of 3			
E	ngi	ne	erin	gl		g -	Bo	orehole		nroio	ct no	754-SVDGE210558			
clier	nt:	Co	untry G	ard	en Δ	ustra	alia F	Ptv I td		date	started.	20 Aug 2018			
Cilei		00		Juiu		usut	ina i			uate	starteu.	20 Aug 2010			
prin	cipal:									date	complete	ed: 21 Aug 2018			
proj	ect:	St	Leonar	ds E	Deve	lopm	ent			logge	ed by:	AM			
loca	tion:	St	Leonar	ds, I	NSW	/				checl	ked by:	AB			
posit	tion: E:	332,6	657.29; N: 6	,255,5	33.79	(MGA9	4)	surface elevation: 61.36 m (AHD)	angle	from he	orizontal: 9	90°			
drill r	model: C	Geopr	obe 7822dt	t, Trac	k mou	nted		drilling fluid: Water	hole o	diamete	r : 125 mm	1			
drill	ling info	rmat	ion		1	mate	erial sul	ubstance							
<u>مە</u>	ration		samples &		Ê	bol	dn	material description	e E	ncy / density	hand penetro-	structure and additional observations			
ethod	penet	ater	lieid tests	L (m)	epth (I	aphic	il gro mbol	SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	oistur	Insiste	meter (kPa)				
ਨ ਸ	- N 0	Ś		2	ð	5	3 6		E8 FD	2 e	40 300 40	FILL			
HA			E	-61	-			FILL: SAND: yellow brown.							
							CL	FILL: SILTY SAND: pale brown, with gravels.				 RESIDUAL SOIL			
P T D			E		-	$\mathbb{V}//\mathbb{V}$	01	CLAY: low plasticity, orange brown.	<wp< td=""><td></td><td></td><td></td></wp<>						
Ì.					1.0-	<i>[////</i>		Borehole BH6 continued as cored hole							
				-60	-							· · · · · · · · · · · · · · · · · · ·			
						1						- - -			
					-	-									
	liii				2.0-	-						- 			
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0/201					-	-									
~ 12/1					3.0-	-						-			
gFile>	liii			-58	-										
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1558.G	liii				4.0-							-			
GE219				-57		1									
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5 1	liii			_	-	-									
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EHOLE	liii					-						-			
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AU LC				-55											
LB rev					-	-						-			
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met	hod	drilling	1*	sup	port		- m ³¹	samples & field tests	ıp symb	ol &	consistency / relative density				
AD AS HA	auger auger	SCLEM	ing*	C N	casing	N	nii	B Duik disturbed sample D disturbed sample	soil de based on <i>i</i>	escriptio AS 1726	n :2017	S soft			
W	washb hand a	ore		pen	etration	1		S split spoon sample	1-4-	1141		St stiff			
		-901			-	no res rangir	sistance ig to il	HP hand penetrometer (kPa) D	dry moist	ndition		H hard Fb friable			
*	bit sho	wn by	suffix	wat	er ▼ ¹⁰	Oct-12 w	ater	N* SPT - sample recovered W Nc SPT with solid cone Wr	wet plastic li	mit	VL very loose				
e.g. B	AD/T blank	bit	level on date shown water inflow					VS vane shear; peak/remouded (kPa)	2 SPT with solid cone 3 vane shear; peak/remouded (kPa) 4 WI liquid lir			WI liquid limit L loose MD medium dense			MD medium dense
T V	TC bit V bit			-	- d wat	ter outflow	v	HB hammer bouncing	D dense VD very dense						



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E	Er	۱Ö	ıin	ee	rin	a Loa - Corec	d Boreł	nole	Э			sheet:		2 of 3		
	ien	- 3 +-	<u> </u>		try G	arden Australia Ptv I	td		-			date sta	no.	20 Aug 2018		
0		inal	ر ۱۰	Jouri	uy e	arden Australia i ty L	iu -					date so	mplotod:	20 Aug 2010		
pi		npa	י. כ	tlo	onar	de Development							hv:	21 Aug 2010 AM		
pi Io		ion		t Le	onar	de NSW						chockor	d by:	AM AR		
	ositic	on:	E: 33	2.657.2	29: N: 6	255.533.79 (MGA94) su	rface elevation: 6	1.36 m (AHD)		angle	e from horiz	ontal: 90°			
dr	ill m	ode	l: Geo	probe	7822dt	, Track mounted dri	lling fluid: Water		,		hole	hole diameter : 125 mm				
d	rillir	ng ir	nform	ation	mate	erial substance material descriptio	n	a7	estimated	samples.	rock	mass defe	cts additional observations and			
method &	support	water	RL (m)	depth (m)	graphic log	ROCK TYPE: grain charac colour, structure, minor con	cterisics, nponents	weathering alteration	strength & Is50 X = axial; O = diametral ⊐ ⊇ ؾ ∓ = =	field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	spacing (mm)	(type, inclination)	defect descriptions ation, planarity, roughness, coating, thickness, other) general		
			-61	- - - -		started coring at 1.00m				- 0.00				-		
			-60			SANDSTONE: medium to coarse grey to dark red-brown, distinctly 10-20° (Class IV to V).	e grained, pale bedded at	MW		a=0.69 d=0.72	70%	- 6 -+ 7 - 6 - 1 - 1 - 1	JT, 5 - 10 JT, 5 - 10 JT, 5 - 10 JT, 5 - 10 JT, 5 - 10 JT, 5 - 10 JT, 5 - 10 PT, 18°, 1)°, PL, RO, CN -)°, PL, RO, CN -)°, PL, RO, CN -)°, PL, RO, CN -)°, PL, RO, CN - PL, RO, CN - PL, RO, CN -		
503			-59	2.0				SW MW HW		a=0.28 d=0.16		· (2) · · · - (1) · · · - (2) · · · · · - (2) · · · · · - (2) · · · · · - (2) · · · · · - (2) · · · · · - (2) · · · · · · - (2) · · · · · · - (2) · · · · · · - (2) · · · · · · · · · - (2) · · · · · · · · · · · · · · · · · · ·	JT, 5°, Pl PT, 10°, I JT, 7°, Pl SM, Clay SM, Clay JT, 2°, Ul JT, 0°, Pl	L, ŘO, ČN PL, RO, CN L, RO, CN rey sand, 11 mm rey sand, 25 mm N, RO, Fe SN L, RO, CN		
wingFile>> 12/10/2018 0			-58 3.0	dded at 10-20°	SW	- E - 1 OK OK 	a=1.00 d=0.61	100%		— JT, 5°, UI	- 					
							a=0.73 d=0.30				- - -					
- BOREHOLE: CORED 754-SY			-56	- 5.0 — - - -		SANDSTONE: medium to coarse grey, distinctly to indistinctly bedo (Class II).	e grained, pale ded at 10-25°	SW		a=0.59 d=0.43	99%		∍— SM, Sano — PT, 25°, I — PT, 12°, I			
KY.GLB rev.AU Log CU	-55 -									a=0.90 d=0.60			JT, 2°, UI			
CDF_0_9_0/_LIBRA			-54	7.0						a=0.82 d=0.86	91%		PT, 15°, I PT, 14°, I JT, 5°, PI	UN, RO, CN - 		
r A C V F F N H F F	neth AS AD CB V RR NML NQ HQ PQ	aug aug cla va roc CNN wir wir wir	& supp ger scr ger dril w or bl shbore k rolle MLC co eline c eline c	oort rewing lade bit r re (51.9 ore (51.9 ore (47. ore (63. ore (85.	0 mm) 6mm) 5mm) 0mm)	support C casing M mud N none water graphic log / core recovery weath RS m water image: support (graphic symbols indicate material) weath RS m water ino core recovered (graphic symbols indicate material) MW in MW m ino core recovered partial drilling fluid loss ore run & RQD view SW is view						thered ed sathered rred Iteration	defect type PT parting JT joint SS shear SZ shear CO contac CS crushe SM seam roughness VR very	e planarity g PL planar CU curved surface UN undulating zone ST stepped ct IR Irregular ed seam rough CN clean		
H	ΗA	har	nd aug	er		니 water pressure test result (lugeons) for depth interval shown	I I RQD = Rock Qu	ality Des	ignation (%)	H high VH very hig EH extrem	redium VR very rough CN clean igh RO rough SN stained SO smooth VN veneer POL polished CO coating SL slickensided			h SN stained oth VN veneer hed CO coating ensided		



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Enai	00	_	din		rad Darah		•			sheet:		3 of 3
Engi	ne	e		g Log - Co	red borer	1016	Ð			project	no.	754-SYDGE219558
client:	Со	unt	ry G	Garden Australia P	Pty Ltd					date sta	irted:	20 Aug 2018
principal:								date completed: 21 A			21 Aug 2018	
project:	St	Lec	onar	ds Development						logged	by:	AM
location:	St	Lec	onar	ds, NSW						checked	d by:	AB
position: E:	332,6	57.29	9; N: 6	,255,533.79 (MGA94)	surface elevation: 67	1.36 m (AHD)		angl	e from horiz	ontal: 90°	
drill model: C	Geopr	obe 7	'822dt	, Track mounted	drilling fluid: Water				hole	diameter : ?	125 mm	
drilling info	drilling information material substance ro									mass defe	cts	
øð		ê	bol	material de ROCK TYPE: grain	scription	ing & n	estimated strength	samples, field tests		defect spacing	a (turno inclin	dditional observations and defect descriptions

Г					_	material description	า	જ	estimated	samples,		defect	additional obs	ervations and
	× –		_	Ê	l og	ROCK TYPE: grain charac	terisics,	ering on	& Is50	& Is(50)	_ ⊆ ∩	spacing (mm)	(type, inclination, planar	scriptions ity, roughness, coating,
		ter	Ē	oth (phic	colour, structure, minor com	ponents	athe erati	X = axial; O = diametral	(MPa)	ROL	. ,	thicknes	s, other)
	aup	wa	RL	del	gra			we alte	∃ ⊐ ¤ ± ₹	d = axal; d = diametral	ö∞	300 300 300 300 300 300 300 300 300 300	particular	general
				_				FR						
			-53	_		SANDSTONE: fine to coarse grai	ned, pale						JT, 28°, CU, RO, CN SM, Clay, 24 mm, gre	ev.
				-		grey, distinct carbonaceous lamir	nae at 3-10°		🕅	a=0.38	91%		PT, 10°, PL, RO, CN	., _
				-	::::	(Class II).			1	u=0.37		╋┵╝╷╷	- PT, 6°, PL, RO, CN	-
			-	-									PT, 6°, PL, RO, CN PT, 6°, PL, RO, CN	-
	NMLO			9.0								╏╎╎┠┧╎	1 1,0 ,1 2,10,01	_
	Ĩ			-					📓			liiiii		-
			-52	-			in a di mata			a=0.73		<u>iii</u> i		-
				-		arev. (Class II).	ained, paie			d=0.76	100%			-
			Ļ	-		3 - ,, (,								-
				10.0 —					®×i	a=1.44			JI, 5 [°] , PL, RO, CN	
				-		Borehole BH6 terminated at 10.0	7 m			d=0.59		11111		-
			-51	-		l'arget deptri								-
g				-										-
3 09:0				-					liiiii			liiiii		-
/2016			Γ	11.0										_
2/10				-										-
Š.			-50	_										-
gFile				_					liiiii			liiiii		_
rawir				_										_
Å			-	12.0										
GPJ				12.0 -										
9558.			-49	-					liiiii			liiiii		-
3E219				-	1									-
λDG				-	1									-
754-5			-	-	1									-
Ð				13.0	1									_
СQ			_48	-	1									-
OLE:			40	-	1									-
REH				-					i i i i i			İİİİİİ		-
F BO			-	-										-
8				14.0 —										-
Log				-										-
UA:V			-47	-					i i i i i i					-
LB re				-										-
RY.G			F	-										-
BRA				15.0 —										-
17_LI				-										-
6			-46	-										-
DF_(-										-
9			L	-					iiiii					-
┢		hod '				aunnart	graphic los / com		<u> </u>	weathering	& alter	ation*	defect type	planarity
	AS	au	supr ger sci	rewing		C casing M mud N none		recove	iy	RS residu	ial soil	athered	PT parting	PL planar
	AD CB	au cla	ger dri ıw or b	lling lade bit		water		overed	material	HW highly	weathe	red	SS shear surface	UN undulating
	W	wa	shbore	e		10/10/12, water level on date shown	(grapnić sym	JUIS II IUICALE	materiai)	SW slight	y weath	ered	CO contact	IR Irregular
	NM		ALC cc	ore (51.9	mm)	water inflow	no core i	recovere	ed	FR fresh *W replaced w	vith A for a	alteration	CS crushed seam SM seam	
	HQ	wir wir	eline c	ore (47. ore (63.	.omm) .5mm)	complete drilling fluid loss	core run & RQD			VL very lo	w		I .	
	PQ	wir	eline c	ore (85.	0mm)		barrel wi	thdrawn		L low M mediur	n		VR very rough	coating CN clean
	HA	har	nd aug	er		water pressure test result		ality Dee	ignation (%)	H high	ab		RO rough SO smooth	SN stained VN veneer
						ក្ត (lugeons) for depth	ROCK QUE	anty DeS	ignau011 (%)	EH extrem	ely high		POL polished	CO coating
- 1										1			OL SICKENSIGEO	







A	TETRA TECH COMPANY											ole ID.	BH7		
	C ~		~~	aria	~	•	~	Da	rahala		sheet	:	1 of 1		
_	Er	Igi	ne	erin	<u>g</u> I	-0(J -	BO	renoie		projec	ct no.	754-SYDGE219558		
_	clien	t:	Со	untry G	ard	en A	ustra	alia P	ty Ltd		date s	started:	22 Aug 2018		
	princ	ipal:									date o	complete	d: 22 Aug 2018		
	proie	ect.	St	Leonar	ds D)eve	lopm	ent			logge	d by:	AM		
	locat	ion:	St.	l oonar	de l	NSW	, ,				check	ed by:	AR		
٢	nositi	.ion. 	32.5	84.02· N· 6	255 5	11 96	MGAQ	4)	surface elevation: 56.93 m (AHD)	angle	from horizontal: 90°				
	drill m	odel: G	eopro	obe 7822dt	, Trac	k mour	nted	•)	drilling fluid: Water	hole d	iameter	: 125 mm			
ļ	drilli	ng info	rmati	on			mate	erial sub	stance						
	ళ	ation		samples &		(L	bo	ę.	material description	, <u>Ais</u> hand n ⊆ 20 penetro-			structure and additional observations		
	support	1 2 penetr	water	field tests	RL (m)	depth (r	graphic	soil grou symbol	SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	moisture conditio	consister relative d	meter (kPa) 0 0 0 00			
	AD/T			E E SPT 1, 1, 18 N=19	-56				FILL: CLAYEY SAND: dark brown, with coarse gravels.	<pre>VP</pre>			FILL		
DF_0_9_07_LIBRARY.G						-							- - -		
5															
	method AD auger drilling* AS auger screwing* HA hand auger W washbore HA hand auger * bit shown by suffix e.g. AD/T B blank bit T TC bit					port mud casing etration er er [ev lev wat	N no res rangir refusa Oct-12 w el on date ter inflow	nil istance g to ater : shown	samples & field tests B bulk disturbed sample D disturbed sample E environmental sample SS split spoon sample U## undisturbed sample ##mm diameter HP hand penetrometer (kPa) N standard penetration test (SPT) N* SPT - sample recovered W Nc VS vane shear; peak/remouded (kPa) R refusal	soil grou soil de based on A dry moist wet p plastic lin liquid lim	p symbo scriptior AS 1726: dition nit it	bl & n 2017	consistency / relative density VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense		



ATE	ETRA TECH COMPANY										Boreł	nole ID.	BH7A
-		~:	~~	orio	~		~	Da	rahala		sheet		1 of 3
	I	gi	ne	erin	<u>g</u> I	<u>_0(</u>	J -	B 0	renole		proje	ct no.	754-SYDGE219558
clie	ent		Со	untry G	ard	en A	ustra	alia P	ty Ltd		date	started:	22 Aug 2018
pri	nci	pal:									date	complet	ed: 22 Aug 2018
pro	ojec	ct:	St	Leonar	ds D)evel	lopm	ent			logge	d by:	АМ
loc	atio	on:	St	Leonar	ds, l	vsw	,				check	ked by:	AB
pos	sitio	n: E:3	32,5	84.41; N: 6	,255,5	12.40 ((MGA94	4)	surface elevation: 56.85 m (AHD)	angle	from ho	prizontal:	90°
dril	l mo	del: G	eopro	obe 7822dt	, Trac	k mour	nted		drilling fluid: Water	hole d	liamete	r : 125 mr	n
dr	illin	g info	rmati	on			mate	erial sub	stance		~		
method &	support	penetratior	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative densit	hand penetro- meter (kPa) 8 8 8 8	structure and additional observations
Ī		- 0 0	-		-				FILL: CLAYEY SAND: dark brown, with coarse	D	01	- 0 0 4	FILL
					-	-			graveis.				
						-							PID: 2.43 ppm
	1000000				-56	10-			FILL: Gravelly CLAY: low plasticity, dark orange brown, with coarse gravels.	<wp< td=""><td></td><td></td><td></td></wp<>			
	SPT 1, 1, 3 N=4 -				-							PID: 2.12 ppm	
	N=4					-							-
- AD/T						-							
	<				-55 2.0		FILL: Sandy CLAY: low plasticity, dark brown, with		-			-	
					-			coarse sand.				:	
8 00:00					-				>Wp			-	
10/201	3, 2, 2 N=4 -54												
> 12													
vingFile		+++			-				SANDSTONE : medium to coarse grained, pale yellow brown, recovered as sand with clay, very low			HAWKESBURY SANDSTONE	
<>Drav						-			to low strength (Class V)				-
8.GPJ					-53	4.0-							
21955						-							-
SYDGE						-							-
D 754-					-52								
COKE					02	5.0-	-						-
NON NON					Ļ								
KEHOLI						-	-						-
JF BCF					-51	-	1						
со Год						0.0-							
ev:AU					F	-	-						
.GLB r						-	1						
BRAR					-50	7.0-	-						-
_07_LI						-	1						
0F_0_5						-]						-
Ũ	-49				-							-	
, m	method support				port			samples & field tests	soil grou	ıp symbo	ol &	consistency / relative density	
AL AS H4	3	auger o auger s hand ai	crewir Laer	ng*		mud casing	N	nil	B bulk disturbed sample D disturbed sample b E environmental sample	soil de ased on /	AS 1726	n 2017	VS very soft S soft F firm
W HA	4	washbo hand a	uger		pen	etration	1 1	intor	S split spoon sample	eturo	dition		St stiff VSt verv stiff
			. - ·				rangin refusa	istance ig to il	HP hand penetrometer (kPa) D N standard penetration test (SPT) M	anion		H hard Fb friable	
*	a.	bit shov AD/T	vn by	suffix	wat	er 10- leve	Oct-12 wa	ater shown	N* SPT - sample recovered W Nc SPT with solid cone Wp	V wet VL very loose Vp plastic limit L loose			VL very loose L loose
B		blank b TC bit	it		vere inflow vere inflow vere inflow vere inflow R refusal vere inflow vere inflow vere inflow vere inflow refusal vere inflow						IIC		MD medium dense D dense
V		Vbit						•	HB nammer bouncing	VD very dense			



A TETRA TECH	1 COMPANY	Borehole ID.	BH7A
Enai	incoring Log Cored Perchala	sheet:	2 of 3
Engi	ineering Log - Cored Borenole	project no.	754-SYDGE219558
client:	Country Garden Australia Pty Ltd	date started:	22 Aug 2018
principal:		date completed:	22 Aug 2018
project:	St Leonards Development	logged by:	AM
location:	St Leonards, NSW	checked by:	AB
position: F	: 332 584 41: N: 6 255 512 40 (MGA94) surface elevation: 56 85 m (AHD)	angle from horizontal: 90°	

posi drill	uon: mode	⊏: 33 d: Ger	2,584.4	1; N: 6 7822dt	Track mounted dri		angle from nonzontal: 90° hole diameter : 125 mm						
dril	ling i	nform	ation	mate	rial substance	iling liulu. Water				rock	mass defe	izo min	
ethod & pport	ater	Œ,	pth (m)	aphic log	material descriptio ROCK TYPE: grain charac colour, structure, minor con	n cterisics, nponents	eathering & eration	estimated strength & Is50 X = axial; O = diametral	samples, field tests & ls(50) (MPa)	re run RQD	defect spacing (mm)	additional obs defect de (type, inclination, planar thicknes	ervations and scriptions ity, roughness, coating, s, other)
ы В	Ň	RL	de	gra			alte	╡」をェ⋛∄	d = diametral	S ∞	30 10 30 30	particular	general
		-56	- - - 1.0 - -										- - - - -
		-55 2.0	- - 2.0— -										- - - -
	/18	-54	3.0 -		started coring at 3.40m								- -
	9/18 4 4 27/08	-53	- - 4.0 <i>-</i> -	· · · · · · · · · · · · · · · · · · ·	SANDSTONE: fine to medium gr (Class II to III). NO CORE: 0.31 m	ained, orange,	MW		a=0.51 d=0.51			- SM, Sandy clay, 36 m	im -
	04/06	-52	- - - 5.0 — -		(Class II). SANDSTONE: fine to medium gr grey, (Class II), distinctly to indist 15-25°.	ained, pale ained, pale inctly bedded at	SW SW		a=0.64 d=0.50	62%		- SM, Saidy day, 34 m Root Joint, 5°, UN, RC SM, Sandy clay, 10 m PT, 18°, PL, RO, CN PT, 19°, PL, RO, CN PT, 19°, PL, RO, CN JT, 65°, PL, RO, CN SM, Sandy clay, 14 m), Roots
		-51	- - 6.0 <i>—</i>	6.0					a=0.22 d=0.24			 SM, Clay, 18 mm JT, 12°, PL, RO, CN PT, 17°, ST, RO, VN 	- - - -
		-50	- - 7.0-						a=1.13 d=0.54	92%		PT, 15°, PL, RO, CN PT, 15°, PL, RO, CN PT, 17°, PL, RO, CN	- - -
		-49	-						a=0.98 d=0.39	79%		PT, 20°, PL, RO, VN PT, 20°, PL, RO, VN PT, 21°, PL, RO, CN JT, 9°, PL, RO, CN	
AS AD CB W RF NM NC HC PC HA	thod au cla cla wa roo ILCNN win win win win	& supp ger sci ger dri aw or b ishbore ck rolle MLC co reline c reline c reline c reline c	ort rewing lade bit r ore (51.9 ore (51.9 ore (47. ore (63. ore (85.	mm) 6mm) 5mm) 0mm)	support C casing M mud N none water 10/10/12, water level on date shown water inflow complete drilling fluid loss partial drilling fluid loss	graphic log / cor core rec (graphic syr no core core run & RQD barrel w	e recovered nools indicate recovere	ry material)	RS residu XW extrer HW highly MW mode SW slight! FR fresh VL very lo L low M mediur H hiah	A alter al soil mely weathe rately we y weathe y weathe with A for a w	ation* red aathered ered ilteration	defect type PT parting JT joint SS shear surface SZ shear zone CO contact CS crushed seam SM seam roughness VR very rough RO rough	planarity PL planar CU curved UN undulating ST stepped IR irregular coating CN clean SN stained
1		5			(lugeons) for depth	ality Des	ignation (%)	1(%) VH very high EH extremely high CO togin Silv stallied POL polished CO coating				VN veneer CO coating	



A TETRA TECH	HCOMPANY		Borehole ID. BH7A		
Engl	incoring Log Co	red Derehale	sheet:	3 of 3	
Eng	ineering Log - Co	project no.	754-SYDGE219558		
client:	Country Garden Australia F	Pty Ltd	date started:	22 Aug 2018	
principal:			date completed:	22 Aug 2018	
project:	St Leonards Development		logged by:	AM	
location:	St Leonards, NSW		checked by:	AB	
position: E	: 332,584.41; N: 6,255,512.40 (MGA94)	surface elevation: 56.85 m (AHD)	angle from horizontal: 90°		
drill model	Geoprobe 7822dt Track mounted	drilling fluid: Water	hole diameter : 125 mm		

ļ	drill r	node	I: Geo	probe	7822dt	t, Track mounted dr	lling fluid: Water	ter hole diam				ole diameter : 125 mm			
ļ	drill	ing ir	nform	ation	mate	erial substance					rock	mass defe	cts		
	method & support	water	RL (m)	depth (m)	graphic log	material descriptic ROCK TYPE: grain chara colour, structure, minor cor	n cterisics, nponents	weathering & alteration	estimated strength & Is50 X = axial; O = diametral ⊃ _ ∑ म 듯 ᇳ	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm)	additional obs defect de (type, inclination, planaı thicknes particular	ervations and scriptions ity, roughness, coating, s, other) general	
			-48 - -47	9.0 — - - - - - 10.0 —		SANDSTONE: fine to medium gr grey, (Class II), distinctly bedded some disturbed bedding.	ained, pale at 20-35° with	FR		a=1.03 d=1.50 a=0.22 d=0.79 a=0.58 d=0.74	79%		JT, 5°, CU, RO, CN JT, 5°, PL, RO, CN = = - -	Defects are: PT, 25°, PL, RO, CN, unless otherwise described	
-ile>> 12/10/2018 09:04			-46	- - 11.0 - -		Borehole BH7A terminated at 10 Target depth	.26 m								
DGE219558.GPJ < <drawingf< td=""><td></td><td></td><td>-45</td><td>- - 12.0 — - -</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>- - - - -</td></drawingf<>			-45	- - 12.0 — - -										- - - - -	
REHOLE: CORED 754-SYI			-44	- 13.0 — - -										- - - -	
ARY.GLB rev:AU Log COF BC			-43 - -42											-	
CDF_0_9_07_LIBR			- -41	15.0 — - - -						weathering	& alto-		defect type:		
	Mel AS AD CB W RR NM NQ HQ PO	hod & aug cla wa roc LCNN wir wir wir	supp ger sci ger dri w or b shbore k rolle MLC cc eline c eline c	oort rewing lling lade bit e r ore (51.9 core (47. core (63. core (85	mm) 6mm) 5mm) 0mm)	support C casing M mud N none water I0/10/12, water level on date shown water inflow complete drilling fluid loss	graphic log / con core rec (graphic syn no core core run & RQD	e recove	er y e material) ed	Weathering RS residu XW extren HW highly MW model SW slighth FR fresh *W replaced w strength VL very lov L low	& altera al soil nely wea weather rately we y weather ith A for a	ation" thered eathered ered Iteration	PT parting JT joint SS shear surface SZ shear zone CO contact CS crushed seam SM seam roughness	PL planar PL planar CU curved UN undulating ST stepped IR Irregular	
	HA	har	nd aug	er	51111)	water pressure test result (lugeons) for depth interval shown	RQD = Rock Qu	<i>i</i> ithdrawn Iality Des	ignation (%)	M mediur H high VH very hig EH extrem	n gh ely high		VR very rough RO rough SO smooth POL polished SL slickensided	CN clean SN stained VN veneer CO coating	






ATETR	RA TEC	CH CON	IPANY							Hc	le ID.	BH7A
Di	07		no	tor	Installation					sh	eet:	1 of 1
	ez	201	ne	ler	installation					pro	oject no.	754-SYDGE219558
clier	nt:	C	ount	ry Gal	rden Australia Pty	Ltd				da	te started:	22 Aug 2018
prin	cipal	:								da	te completed:	22 Aug 2018
proj	ect:	S	t Leo	onards	s Development					log	ged by:	AM
loca	tion:	Si	t Lec	onards	s, NSW					ch	ecked by:	AB
posit	ion: I	E: 332	,584.4 ⁻	1; N: 6,25	5,512.40 (MGA94)	surface elev	vation: 56.85	m (AHD)		angle fron	n horizontal: 90°	
equip	omen	t type:	Geopr	obe 7822	2dt, Track mounted	drilling fluid	Water			hole diam	eter : 125 mm	
drillir	ng inf	ormat	ion	materia	I substance		piezometer o	construction	details		bore construction lic	ansa.
% p t			(E	ic log	material name						drilling company:	
metho	water	RL (m	depth	graphi					3H7A		driller: driller's permit no.:	
			-	F	ILL							
			-									-
		-56	- 1-									-
			-									_
- AD/T		_	-							▓₄	- Grout	
			2-									-
			-									-
8.2	/18	-54	3-				3.22 m					
	27/08		-	н Н	AWKESBURY SANDSTON	E				-	- BentoneiseCRIPTION C	/OD: 51/60.2 mm F SLOTS: Slot Spacing = 4 mm, -
3	¥		-				3.76 m				SA	ot width = 0.5 mm ND PACK: K2 mm
2	4/09/18		-				4.26 m					
	Ó	50	-									-
		-52	5-									-
2.0000			-									-
		-	- 6									_
			-									
		-50	-									-
ž			7								- Sand	-
			-									-
		-	8-									-
			-	· · · · · · · · ·								
		-48	-									
8			9									-
			-	· · · · · · · · · ·								-
		-	10-				10.26 m					-
			-				10.20 111			<u> </u>		
		-46	-									
												-
2			-									-
meti	nod &	Suppo	rt		graphic log / core recover	/ ID		type	installation	stickup t	ip depth water level	Relative Levels
se	e engi er	ineering	g log for	details				VF -	date	(m)	(m) (m)	(AHD) stickup tip water level
-₹	lev	-Oct-12 rel on d	, water ate sho	wn	(graphic symbols indicate material)	BH7A	5	standpipe			10.26 m	46.59
	– wa € co	ter inflo	w drilling f	luid loss	no core recovered							
	⊲ pa	rtial dril	ling fluic	lloss								
25	wate (luge	r pressu	ure test r depth	result								
	inter	/al show	vn									



ATET	RA TECH		ANY							Borel	nole ID.	BH8
_					1					sheet	t:	1 of 3
E	ngi	ne	erin	g I	-0	g -	BO	rehole		proje	ct no.	754-SYDGE219558
clier	nt:	Со	untry G	Gard	en A	ustra	alia P	ty Ltd		date	started:	21 Aug 2018
prin	cipal:									date	complet	ed: 22 Aug 2018
proi	ect:	St	Leonar	ds E)eve	lonm	ent			logge	d bv [.]	ΔΜ
loop	tion.	C+	Loonar	de L	NGN	/opiii	one			obool	a by.	
loca		30.0		us, 1	10.07		4		anala	frame	eu by.	
drill r	nodel: G	eopro	obe 7822dt	,200,0 ;, Trac	k mou	nted	+)	drilling fluid: Water	hole d	liamete	r : 125 mr	n
drill	ling info	rmati	on			mate	erial sul	ostance				
~	ation		samples &		_	Бc	٩	material description		cy / ensity	hand	structure and additional observations
method a	1 2 penetra	water	field tests	RL (m)	depth (m	graphic I	soil grou symbol	SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	moisture conditior	consisten relative de	meter (kPa) ₽ ሺ ႙ ၛ	
								BRICK PAVERS.	_/ □			PAVEMENT 7
				_	.			FILL: SAND: pale brown. FILL: SAND: dark brown, with coarse gravels.]			FILL -
D/T												
				-54	10-	V///		GLAY: low plasticity, orange-brown, with fine grained sand.	<vvp< td=""><td>St</td><td></td><td>RESIDUAL SOIL</td></vvp<>	St		RESIDUAL SOIL
						<i>\///</i>						
		9		-	· ·			Borehole BH8 continued as cored hole				-
					-	1						
				-53	2.0-							-
					-							-
3 09:03				-							liii	-
0/2018					.							-
> 12/1				-52	3.0-							-
Jgrile>					-							
CUrawii					.							
Subsection of the section of the				-51	.							
19558.0					4.0-	1						
DGEZ				_	.							
2-40/					.							-
				-50	50-							· ·
					-	-						:
				-	-	1						_
CKEH						1						
COFB				-49	6.0-	-						
Log					.	-						-
LEV.AL				-		1						
4.GLE					.							:
LIBRAR				-48	7.0-	1						-
10 8						1						
0					.	-						-
				-47	-	-						
met AD	hod auger	Irillina	*	sup M	port	N	nil	samples & field tests	soil grou	ip symb	ol &	consistency / relative density
AS HA	auger : hand a	crewii uger	ng*	C	casing	N	1111	D disturbed sample E environmental sample	based on /	AS 1726	2017	S soft F firm
W HA	washb hand a	ore uger		pen	etratior - ∾ ∞	n T– nore∘	istance	SS split spoon sample U## undisturbed sample ##mm diameter m	noisture cor	ndition		St stiff VSt very stiff
						rangir refusa	ig to al	HP hand penetrometer (kPa) D N standard penetration test (SPT) M	dry 1 moist			H hard Fb friable
* e.a	bit shơ AD/T	vn by	suffix	wat	er ▼ ¹⁰⁻ lev	Oct-12 w el on date	ater e shown	N* SPT - sample recovered W Nc SPT with solid cone W	/ wet /p plastic li	mit		VL very loose L loose
B T	blank t TC bit	it			wat	ter inflow	v	VS vane shear; peak/remouded (kPa) W R refusal	n iiqula lifî	nt		MD medium dense D dense
V	V bit						•	HB hammer bouncing				VD very dense



ATET	RA TE	ECH CC	MPANY								Boreho	le ID.	RHS		
				-	-	•	_				sheet:		2 of 3		
Ε	nç	jin	ee	rin	g Log - Cored	d Borel	lol	Э			project	20	754-SYE)GF2195	58
clie	nt:	<u>,</u>	`oun	trv (erden Δustralia Ptv Li	td					date sta		<u>21 Δμα :</u>	2018	00
			.ou	uy c	aruen Australia i ty =.	, C						liteu.	21 Aug -	2010	
prir	сгра	il:			,						date co	mpletea:	22 Aug 2	2018	
pro	ject:	3	t Le	onar	ds Development						logged	by:	АМ		
loca	ation	: S	it Le	onar	ds, NSW						checked	d by:	AB		
posi	tion:	E: 33	2,627.6	34; N: 6	,255,510.97 (MGA94) su	rface elevation: 54	4.92 m (/	AHD)		angle	e from horiz	ontal: 90°			
arıı dril	moae ling i	il: Geo	probe	782201	, Track mounted un	lling fluid: vvater				hole	diameter .	125 mm			
—					material descriptio	'n	8	estimated	samples,		defect	a	dditional observa	tions and	
od & ort	1	Ê	(ш) ч	hic loç	ROCK TYPE: grain charac colour, structure, minor con	xterisics, nponents	thering	& Is50 X = axial;	& Is(50) (MPa)	БG	(mm)	(type, inclin	ation, planarity, re thickness, oth	ons oughness, coa ner)	ting,
meth supp	wate	RL (I	dept	grap			weat alter	O=diametral J_Σ ± 못 ⊞	a = axial; d = diametral	Core & R	30 300 3000 3000	particular		ge	neral
			-												
		-	-												_
			-												1
		-54	1.0-												_
			-		started coring at 1.33m										-
	\square	F	-		SANDSTONE: fine to coarse grain or ange-red-brown to pale grey.	ined, Class IV)	MW			81%		PT, 26°, JT, 5°, U	PL, RO, CN N, RO, CN		
			-		indistinctly bedded at 5-15°.	0103311,			a=0.78 d=0.54]
		-53	2.0 —									JT, 6°, C	U, RO, Clay CO		
			-									DT 10°	C DO ON		-
		- '	-						a=0.68 d=0.46	95%		JT, 5°, U	PL, RO, CN N, RO, CN		
									d=0.92			— JT, 33°, I	R, RO, Fe SN		-
		-52	3.0 —												-
2			-		SANDSTONE: fine to medium gr	ained, pale	SW -		a=1.17 d=0.43		li <u>fi</u> ii	PT, 18°,	PL, RO, CN		-
ß			-		grey, (Class II), indistinctly bedde	ed at 5-20°.	FR					-			-
		-51	-								╽┿╪╅╝╷╷╷ ╽╷┝┓╷╷╷	⊨— JT, 41°, F ⊢	PL, RO, CN		-
5		-21	4.0 —									JT, 65°, I	PL, RO, CN		žed
20000			-							81%		-		à	80, Cl
MLC -			-											ots are	Vise d
		-50	-											Defei	othen,
			5.0						a=1.13 d=0.68			=			PT, 5 nless
		-	-									- SM, Clay	/, 11 mm		-
			-									SM, San SM, San	dy clay, 6 mm dy clay, 5 mm		-
		-49	- 60-		SANDSTONE: fine to meaium gra orange-brown, (Class IV), indistir	ained, nctly bedded at	SW					JT, 3°, U	N, RO, CN		
			- 0.0		10-25°.							JT, 71°, F JT, 3°, P	PL, RO, CN L, RO, CN		
		-	-						a=1.45 d=0.48			- JI, J, FI	L, KU, UN		-
C L D			-							200/		F			
		-48	7.0							83%		PT. 25°.	PI RO. Fe SN		
			-						0.86				- <u>L</u> ,,		
		- '	-						a=0.86 d=0.46		 	_			
3			-												-
	thod	-47	art	::::	cunnort	graphic log / cou		<u> </u> 	weathering	& alter;	ation*	defect type	e p	lanarity	
AS AC	au au	iger scr iger dri	i on ewing Ilina		C casing M mud N none	graphic log / coi	'e recover	ry	RS residu XW extrem	al soil nely wea	athered	PT parting JT joint	g P C	L planar U curved	
CB W	cla Wa	ashborr	ade bit		water	(graphic syr	mbols indicate	material)	HW nigniy MW moder SW slight	weather rately we	ed eathered	SS snear SZ shear	surface u zone S	T stepped	
RF NN		ck roller MLC cc	r re (51.9	mm)	water inflow	no core	recovere	d	FR fresh *W replaced w	/ith A for a	alteration	CS crushe SM seam	ed seam	(inegulai	
NQ wireline core (47.6mm) HQ wireline core (63.5mm) PO wireline core (68.5mm) DO wireline core (68.5mm)							VL very lov	w		roughnese	6 C	oating			
HA hand auger							M mediun H high	n		VR very RO rougi	rough C h S	N clean N stained			
					(lugeons) for depth interval shown	RQD = Rock Qu	Jality Desi	ignation (%)	VH very hig EH extrem	gh ely high		POL polis	hed C	O coating	

roughness VR very rough RO rough SO smooth POL polished SL slickensided



ATE	TRA	TEC	нсо	MPANY									Borehol	e ID.	BH8		
F			:	~~		alaa Cara	d Darak		_				sheet:		3 of 3		
_	I	Ig	IN	ee	rin	g Log - Corec	a Borer	101	e				project	no.	754-S	YDGE2195	58
clie	ent	:	C	coun	try G	Garden Australia Pty L	td						date sta	arted:	21 Au	g 2018	
pri	nci	pal:	:										date co	mpleted:	22 Au	g 2018	
pro	ojec	ct:	S	t Le	onar	ds Development							logged	by:	AM	-	
loc	catio	on:	S	t Le	onar	ds, NSW							checked	d by:	AB		
pos	sitio	n: E	: 33	2,627.6	64; N: 6	5,255,510.97 (MGA94) su	rface elevation: 54	1.92 m ((AHD)			angl	e from horiz	ontal: 90°			
dril	l mc	odel:	Geo	probe	7822di	t, Track mounted dri	lling fluid: Water					hole	diameter :	125 mm			
dr	illing	g ini	form	ation	mate	erial substance	-	1	a atima a	tod	complex	rock	mass defe	cts	ditional abor	un cations and	
ethod &	Lioddr	ater	r (m)	epth (m)	aphic log	ROCK TYPE: grain charac colour, structure, minor cor	cterisics, nponents	eathering & teration	streng & Is5 X = axi O = diam	gth 50 ^{ial;}	field tests & Is(50) (MPa) a = axial;	ore run 2 RQD	spacing (mm)	(type, inclina	defect des ation, planari thickness	criptions ty, roughness, coat , other)	ting,
5 3	S I	>	Ľ	ō	Б 			≥ oo MW -	Z J Z I	: > 血 	d = diametral	8 %	8 5 8 5 8	particular		gei	nerai
				-	· · · · · · · · · · · · · · · · · · ·	SANDSTONE: fine to medium gr grey, (Class III), indistinctly bedd	ained, pale ed at 10-30°.	SW SW			a=0.74 d=0.04	83%		- JT, 83°, U	JN, RO, CN		-
0			46	_	\sim	NO CORE: 0.35 m				††	-			FZ, 110 m	im		-
NN				9.0		SANDSTONE: fine to medium gr	ained, pale	FR			-			-			-
		ŀ	-	_	· · · · ·	grey, (Class II), indistinctly bedde	ed at 10-30°.			ij.	a=1.09 d=1.07	74%		_			-
				-	· · · · ·					ij.			┣┿╝╎╎╎		lay, 15 mm N, RO, CN		-
+	+	-	45	10.0		Borehole BH8 terminated at 10.0)0 m										¥
				-		Target depth											-
ţ				-													-
20 0 07		-	44	- 11 0 —													-
				-													-
		ŀ		-						İİ.							-
				_					:::	ij.							-
		F	43	12.0 —						ij.							
2000				-						ii.							-
				-						ļļ							-
0-10-		+	42	- 130—													_
COVER 1				-													-
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				-													-
500			41	14.0 —													_
				_						İİ.							-
				_					! ! !	ij.							-
		-	40	- 15.0 —					; ; ; ;	ij.							_
				_						ii.							-
		ŀ		-													-
3			-30	-													-
m	etho	sd &	supp	ort		support	graphic log / cor	e recove	ery		weathering RS residu	& alter al soil	ation*	defect type PT parting	1	planarity PL planar	
A A C	S D B	aug aug claw	er scr er dril v or bl	ewing ling ade bit		water	core rec	overed	e material)		XW extrem HW highly	nely weathe	athered red	JT joint SS shear	surface	CU curved UN undulating	
N R	/ R MIC	was rock	hbore rolle	re (51 0	mm)	level on date shown	no core	recovere	ed		SW slightly FR fresh	y weath	ered	CO contac CS crushe	t d seam	IR Irregular	
NQ wireline core (47.6mm) HQ wireline core (63.5mm)							*W replaced w strength VL very low	nth A for a	alteration	SM seam							
P H	Q A	wire hand	eline c d auqu	ore (85. er	0mm)		barrel w	ithdrawn			L low M mediur H hiah	n		VR very r RO rough	ough	coating CN clean SN stained	
	IA hand auger water pressure test result (lugeons) for depth interval shown M me barrel withdrawn M me hig RQD = Rock Quality Designation (%) VH ver EH ext									VH very hi EH extrem	gh ely high	I	SO smoo POL polish SL slicke	ith ned insided	VN veneer CO coating		



original size



drawn			client:	Country Garden A	Australia	PTY LTD	
approved		<i>cc</i> b	project:	Country Garden St Le	eonards l	Development	
date	22-08-2018	coffey	title:	St Leo	onards		
scale	N.T.S.	A TETRA TECH COMPANY		CORE PHC BI	DTOGR/ H8	APH	
original size	A4		project no:	754-SYDGE219558	fig no:	FIGURE 2	rev:



ATETR	A TECH	COMP	ANY							Boreł	nole ID.	BH9
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	igi	ne	erin	<u>g ı</u>	<u>-0(</u>	<u>J</u> -	во	renoie		proje	ct no.	754-SYDGE219558
clien	t:	Со	untry G	arde	en A	ustra	alia P	ty Ltd		date	started:	20 Aug 2018
princ	ipal:									date	completed	d: 20 Aug 2018
proje	ect:	St	Leonard	ds D)evel	орт	ent			logge	ed by:	AM
loca	tion:	St	Leonard	ds, I	vsw	,				checł	ked by:	AB
positi	on: E::	332,6	66.75; N: 6,	255,5	16.48 (MGA94	4)	surface elevation: 60.16 m (AHD)	angle	from ho	orizontal: 90	0°
drill m	nodel: G	eopro	obe 7822dt,	Trac	k mour	nted		drilling fluid: Water	hole	diamete	r : 125 mm	
drill	ing info	rmati	on			mate	rial sub	stance		~		
method & support	penetration	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative densit	hand penetro- meter (kPa) 8 8 8 8	structure and additional observations
A — AD/T — HA			E SPT	-60	- - - 1.0-			TOPSOIL: SILTY SAND: pale yellow brown. SANDSTONE: orange brown, recovered as low strength clayey sand.			TOPSOIL PID: 3.5 ppm7 HAWKESBURY SANDSTONE	
<u>v</u> v			SPT 2,8, /100mm HB N*=R	-59 -58 57 56 55 55 54 53 53	1.0 			Borehole BH9 continued as cored hole	soil gro	up symbol		consistency / relative density
method AD support AD auger drilling* AS auger screwing* HA hand auger W washbore HA hand auger * bit shown by suffix e.g. AD/T B blank bit T T C bit V V bit					port mud casing etration er er ₩ leve wat wat	N no res rangin refusa Oct-12 we el on date er inflow er outflov	nil istance g to d ater : shown	samples & field tests B bulk disturbed sample D disturbed sample E environmental sample SS split spoon sample U## undisturbed sample ##mm diameter HP hand penetrometer (kPa) N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone VS vane shear; peak/remouded (kPa) R refusal HB hammer bouncing	soil gro soil d based on moisture co D dry M moist W wet Wp plastic I WI liquid lir	up symbo escriptio AS 1726: ndition ndition	ol & n :2017	VSvery softSsoftFfirmStstiffVStvery stiffHhardFbfriableVLvery looseLlooseMDmedium denseDdenseVDvery dense

CDF_0_9_07_LIBRARY.GLB rev.AU_Log_COF BOREHOLE: NON CORED_754-SYDGE219558.GPJ_<<CDrawingFile>> 12/10/2018 09:03



ATE	rra te	CH CC	MPANY	_							Boreho	le ID.	BH9	
E	n	nir	~~	rin	a Loa - Coro	d Borok		•			sheet:		2 of 3	
	ΠĆ	<u> </u>	CC		y Lug - Cure			5			project	no.	754-SY	DGE219558
clie	ent:	C	Coun	try G	Garden Australia Pty L	td					date st	arted:	20 Aug	j 2018
priı	ncipa	al:									date co	mpleted:	20 Aug	j 2018
pro	ject:	S	St Le	onar	ds Development						logged	by:	AM	
loc	atior	: S	St Le	onar	ds, NSW						checke	d by:	AB	
pos	ition:	E: 33	2,666.7	'5; N: 6	,255,516.48 (MGA94) su	Inface elevation: 60).16 m	(AHD)		angl	e from hori	zontal: 90°		
drill	mode	el: Geo	probe	7822dt	r, Track mounted dr	illing fluid: Water				hole	diameter :	125 mm		
dri	lling i	ntorm	ation	mate	rial substance material descriptic	งท	ళ	estimated	samples,	rock	defect	acts	ditional obser	vations and
% pd		Ê	(E)	nic log	ROCK TYPE: grain chara colour, structure, minor cor	cterisics, nponents	hering	strength & Is50 X = avial:	field tests & Is(50) (MPa)	EQ	spacing (mm)	(type, inclina	defect desc ation, planarity thickness	riptions , roughness, coating, other)
meth	water	RL (n	depth	graph			weath	O=diametral	a = axial; d = diametral	core & RC	30 300 300 3000	particular	tillokiitess,	general
		-60	-											-
			-											-
		-	-											-
			1.0		started coring at 1.10m									_
l 1		-59	-	· · · · ·	SANDSTONE: medium to coarse orange brown to dark red-brown	e grained, , indistinctly	MW		1 70			— JT, 5°, Cl	J, RO, CN	-
				· · · · ·	bedded at 20-25° (Class V).				d=1.72 d=1.90					
			-									— PT, 25°, F	²L, RO, CN	-
		-58	2.0-				MW		a=0.44 d=0.44	76%	<mark>│ ╷ ╓┛</mark> ╷╷╷ ┝┽┽┩┼┼┼	│── JT, 2°, PL	., RO, CN	-
			-		SANDSTONE: medium to coarse	e arained nale	xw		-				in a ID an ata	-
to 20		-	-	· · · · ·	grey, indistinctly to distinctly cros	s bedded at						Root Jack	ing, IR, roots ing, IR, roots	-
			3.0		NO CORE: 0.24 m				-		┠┼┎┾┛╹╵╵	JT, 5°, UI	√, RO, CN	CN,
Ì		-57	-		SANDSTONE: medium to coarse	e grained, pale	xw		-			SM, Claye	ey sand, roots	are: RO: desc
2			-	· · · · ·	grey, indistinctly to distinctly cros	s bedded at	FR		a=0.54		} 4+4	рт, 8°, Рі	_, RO, CN	efects 2°, PL herwis
		-	-						d=0.51					Ss off.
5		-56	4.0 —	· · · · ·							l i i i i i i	— PT, 20°, F	ΡL, RO, CN	, and the second s
			-						2=0.80	77%		PT, 15°, F	PL, RO, CN	-
- NMLO	/08/18	-	-						d=0.44		│ ┆┆ │ ┆┆	PT, 3°, PI	L, RO, CN	-
	27	-	- 50-								 	PT, 10°, F	PL, RO, CN	-
		-55		· · · · ·										-
	04/09/-		-	· · · · ·	5.45 m; orange brown to pale gr	ev	SW					PT, 20°, F PT, 20°, F	²L, RO, CN ²L, RO, CN	-
		-	-	· · · · ·		-)			a=0.36			JT, 5°, ST PT, 18°, F	, RO, CN ²L, RO, CN	-
3			6.0 —		NO CORE: 0.35 m				-		┢┿╝┆┊┆	-		-
		-94	-				SW		_			1 10— лт		-
			-		SANDSTONE: as previous. SANDSTONE: medium to coarse	e grained, pale	300		a=0.25 d=0.26					-
2			-	· · · · ·	grey, massive (Class II).				0.20	79%				-
		-53	7.0-						0.70					
			-						a=0.79 d=0.77			JT, 0°, PL	., RO, CN ., RO, CN	-
3		-	-									JT, 0°, PL	., RO, CN	-
\vdash	athor	8	ort	::::	support	graphic los / com			weathering	& alter	ation*	PT, 2°, Pl defect type	_, RO, CN	planarity
AS	Bai Dai	iger sc iger dri	ewing		C casing M mud N none		overed	y	RS residu XW extrem	al soil nely wea	athered	PT parting JT joint	surface	PL planar CU curved
CE W	di Wa	aw or b ashbore	ade bit e r		10/10/12, water level on date shown	(graphic syn	nbols indicate	e material)	MW mode SW slight	ately weath	eathered ered	SZ shear CO contac	zone	ST stepped IR Irregular
NI N	MULCINILC core (51.9 mm) NQ wireline core (47.6mm)					FR fresh *W replaced w strength	ith A for a	alteration	CS crushe SM seam	d seam				
HQ wireline core (63.5mm) PQ wireline core (85.0mm)						VL very lov L low M medium	w n		roughness VR vervir	rouah	coating CN clean			
HA	A ha	nd aug	er		water pressure test result	RQD = Rock Qu	ality Des	ignation (%)	H high VH very hi	y high SO smooth VN veneer				
					interval shown				EH extrem	ely high	I	POL polish SL slicke	ied insided	CO coating



A TETRA TECH	H COMPANY								Borehol	e ID.	BH9
Engi	Inna	rin		rad Darah		•			sheet:		3 of 3
Engi	inee	rin	g Log - Co	rea Borer	1016	J			project i	10.	754-SYDGE219558
client:	Coun	try G	arden Australia F	Pty Ltd					date sta	rted:	20 Aug 2018
principal:	principal:										20 Aug 2018
project:	St Le	ds Development					logged by: AM				
location:	St Le	onar	ds, NSW					checked by:			AB
position: E:	: 332,666.7	'5; N: 6	,255,516.48 (MGA94)	surface elevation: 60).16 m (AHD)		angl	e from horiz	ontal: 90°	,
drill model:	rill model: Geoprobe 7822dt, Track mounted drilling fluid: Water									25 mm	
drilling info	ormation	mate	rial substance					rock mass defects			
	material description of estimated								defect additional observations and		

					_	material descriptio	n	જ	е	stima	ated	samples,			de	fect		additional o	bservations and	
ø	<u>ب</u>		~	Ē	c log	ROCK TYPE: grain charac	cterisics,	ering		stren & Is	gth 50	& ls(50)	50	1	spa m	icing im)	(type	, inclination, plar	descriptions narity, roughness, c	oating,
etho	odd	ater	E L	spth	aphi		iponents	eathe	0	X = ax) = dian	dal; netral	(MPa) a = axial;	RQ RQ			. 8 8	3	thickn	ess, other)	
E	ะ	š	Ř	ą	- лб			ਤੇ ਹੋ	₹.	- ≤ - 608	∊ ⋽ ⊞ ञ	d = diametral	୍ଧ <i>ବ</i> 98%	8	É é	ğ₽8	§ partici	ular		general
			-52	-	· · · · ·	grey, distinctly bedded at 0-10° (ained, paie Class II),		li	×	i 8	a=0.57		Ιi	i.	ii i				-
				-	· · · · ·	carbonaceous laminae. (continue	ed)					d=0.75	0.00/							-
			_	-	· · · · ·						8 I 8 I		98%	Ľ	ì	ľ.	!	/l, Clay, 8 mm		-
				-	: : : :	SANDSTONE: fine to coarse gra grey massive (Class II)	ined, pale		İ		i i			İ	Ì.	i i	i			-
				9.0 —		g.ey,				¢	8 8	a=1.26				4				
M			-51	-					li		ŝ i	u=0.99		Ιi	i.	i i	i			-
Ī				-	· · · · ·															-
			-	-	· · · · ·								100%	Ľ	ì					-
				-	· · · · ·				İ		Ì.			Ì	Ì		i			-
			-50	10.0 -	· · · · ·						8 I 8 I	a=0.93 d=0.91		H	ir-		т — л	. 8°. ST. RO. CN		
					: : : :				i		ŝ i			Ιi	ή		TL -	, 25°, ST, RO, C	N	_
				_		10.41 m: dark grey laminations	/			<u> </u>	4+				+					
0.00			-	_		Borehole BH9 terminated at 10.4 Target depth	8 m							l i	ì					-
1010				11.0 —						!!	11				1					_
17			-49	-										Ľ	Ì					-
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D.			-	-										H	Ì					-
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																				_
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5				13.0 —						11										
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Š			-40	-						ii	ίi			Ιi	i					-
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	neth	od 8	k supp	ort		support	graphic log / cor	e recove	ery			weathering	& alter	atio	n*		defe	ct type	planarity	
A	NS ND	aug aug	ger scr ger dri	ewing lling		C casing M mud N none		nvered				XW extrem	nely weatho	athe	ered	i	JT	joint shear surface	CU curved	na
V	:В V	cla wa	w or bl shbore	ade bit		10/10/12, water	(graphic syn	nbols indicate	e mate	erial)		MW moder	ately weath	eath	nere 1	ed	SZ	shear zone	ST stepped	
F	RR ML	roc CNN	k rolle	r re (51.9	mm)	water inflow	no core	recovere	ed			FR fresh *W replaced w	ith A for a	altera	ation	n	CS SM	crushed seam		
I I	IQ IQ	wir wir	eline c eline c	ore (47. ore (63.	6mm) 5mm)	complete drilling fluid loss	core run & RQD					Strength VL very lov	v				Givi			
F	2 VQ	wir	eline c	ore (85.	0mm)		barrel w	ithdrawn	1			L low M mediun	n				VR	very rough	coating CN clean	
⊦	ΙA	han	id aug	er		water pressure test result	RQD = Rock Qu	ality Des	signa	ation	(%)	H high VH very hig	gh				RO SO	rough smooth	SN stained VN veneer	
						interval shown						EH extrem	ely high				POL SL	polished slickensided	CO coating	







A TETRA TECH COI	MPANY				Hole ID.	BH9
Diazo	moto	r Installation			sheet:	1 of 1
Piezoi	nete	rinstallation	LOG		project no.	754-SYDGE219558
client: C	ountry C	Garden Australia Pty L	td		date started:	20 Aug 2018
principal:					date completed:	20 Aug 2018
project: S	t Leonar	rds Development			logged by:	AM
location: S	t Leonar	rds, NSW			checked by:	AB
position: E: 332	2,666.75; N: 6	6,255,516.48 (MGA94) su	rface elev	vation: 60.16 m (AHD) ar	ngle from horizontal: 90°	
equipment type:	Geoprobe 7	822dt, Track mounted dri	lling fluid:	: Water ho	ole diameter : 125 mm	
drilling informat	tion mate	erial substance		piezometer construction details	bore construction lic	ense:
od &	(m) lic log	material name			drilling company:	
metho suppo water RL (m	depth graph			ВН9	driller's permit no.:	
H → GO -58 -58 -58 -58 -58 -58 -58 -58		HAWKESBURY SANDSTONE		3.50 m 4.00 m 4.48 m	- Grout Bentonite	
					. 1	-
	11					
method & suppo see engineerin	ort g log for details	graphic log / core recovery	ID	type installation state	stickup tip depth water level (m) (m) (m)	Relative Levels (AHD)
water 10-Oct-12 level on ci water infle complete partial dri 10-Oct-12 level on ci water infle partial dri 10-Oct-12 level on ci water infle partial dri 10-Oct-12 level on ci water infle partial dri 10-Oct-12 level on ci water infle partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci partial dri 10-Oct-12 level on ci 10-Oct-12	2, water late shown ow drilling fluid los lling fluid loss ure test result or depth	ss	BH9	standpipe	10.48 m	stickup tip water level 49.68

Appendix D – Groundwater Monitoring results



Groundwater monitoring results

Borehole ID	Date: 27/08/18	04/09/18				
	Groundwater Level (me	tres below ground level)				
BH1	Not drilled	4.47				
BH3	Not drilled	3.82				
BH5	4.15	4.30				
BH7A	3.77	3.90				
BH9	4.98	5.17				

Appendix E – Soil & Rock Laboratory Results



Client: Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067 **Principal:** Project No.: 754-SYDN00220AA 754-SYDGE219558 - 754-CGA ST LEONARDS Project Name: Lot No.: -TRN: -

SYDN18S-07107

Sample Details

Sample ID: **Client Sample:** Date Sampled: Source: Material: Specification: Sampling Method: Project Location: Sample Location:

Ex. Site Clay No Specification Submitted by client CGA ST LEÓNARDS BH1 1.0 - 1.45

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	28	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	11	
Date Tested		6/09/2018	
Moisture Content (%)	RMS T120	8.7	
Date Tested		5/09/2018	

Comments

N/A



Sydney Laboratory

Coffey Services Australia Pty Ltd ABN 55 139 460 521 31 Hope Street Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

Report No: SYDN18S-07107-1 Issue No: 1

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.

Approved Signatory: Renni Cetinich (GeoTechnician) NATA Accredited Laboratory Number:431 Date of Issue: 10/09/2018

Form No: 18909, Report No: SYDN18S-07107-1



Client: Level 19, 799 Pacific Highway Chatswood NSW 2067 **Principal:** Project No.: 754-SYDN00220AA 754-SYDGE219558 - 754-CGA ST LEONARDS Project Name: Lot No.: -TRN: -

SYDN18S-07108

Sample Details

Sample ID: **Client Sample:** Date Sampled: Source: Material: Specification: Sampling Method: Project Location: Sample Location:

Ex. Site Clay No Specification Submitted by client CGA ST LEÓNARDS BH2 2.5 - 2.8

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.5	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	28	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	12	
Date Tested		6/09/2018	
Moisture Content (%)	RMS T120	11.2	
Date Tested		5/09/2018	

Sydney Laboratory

Coffey Services Australia Pty Ltd ABN 55 139 460 521 31 Hope Street Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

Report No: SYDN18S-07108-1 Issue No: 1 Accredited for compliance with ISO/IEC 17025 -Testing. Coffey Services Australia Pty Ltd (Chatswood) The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.



RMature Approved Signatory: Renni Cetinich (GeoTechnician) NATA Accredited Laboratory Number:431 Date of Issue: 10/09/2018

Comments

N/A



Client: Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067 **Principal:** Project No.: 754-SYDN00220AA 754-SYDGE219558 - 754-CGA ST LEONARDS Project Name: Lot No.: -TRN: -

SYDN18S-07109

Sample Details

Sample ID: **Client Sample:** Date Sampled: Source: Material: Specification: Sampling Method: Project Location: Sample Location:

Ex. Site Clay No Specification Submitted by client CGA ST LEÓNARDS BH3 1.0 - 1.45

Test Results

		- "	
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	8.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	41	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	22	
Date Tested		6/09/2018	
Moisture Content (%)	RMS T120	15.2	
Date Tested		5/09/2018	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd ABN 55 139 460 521 31 Hope Street Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

Report No: SYDN18S-07109-1

Issue No: 1

Accredited for compliance with ISO/IEC 17025 -Testing.



KMature

WORLD RECOGNISED

Approved Signatory: Renni Cetinich (GeoTechnician) NATA Accredited Laboratory Number:431 Date of Issue: 10/09/2018



 Client:
 Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067

 Principal:
 Project No.:

 Project No.:
 754-SYDN00220AA

 Project Name:
 754-SYDGE219558 - 754-CGA ST LEONARDS

 Lot No.:

SYDN18S-07110

Sample Details

Sample ID: Client Sample: Date Sampled: Source: Material: Specification: Sampling Method: Project Location: Sample Location:

-Ex. Site Clay No Specification Submitted by client CGA ST LEONARDS BH4 2.5 - 2.95

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	31	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	12	
Date Tested		6/09/2018	
Moisture Content (%)	RMS T120	10.6	
Date Tested		5/09/2018	

Comments

N/A



Sydney Laboratory

Coffey Services Australia Pty Ltd ABN 55 139 460 521 31 Hope Street Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

Report No: SYDN18S-07110-1

Issue No: 1

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.



Approved Signatory: Renni Cetinich (GeoTechnician)

(GeoTechnician) NATA Accredited Laboratory Number:431 Date of Issue: 10/09/2018



Attention:

Project name

Report



Certificate of Analysis

Coffey Geotechnics Pty Ltd Chatswood Level 18, Tower B, Citadel Tower 799 Pacific Highway Chatswood NSW 2067

Aidan McKenzie

SYDGE219558

615231-S

mgt



NATA Accredited Accreditation Number 1261 Site Number 1254

WORLD RECOGNISED

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.

Received Date Aug 30, 2018					
Client Sample ID Sample Matrix			BH8/0.8 Soil	BH7/1.0 Soil	BH4/1.0 Soil
Eurofins mgt Sample No.			M18-Au41243	M18-Au41244	M18-Au41245
Date Sampled			Aug 23, 2018	Aug 23, 2018	Aug 23, 2018
Test/Reference	LOR	Unit			
Chloride	5	mg/kg	8.4	17	29
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	35	68	39
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	8.5	8.7	8.2
Resistivity*	0.5	ohm.m	290	150	260
Sulphate (as SO4)	30	mg/kg	46	< 30	< 30
% Moisture	1	%	18	15	17



Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported. A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

mgt

Description	Testing Site	Extracted	Holding Time
Chloride	Melbourne	Sep 03, 2018	28 Day
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Melbourne	Sep 03, 2018	7 Day
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Melbourne	Sep 03, 2018	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Sep 03, 2018	28 Day
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
% Moisture	Melbourne	Aug 31, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

eurofins mgt	ABN– 50 005 085 e.mail : EnviroSale	521 es@eu	rofins.com	Melbourne 2-5 Kingston Town Close Oakleigh VIC 3166 Phone : +61 3 8564 5000 NATA # 1261	Sydney Unit F3, Building F 16 Mars Road Lane Cove West NSW 2066 Phone : +61 2 9900 8400	Brisbane 1/21 Smallwood Place Murarrie QLD 4172 Phone : +61 7 3902 4600 NATA # 1261 Site # 2079	Perth 2/91 Leach Highway Kewdale WA 6105 Phone : +61 8 9251 9600 MATA # 1261
	web : www.eurofir	ns.com.	au	Sile # 1254 & 142/1	INATA # 1201 Site # 18217		SILE # 23/30
Company Name: Coffey Geotechnics Pty Ltd Chatswood Address: Level 18, Tower B, Citadel Tower 799 Pacific Hi Chatswood NSW 2067	lighway		Order No.: Report #: Phone: Fax:	615231 +61 2 9406 1000 +61 2 9406 1002		Received: Due: Priority: Contact Name:	Aug 30, 2018 2:07 PM Sep 6, 2018 5 Day Aidan McKenzie
Project Name: SYDGE219558							
					Eurofir	ns mgt Analytical Ser	vices Manager : Nibha Vaidya
Sample Detail		Aaaressivity Soil Set	Moisture Set				
Melbourne Laboratory - NATA Site # 1254 & 14271		х	х				
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794							
Perth Laboratory - NATA Site # 23736							
No Sample ID Sample Date Sampling Matrix							
Time							
1 BH8/0.8 Aug 23, 2018 Soil M18	8-Au41243	х	х				
2 BH7/1.0 Aug 23, 2018 Soil M18	8-Au41244	х	х				
3 BH4/1.0 Aug 23, 2018 Soil M18	8-Au41245	Х	X				
Test Counts		3	3				



mgt

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.

- 2. All soil results are reported on a dry basis, unless otherwise stated.
- 3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
- 4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences
- 5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
- 6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
- 7. Samples were analysed on an 'as received' basis.
- 8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days. **NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	mg/L: milligrams per litre	ug/L: micrograms per litre
ppm: Parts per million	ppb: Parts per billion	%: Percentage
org/100mL: Organisms per 100 millilitres	NTU: Nephelometric Turbidity Units	MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
сос	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
СР	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

- 1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- 2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- 3. Organochlorine Pesticide analysis where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
- 4. Organochlorine Pesticide analysis where reporting Spike data, Toxaphene is not added to the Spike.
- 5. Total Recoverable Hydrocarbons where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
- 6. pH and Free Chlorine analysed in the laboratory Analysis on this test must begin within 30 minutes of sampling. Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
- 7. Recovery Data (Spikes & Surrogates) where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
- 8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
- 9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
- 10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.



mgt

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25°C as rec.)	M18-Au40474	NCP	uS/cm	160	190	2.3	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	M18-Au41264	NCP	pH Units	7.9	7.9	pass	30%	Pass	
Resistivity*	M18-Au40474	NCP	ohm.m	62	53	2.3	30%	Pass	
Sulphate (as SO4)	A18-Au38451	NCP	mg/kg	570	380	41	30%	Fail	Q15
% Moisture	M18-Au41243	CP	%	18	19	4.0	30%	Pass	



mgt

Comments

Sample Integrity	
Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

 Code
 Description

 Q15
 The RPD reported passes Eurofins | mgt's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Nibha Vaidya Alex Petridis Michael Brancati Analytical Services Manager Senior Analyst-Metal (VIC) Senior Analyst-Inorganic (VIC)

Glenn Jackson National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

- * Indicates NATA accreditation does not cover the performance of this service
- Measurement uncertainty of test data is available on request or please click here.

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Point Load Test Results

Borehole ID	Depth (m)	ls(50)
BH1	1.83	0.06
BH1	2.36	0.13
BH1	3.42	0.53
BH1	4.49	0.68
BH1	5.33	0.57
BH1	6.44	0.21
BH1	7.42	0.82
BH1	8.48	0.64
BH1	9.47	0.53
BH2	3.18	0.27
BH2	4.26	1.66
BH2	5.39	2.65
BH2	5.69	0.62
BH2	7.00	1.13
BH2	8.00	1.44
BH2	9.04	1.48
BH2	10.00	1.57
BH3	2.27	0.17
BH3	3.17	0.27
BH3	4.72	0.33
BH3	5.50	0.75
BH3	6.63	0.48
BH3	7.70	1.29
BH3	8.21	0.90
BH3	9.63	0.86
BH3	10.00	0.99
BH4	3.06	0.93
BH4	3.45	0.89
BH4	4.00	1.03
BH4	4.76	1.34
BH4	5.76	1.39
BH4	5.90	0.97
BH4	6.22	1.42
BH4	6.44	0.70
BH4	7.30	0.90
BH4	8.24	0.33
BH4	9.44	1.46
BH4	10.31	2.06
BH5	1.90	0.11
BH5	2.75	1.20
BH5	3.90	0.93
BH5	4.91	1.04
BH5	5.12	0.94
BH5	5.38	1.04
BH5	6.10	1.39
BH5	6.30	1.10
BH5	7.10	1.10

Borehole ID	Depth (m)	ls(50)
BH5	7.62	0.74
BH5	8.09	0.94
BH5	8.89	1.30
BH5	9.09	1.16
BH5	9.20	1.13
BH6	1.04	0.71
BH6	2.07	0.28
BH6	3.00	1.06
BH6	4.13	0.75
BH6	5.13	0.59
BH6	6.45	0.86
BH6	7.45	0.80
BH6	8.44	0.38
BH6	9.45	0.72
BH6	10.00	1.53
BH7A	3.55	0.52
BH7A	4.60	0.62
BH7A	5.54	0.21
BH7A	6.58	1.14
BH7A	7.74	0.96
BH7A	8.00	1.02
BH7A	9.00	0.21
BH7A	10.00	0.60
BH8	1.65	0.76
BH8	2.36	0.70
BH8	2.49	1.30
BH8	3.13	1.16
BH8	5.00	1.13
BH8	6.32	1.42
BH8	7.32	0.87
BH8	8.32	0.71
BH8	9.30	1.09
BH9	1.39	1.71
BH9	2.02	0.45
BH9	3.56	0.54
BH9	4.43	0.77
BH9	5.72	0.34
BH9	6.55	0.26
BH9	7.27	0.75
BH9	8.24	0.58
BH9	9.00	1.23
BH9	10.00	0.92

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Area 22 Proposed Residential Development 26-36 Park Road, 27-47 Berry Road, and 48-52 River Road, St Leonards

Geotechnical Desktop Study

Berry Road Development Pty Ltd



Reference: SYGE304523-AA

06 June 2023

AREA 22 PROPOSED RESIDENTIAL DEVELOPMENT, 26-36 PARK ROAD, 27-47 BERRY ROAD AND 48-52 RIVER ROAD, ST LEONARDS

Geotechnical Desktop Study

Report reference number: SYGE304523-AA

06 June 2023

PREPARED FOR

Berry Road Development Pty Ltd Shop 24/25, 1 Nipper Street Homebush NSW 2140

PREPARED BY

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QUALITY INFORMATION

Revision history

Revision	Description	Date	Author	Reviewer	Approver
Rev 0	First Issue	19 July 2022	Phil Mackenzie	Robert Turner	Robert Turner
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APPENDICES

APPENDIX A: LIMITATIONS

1. INTRODUCTION

1.1 PURPOSE

Berry Road Development Pty Ltd (BRD) has acquired a parcel of land titled Area 22 at St Leonards, NSW comprising the properties at 26 – 50 Park Road, 27 – 47 Berry Road, 48 – 54 River Road, on which it proposes to construct a multi-storey residential development with associated basement carparking and amenities. A detailed investigation was not possible at this time due to site occupancy so BRD commissioned Tetra Tech Coffey Pty Ltd (Coffey) to prepare this desktop study report to assess the geotechnical feasibility of the proposed development, assist initial design and support the Development Application process. The study was conducted in accordance with Coffey proposal SYDGE21955AB dated 2 June 2022.

1.2 BACKGROUND

The southern portion of the site, titled Area 23 was the subject of a previous geotechnical investigation by Coffey commissioned by Country Garden Australia Pty Ltd in 2018. Outcomes were documented in Coffey report reference SYDGE219558-GAR-RPT-02 dated 19 October 2018 (Coffey 2018). Since then the site developer has acquired neighbouring land. The expanded development site is now called the Berry Road Development.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The approximate site boundary is shown in red. The yellow outline shows the site boundary at the time of the previous investigation (Coffey, 2018) (sourced from Google maps, accessed 20 June 2022).



Figure 1: Approximate Site Boundary

A site walkover was carried out by a Coffey on 27 June 2022. The key site features are summarised below.

- The site of about 12,450 m² comprises 26 residential lots bounded by Berry Road to the west, River Road to the south, Park Road the east, residential properties to the north. Berry Lane bisects the site middle.
- The lots were occupied by single or double storey residential dwellings, with some dual occupancy and townhouses, swimming pools, sheds and landscaped areas.
- The site ground levels fall from approximately 75 m AHD at the northern boundary to 57 m AHD towards River Road at grades of approximately 8 to 10 degrees, steepening into a small rock face with outcropping sandstone (approximately 5 m high) at the southern end of Berry Road.
- Cut and fill activities appear to have occurred across the site to provide level construction surfaces for individual plots. Some fill would have likely been placed beneath the existing building footprints and landscaped areas.

3. PROPOSED DEVELOPMENT

Coffey understands that BRD propose to develop a multi-storey residential development with basement carparking. The preliminary architectural plan shown in figure 2 indicates the basement will be excavated to approximately 54 mAHD. This will provide a two-level basement at the southern end of the site and a four-level basement at the northern end. This results in expected excavation depths ranging from 4m in the south west corner to 20m in the north eastern corner of the site. Coffey understands that the "U" shaped area shaded green in figure 2 has been designated as "Green Space" and will not be excavated for basement construction.



Figure 2: Preliminary Basement Plan (Source: Drawing DA200 Rev C by DKO Architecture (NSW) Pty Ltd)

4. DESKTOP STUDY INFORMATION

4.1 LOCAL GEOLOGY

Review of the 1:100,000 Sydney Geological Sheet indicates the site is bisected by the boundary between Ashfield Shale and the underlying Hawkesbury Sandstone. This boundary is located near the junction between the Coffey 2018 investigation and the newly acquired land. This is illustrated in Figure 1 by the yellow line at 38 Park Road. The bedrock units are summarised below.

- Ashfield Shale: Dark-grey to black claystone-siltstone and fine sandstone-siltstone laminite of the Wianamatta Group.
- Hawkesbury Sandstone: Medium to very coarse-grained quartz sandstone, very minor shale and laminite lenses. Typically bedded between 1 m and 3 m thickness.

These units are typically separated by the Mittagong Formation comprising interbedded shale and sandstone of variable strength. It varies in thickness in Sydney up to 10 m, with an average thickness of 2 m.

4.2 SOIL LANDSCAPE AND ERODABILITY

The Sydney Soils Landscape Sheet indicates that the majority of site is within the Glenorie soil landscape with the southern boundary underlain by the Gymea soil landscape. Glenorie landscapes are characterised by undulating to rolling low hills on Wianamatta group shales. The soil horizons are typically friable to hard setting topsoil, underlain by grey to brown, plastic clays with shale gravel. Clays within the lower horizons are typically moderately reactive, with potential for erodibility.

Gymea soil landscapes are characterised by undulating to rolling rises and low hills on benched Hawkesbury sandstone. Soil horizons below the topsoil are typically clayey sand, slightly reactive with very low erodibility, transitioning to moderately reactive, highly erodible clay.

4.3 GROUNDWATER

Groundwater at the site is likely to occur as discontinuous lenses at the soil and bedrock interface. This groundwater is likely recharged by local rainfall events and possibly by runoff from the land situated to the north (up topographical gradient) of the site.

Results from the Coffey 2018 investigation indicated that the average depth below existing surface to groundwater was 4.3m with minimum and maximum depths of 3.8m and 5.2m respectively. Typically, the measured ground water levels coincided with the very low to low strength sandstone layers.

4.4 ACID SULFATE SOILS

Reference to local acid sulfate soil (ASS) risk maps, indicates that the site is located in an area of no known occurrence of ASS.

4.5 COFFEY ARCHIVE AND OTHER INFORMATION

Coffey has prepared previous geotechnical reports for parts of the current site. The following reports were referenced for this desktop study.

- Geotechnical Desk Study GEOTLCOV25696AA-AC, 48-54 River Rd, 47 Berry Rd and 42-50 Park Rd.
- Geotechnical Assessment Report SYDGE219558-GAR-RPT-02 (Coffey 2018).

We also referred to 2017 report reference SYDGE25684AA-AL for a site located at the southern end of the RNSH precinct, some 400 m to the north of the subject site. That site was also located near the boundary of Ashfield Shale and Hawkesbury Sandstone. The boreholes for that investigation intersected the top of Hawkesbury Sandstone at about 70 to 74 mAHD. The Hawkesbury Sandstone dips very gently to the south so the transition from Ashfield Shale to Hawkesbury Sandstone would be expected at lower elevation on the subject site.

5. PRELIMINARY GEOTECHNICAL MODEL

Based on the mapped geological boundaries and the archival information we have provide two geotechnical models to describe the southern and northern halves of the site. The model for the southern portion of the site is informed by the Coffey 2018 investigation and the northern portion of the site is informed by the geological mapping and the Coffey 2017 investigation at the RNSH precinct reference in section 4.5 above.

The southern portion of the site is likely underlain by (in descending order).

- **Soil strength materials:** Variable Fill (variable depth associated with current development) overlying Residual Soil. The combined thickness of soil strength may be about 3m on average.
- **Class V and IV Sandstone** Very low and low strength sandstone between 3m and 6m in thickness, possibly including some Mittagong Formation.
- **Class III and II Sandstone** mainly medium and high strength, expected to be encountered from about 53 mAHD near the southern boundary to 57 mAHD at the midpoint of the site.

The northern portion of the site is expected to be underlain by (in descending order):

- Soil strength materials: Variable Fill associated with current development, overlying Residual Soil. Thickness likely to be reasonably similar to the southern portion of the site, but with slightly deeper Residual Soil and some Class Vertical Shale
- Class IV and III Shale: Very low and low strength. Thickness unknown
- Class II Shale mainly medium or high strength, more likely towards northern end of site.
- **Class V and IV Sandstone** Very low to low strength sandstone, possibly including some Mittagong Formation.
- Class III and II Sandstone Sandstone (medium and then high strength) is expected to be encountered from about 57 mAHD near the midpoint of the site to between 60 and 65 mAHD at the northern boundary. Consideration should also be given to the possible impact of this sandstone layer being present up to 70 mAHD at the northern boundary.
- Not all the above soil and rock units may be present at any particular location within the northern portion of the site.

Rock classification is based on the system presented in "Foundations on Sandstone and Shale in the Sydney Region" Aust. Geomech. Jnl, Dec 1998, Pells et al (1998).

6. DISCUSSIONS AND RECOMMENDATIONS

6.1 EXCAVATIONS

6.1.1 Excavation Conditions

The proposed development comprises two or four basement levels with bulk excavation level at about 54 mAHD. Excavation of Soil Strength Materials and some Class IV Shale or Class V/IV Sandstone should be able to be excavated using conventional earthmoving equipment such as a tracked excavator with toothed bucket. Light ripping may be necessary to assist where stronger rock bands occur.

Based on the proposed bulk excavation level and the estimated site geology, it is likely that up to 5m of Class III or better Shale and/or Sandstone may have to be excavated to achieve the design bulk excavation level. Where medium strength or better shale and sandstone is present, hard rock excavation techniques such as large dozers fitted with rippers, or large excavators fitted with rock saws, rock grinders and rock hammers may be required. The use of hard rock excavation techniques will cause vibrations that could damage vibration sensitive structures, infrastructure, and underground services. Assessment of the potential impacts of excavation induced vibrations should be considered as part of the detailed design and excavation planning.

6.1.2 Bulk Excavation Support Requirements

The depth and proximity of the excavation to adjacent roads and residential properties will most likely preclude the use of unsupported excavations at this site.

It may be possible to batter or bench the excavation next to the River Road boundary if there is sufficient offset from the road. For a feasibility study of this option, the basement offset, and depth should allow for a temporary batter of 2H:1V.

Typically, in these geological conditions a drained basement would be constructed at this site. This could comprise either anchored soldier pile retaining walls with shotcrete infill or anchored contiguous pile retaining walls as excavation support depending on wall stiffness requirements. For preliminary design Coffey recommends the piles be drilled and socketed into rock below the bulk excavation (BE) level. Where Class III or better Sandstone or Shale is encountered above the BE level, it may be feasible to terminate the shoring piles in these units and progress the excavation as a vertical cut in the rock face. Where this method is adopted regular geotechnical inspections are necessary to determine if additional support mechanisms are required such as shotcrete with rock bolt anchors to stabilise the rock face.

Additional consideration will be required for the "U" shaped Green Space. The opposing internal walls may require temporary struts or passive tie rods as temporary support if inclined strand anchors cannot be installed without conflicting with the opposing piles and anchors. A second option would be to install the perimeter walls only and to then excavate the "U" to Class III rock from where it can be cut vertical. This option would then require the "U" area to be backfilled with engineered fill after the basement walls have been constructed.

Alternative shoring solutions could be considered in consultation with specialist contractors.

Basement excavations may have the potential to impact on neighbouring structures and buried services within the streets. The location and sensitivity of such structures and services should be assessed and allowed for during detailed retaining wall design works.
6.1.3 Excavation Induced Ground Movements

Excavation will cause some ground movements adjacent to the excavation site. The magnitude of the movements that will be experienced by a retaining wall will depend on various factors including the earth pressures that exist, groundwater conditions and construction sequence. Documented data in Sydney excavations has shown that for well-designed and constructed shoring, vertical and lateral movements can be about 0.1% to 0.3% of the retained height at the excavation face. Lateral ground movements can occur at distances up to twice the basement depth from the edge of excavations.

Notwithstanding typical ground movements described above, the assessment of excavation-induced ground movements involves detailed soil structure interaction analysis. The accuracy of the assessment results plays an important role in determining the impact of the excavation on the adjacent structures and roads as well as evaluating the effectiveness of the proposed retaining wall. If this assessment is required, Coffey can provide the assessment (by numerical analyses) during the detailed design when more design information becomes available.

It is recommended that dilapidation surveys be carried out prior to the commencement of the excavation to assess the condition of the buildings within the zone of influence of the excavation. Potential risk of damage to buildings from ground movements during excavation should be considered during the development of the excavation methodology. Ground movements of the buildings should be monitored during excavation to reduce the risk of damage from excessive ground movements.

6.1.4 Groundwater Control During Excavation

Groundwater seepages in this geological setting typically occur at soil/rock interfaces, through bedrock joints, bedding planes, partings, and other defects within the rock mass.

Groundwater levels recorded in the Coffey 2018 investigation suggest basement excavation could encounter groundwater inflow. In this geology groundwater inflows into the basement can generally be controlled using conventional sump and pump techniques for discharge into stormwater or sewer systems networks, subject to regulatory approvals. For a drained basement, permanent floor and wall drainage will need to be installed and maintained to relieve hydrostatic pressures on retaining walls and buoyancy pressures on basement floors. To dispose of groundwater inflows throughout the life of the structure, it is expected that the drainage system would include a sub-floor drainage blanket with slotted drainage pipes and a sump and pump system with the ability to effectively back flush the system for long-term maintenance.

As part of further site investigations, groundwater quality/chemistry testing may be necessary to obtain regulatory approvals for discharge into sewer or stormwater. Groundwater inflow assessment may also be required where a drained basement is used.

6.1.5 Excavation Induced Vibrations

The use of excavation plant such as impact hammers will generate vibrations that may affect any surrounding sensitive structures and buried services. Measures to mitigate the risks associated with construction vibration such as the use of rock hammers on excavators during construction should be considered. It is recommended that vibration monitoring be undertaken on the existing structures and on the ground adjacent to the structures.

6.2 FOUNDATIONS

It is expected that Class III Sandstone or better will be exposed at BE level over the majority of the basement footprint, so that pad/strip footing system could be adopted. A portion of the basement adjacent to the River Road boundary may expose Class IV Sandstone at BE level, so piled footings to Class III Sandstone may be needed in this area. (For structures sensitive to differential movements, Coffey would recommend all footings be founded in similar rock). A preliminary serviceability geotechnical design bearing pressure of 3,500kPa can be adopted for Class III Sandstone or better.

6.3 SOIL AGGRESIVITY

The result of laboratory testing conducted during the 2018 investigation indicated the soil has an exposure classification of 'Mild' and 'Non-aggressive' as according to AS2159-2009 for concrete and steel. It is expected that these classifications will be applicable to the current site pending detailed site investigation.

6.4 FURTHER SITE INVESTIGATIONS

We recommend that further geotechnical site investigation be carried out to augment the Coffey 2018 investigation and support detailed design. For the proposed development we recommend drilling an additional six boreholes below the proposed bulk excavation and footing levels. The aim of the investigation would be to assess and refine the site models presented here, and provide data for design.

Existing standpipes should be located and inspected to determine if they are still operational. Based on these inspections additional standpipes should be installed to ensure adequate site coverage. These standpipes are required to assess groundwater levels and enable water samples to be collected for water quality/chemistry which will most likely be required if constructing a drained basement.

7. CONCLUSION

Based on our site observations, the previous investigation conducted by Coffey, and experience on similar projects, the proposed development is considered feasible from a geotechnical perspective. In our opinion, the proposed development would present a low risk to surrounding structures and the groundwater environment, provided that a detailed geotechnical site investigation and appropriate project specific design assessments and construction monitoring normally associated with this type of development are carried out.

The attached document entitled "Important Information about your Tetra Tech Coffey Report" presents additional information about the uses and limitations of this report.



IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY REPORT

As a client of Tetra Tech Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Tetra Tech Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Tetra Tech Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Tetra Tech Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Tetra Tech Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Tetra Tech Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Tetra Tech Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Tetra Tech Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Tetra Tech Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Tetra Tech Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Tetra Tech Coffey to work with other project design professionals who are affected by the report. Have Tetra Tech Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Tetra Tech Coffey for information relating to geoenvironmental issues.

Rely on Tetra Tech Coffey for additional assistance

Tetra Tech Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Tetra Tech Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Tetra Tech Coffey to other parties but are included to identify where Tetra Tech Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Tetra Tech Coffey closely and do not hesitate to ask any questions you may have.