Attachment A9

Geotechnical Report

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on Geotechnical Investigation and Acid Sulphate Soil (ASS) Assessment

Proposed Woolworths Development
923-935 Bourke Street, Waterloo

Prepared for
Fabcot Pty Ltd

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Geotechnical Investigation and Acid Sulphate Soil (ASS) Assessment

Proposed Woolworths Development

923-935 Bourke Street, Waterloo

1. Introduction

This report presents the results of a geotechnical investigation and acid sulphate soil (ASS) assessment undertaken for a proposed mixed-use development located at 923-935 Bourke Street, Waterloo (the site). The assessment was commissioned by behalf of Fabcot Pty Ltd (Fabcot) and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal SYD190724.P.002.Rev0 dated 1 August 2019.

It is understood that the proposed development will include the demolition of existing structures and construction of a multi-storey mixed-use development over a three-level basement. It is understood that a new Woolworths and BWS (liquor store) is to be incorporated into the development. Excavation for the basement is anticipated to extend to depths of about 9 m below existing surface levels. Locally, deeper excavation may be required for service trenches and crane pads. The investigation was carried out to provide information on the subsurface conditions for design and planning purposes.

The investigation included the drilling of six rock cored boreholes into the rock and three augured boreholes to the top of rock. Details of the field and laboratory testing are given in the report, together with comments on design and construction issues.

Arcadis Pty Ltd has previously prepared a Phase 2 Environmental Site Assessment report for the site, reference 10020729RP01, dated 31 May 2018.

DP has also prepared the following reports for the site, for due diligence purposes (for Fabcot) in relation to the purchase of the site:

- Geotechnical desktop study, reference 86864.00.R.001.Rev0, dated 23 July 2019. This geotechnical investigation report supersedes the geotechnical desktop study report; and
- Environmental Preliminary Site Investigation (PSI), reference 86864.00.R.002.Rev0.

2. Site Description

The site comprises a parallelogram shaped area of about 5,200 m^2, the general layout of which is shown on Drawing 1, Appendix B. At the time of DP's presence on site, single and two-storey commercial buildings with on-ground parking occupied the site. Currently the site is occupied by a crystal wholesaler, a textile wholesaler, a tyre shop, and various other retail / wholesale stores. Existing surface levels were observed be relatively flat across the site.

Based on a casual observation during the field work:

- The external brickwork of the commercial buildings on the site appeared to be in a relatively good condition; and
- The pavements within the site appeared to be in a fair condition with some signs of minor cracking evident.

The site is situated within an area developed for a variety of uses. A summary of the current land uses adjacent to the location of the proposed building (at the time of DP's presence on site) is given in Table 1.

Table 1: Summary of Adjacent Land Use

Direction Relative to the Site	Land Use Description
North	McEvoy Street followed by a largely paved vacant block with an old derelict building. This block has been fenced off with signage indicating that the site has been approved for a multi-storey (high rise) building / complex. Given the size of the proposed development it is anticipated that this development will include a multi-level basement car park. McEvoy Street is a Roads and Maritime Services (RMS) asset.
East	Bourke Street followed by six to ten-storey mixed-use buildings over a probable multi-level basement car park. During DP's presence on site, access to the basement car park below these buildings was not possible. The extent and depth of these nearby basement car parks should be confirmed prior to final design.
South	Single and two-storey commercial building with on-ground parking adjoining the southern site boundary. Further to the south is a United Petroleum petrol station.
West	Young Street and further to the west single and two-storey commercial buildings with on-ground parking and a multi-storey residential building over a probable multi-level basement. During DP's presence on site, access to the basement car park below these buildings was not possible. The extent and depth of these nearby basement car parks should be confirmed prior to final design.

3. Regional Geology and Hydrogeology

3.1 Geology

Reference to the Sydney 1:100,000 Geological Series Sheet indicates that the site is underlain by Quaternary sediments comprising fine to medium grained sands probably underlain by Hawkesbury Sandstone and / or Ashfield shale, which is mapped north (1.3 km) and the west (2 km) of the site. The elevation (Reduced Level) of the site is approximately 23 m above Australian Height Datum (AHD).

The investigation confirmed the geological mapping and encountered aeolian sediments and residual soils overlying sandstone. Ashfield Shale was not encountered in the boreholes.

3.2 Hydrogeology

The Botany Sand Beds, Botany Basin, NSW Northern, Southern and Western Zones Status Report No.2 prepared by the Department of Land and Water Conservation (DLWC) [GWMA018, March 2000] provides an overview of the Botany sand beds. The report indicates that there are two groundwater systems operating in the region, one being a deeper confined aquifer system in the fractured Triassic bedrock and a shallower unconfined to semi-confined system which is present within the unconsolidated sediments of the Botany sand beds. The saturated portion of the Botany sand beds is known as the Botany Sands Aquifer.

3.3 Acid Sulphate Soils and Salinity

Acid Sulphate Soil Risk Mapping by the NSW Department of Planning Industry and Environment identify the site to be within a 'Class 5' zone. ASS is typically not found in Class 5 areas and the site is only at risk of ASS from an environmental point of view if proposed works are within 500 m of a Class 1, 2, 3 or 4 'land' that is below RL 5 m AHD, and by which the groundwater table is likely to be lowered below RL 1 m AHD.

The results of the laboratory test results completed as part of the investigation indicate that ASS are not present at the site.

Water quality in the Botany Sand Aquifer is typically of low salinity (less than 150 uS/m) and pH varies between 4.3 - 8.9.

4. Field Work Methods

The field work for the investigation included:

- On-site electronic scanning for buried services at proposed borehole locations:
- Drilling of six boreholes (BH101 to BH106) using a tight access tracked drilling rig. The boreholes were initially hand dug to a depth of between 0.5 m and 1.0 m to clear the locations of any buried services and to remove any drilling obstructions (e.g. bricks) within the fill. The boreholes were then drilled onto the top of rock to a depth of between 5.5 m and 8.0 m using a combination of solid fight augers and wash boring, before being continued to depths of between 12.5 m and 14.3 m using NMLC-sized (51 mm) diamond core drilling equipment to obtain continuous core samples of the bedrock;
- Drilling of three additional 'companion' boreholes (BH101A, BH103A and BH104A) using a tight access tracked drilling rig in close proximity (within 0.5 m) to the original cored borehole locations (BH101, BH103 and BH104). The boreholes were drilled onto the top of rock using solid flight augers, with disturbed soil sampling at regular 1.0 m depth intervals for the purpose of collecting

samples for acid sulphate soil assessment. Logs for these three 'companion' boreholes are attached but were not used for interpretation of the geotechnical model (Section 8) within this report;

- Purging of drilling water in BH101 and groundwater level measurement in BH101 following purging;
- Measurement of groundwater levels in existing groundwater monitoring wells MW1, MW3 and MW6 installed by Arcadis at the site; and
- All boreholes were backfilled with drill spoil upon completion. The test locations are shown on Drawing 1 in Appendix B. The locations and reduced levels of three boreholes (BH104, BH105 and BH106) were measured using a high precision differential GPS unit that is accurate to within 0.1 m.

5. Field Work Results

The detailed borehole logs and rock core photographs are included in Appendix C, together with notes defining classifications methods and terms used to describe the soils and rock profile encountered.

5.1 Boreholes

The general sequence of subsurface materials encountered at the borehole locations, in increasing depth order, is summarised in Table 2. Discussion on the selection of the 'Units' is provided in Section 8.

Table 2: Summary of the Subsurface Profile at Boreholes

Unit	Material	Depth Range to Top of Unit (m)	RL Range to Top of Unit (m AHD)	Thickness (m)	General Description
1	Fill	0	24.4 to 22.2	1.0 to 2.0	Typically sand fill that appeared generally poorly to moderately compacted. Across the eastern portion of the site, the fill comprised bricks and an existing second concrete slab (approximately 0.1 m thick) was encountered at about 1.0 m depth.
2	Sand / Clayey Sand (Aeolian Soil)	1.0 to 2.0	22.4 to 21.2	2.2 to 7.1	Typically fine to medium grained aeolian sand and clayey sand deposits, generally a loose condition.
3	Residual Soil	4.0 to 7.5	20.2 to 14.7	0.7 to 3.0	Typically very stiff to hard sandy clay and medium dense clayey sand with occasional medium and high strength ferruginised sandstone (i.e 'ironstone') bands.
4	VL & L Sandstone	5.5 to 8.2	18.74 to 14.0	0.6 to 2.1	Very low and low strength sandstone.
5	M & H Sandstone	6.1 to 9.6	16.9 to 12.7	3.1 to 6.9	Medium and high strength sandstone.

Notes: VL = Very Low Strength, L = Low Strength, M = Medium Strength, H = High Strength

5.2 Groundwater

Groundwater was observed during auger drilling of all the boreholes. The essential use of water as a drilling fluid, during the coring of the boreholes, precluded any further groundwater observations. On completion of the drilling, BH101 was left open and purged dry of drilling fluids using a submersible pump. A groundwater measurement was made prior to backfilling of the open borehole.

Measurements of the groundwater level were also taken within the existing monitoring wells (MW1, MW3 and MW6) previously installed by others (Arcadis). The location of these wells is shown on Drawing 1 in Appendix B.

A summary of the measured groundwater levels is provided in Table 3

Table 3: Summary of Groundwater Measurements

Location ID	Surface RL (m AHD)	Groundwater Depth (m)	Groundwater RL (m AHD)	Date Measured	Comments
BH101	24.4	5.13	19.3	27.08.2019	Measured 13 hours after being purged dry
BH101	24.4	5.5	18.9	26.08.2019	Free groundwater observed during auger drilling of the borehole
BH102	24.3	5.0	19.3	27.08.2019	Free groundwater observed during auger drilling of the borehole
BH103	24.4	5.0	19.4	27.08.2019	Free groundwater observed during auger drilling of the borehole
BH104	23.0	5.0	18.0	28.08.2019	Free groundwater observed during auger drilling of the borehole
BH105	22.5	5.0	17.5	28.08.2019	Free groundwater observed during auger drilling of the borehole
BH106	22.2	4.8	17.4	29.08.2019	Free groundwater observed during auger drilling of the borehole
MW1	24.5*	4.5	20.0	26.08.2019	Measured in existing monitoring well
MW3	24.0*	3.1	20.9	26.08.2019	Measured in existing monitoring well
MW6	22.5*	4.6	18.5	26.08.2019	Measured in existing monitoring well

*Surface RL of bore not available to DP; estimated from NSW government online mapping

It should be noted that groundwater levels are transient and that fluctuations may occur in response to climatic and season conditions.

Data loggers were installed within the three existing groundwater wells (MW1, MW3 and MW6) for long term monitoring of groundwater levels at the site at hourly intervals. Periodic site visits will be carried out to collect the monitoring data and a groundwater monitoring report with details of the recorded water levels will be provided in a separate report.

6. Laboratory Testing

Laboratory testing was undertaken on a selection samples, summarised as follows:

- One particle size distribution test; and
- Three samples (two soil and one groundwater) to determine soil and groundwater aggressiveness (pH, Electrical Conductivity, Chloride Ion Content, Sulphate Ion Content) for exposure classification of buried concrete and steel elements.

The results of the laboratory testing are included in Appendix D, with the results summarised in Table 4 and Table 5.

Table 4: Particle Size Distribution

Borehole ID	Depth (m)	Gravel (%)	Sand (%)	Fine Grained (%)	Soil Classification (AS1726-2017)
105	2.5-2.95	0	96	4	SAND with trace silt

Table 5: Summary of Chemical laboratory Test Results

Borehole	Material	Depth (m)	Conductivity (µS/cm)	pH	Cl (PPM)	SO_4 (PPM)
MW3	Water	-	190	6.6	22	5
101	Sand	4.0 – 4.45	17	8.1	<10	<10
103	Fill	1.2 – 1.65	240	7.9	58	280

Notes: Cl = Chloride ion concentration, SO_4 = Sulphate ion concentration, PPM = Parts Per Million

The point load test results on rock cores were tested in-house, with the results shown on the borehole logs in Appendix C, at the respective test depths.

7. Acid Sulphate Soils

The Acid Sulphate Soils Management Advisory Committee (ASSMAC) prepared an Acid Sulphate Soil Manual (August 1998) which includes guidelines for assessing Actual Acid Sulphate Soils (AASS) and Potential Acid Sulphate Soils (PASS). The current ASS screening and laboratory testing for this assessment was developed in general accordance with the ASSMAC Acid Sulphate Soil Manual.

Twenty-five samples of soil collected from the approximate four corners of the site (BH101A, BH103A, BH104A and BH106) were tested / screened in an external laboratory for preliminary signs of AASS and PASS. The screening involved measurement of the pH value of each soil sample after the addition of distilled water (pH_F). Hydrogen Peroxide was then added to oxidise the sample and the pH value (pH_{FOX}) was measured again after at least one hour. The results for the pH screening are presented in Table 6.

Table 6: PASS & AASS Screening Results

Borehole ID	Depth (m)	Material Description	Screening Tests			
			Natural pH_F	Oxidised pH_{FOX}	Change in pH	Reaction
101A	0.0-0.1	Fill	7.2	6.3	0.90	Moderate
101A	1.1-1.2	Fill	10.6	7.2	3.40	Slight
101A	2.0-2.1	Sand	8.3	6.4	1.90	Moderate
101A	3.0-3.1	Sand	8.3	6.4	1.90	Slight
101A	4.0-4.1	Sand	8.3	6.3	2.00	Slight
101A	5.0-5.1	Sand	7.8	6.3	1.50	Slight
101A	6.0-6.1	Clayey Sand	7.2	6	1.20	Slight
103A	0.0-0.1	Fill	7.2	5.3	1.90	Moderate
103A	1.1-1.2	Fill	10.8	9.2	1.60	Very High
103A	2.0-2.1	Sand	8.0	4.2	3.80	Slight
103A	3.0-3.1	Sand	5.6	4.6	1.00	Slight
103A	4.0-4.1	Sandy Clay	4.9	2.7	2.20	Slight
103A	5.0-5.1	Sandy Clay	5.4	3.8 [1]	1.60	Slight
104A	0.0-0.1	Fill	7.1	5.8	1.30	Moderate
104A	1.1-1.2	Fill	7.1	6.5	0.60	Slight
104A	2.0-2.1	Sand	6.4	6.6	-0.20	Slight
104A	3.0-3.1	Sand	6.5	6.8	-0.30	Slight
104A	4.0-4.1	Sand	6.5	5.2	1.30	Slight
104A	5.0-5.1	Sandstone	6	5.3	0.70	Slight
106	0.0-0.1	Fill	6.5	4.7	1.80	High
106	1.0-1.45	Sand	7.5	6.2	1.30	Slight
106	2.5-2.95	Sand	8	6.3	1.70	Slight
106	4.0-4.45	Sand	7.6	6.3	1.30	Slight
106	5.5-5.95	Sand	7.3	6.2	1.10	Slight
106	7.0-7.45	Clayey Sand	6.1	3.8 [1]	2.30	Moderate
Action Criteria for Further Assessment			**≤ 4**	**≤ 3.5**	**>1**	**-**

Note: ..... - yellow highlight are samples selected for chromium reducible sulfur testing

2.7 - red font exceeds action criteria

(1) pH_{FOX} value of 3.8 is technically above action criteria of 3.5, however given the test results indicate they are only marginally above the action criteria (of 3.5), samples were selected for chromium reducible sulfur testing

The screening test results were assessed for the possible presence of AASS or PASS and the need for 'further assessment' was based on the following guidance indicators specified in the ASSMAC Guidelines:

- $pH_F \leq 4$ strongly indicates oxidation has occurred in the past and that AASS are likely to be present;
- $pH_{FOX} < 3.5$ **and** preferably one or more of the following strongly indicates the presence of PASS:
    - A pH_{FOX} reading at least one pH unit below the corresponding pH_F; or

- A strong reaction with peroxide; or
- Change in soil colour from grey tones to brown tones; or
- A release of sulphurous gases.

Based on the above, it is the following is noted

- All pH_F values were well above pH 4, indicating that AASS were not detected;
- Only one pH_{FOX} value was below pH 3.5, providing a positive indicator of PASS; and
- Two sample pH_{FOX} values were only marginally over pH 3.5, providing a marginal positive indicator of PASS.

All three samples providing a positive / marginal indicator of PASS were tested for a Chromium Suite (SCr) at Envirolab Services, a NATA registered laboratory for ASS testing. The results of the analysis are summarised in Table 7 and compared with the action criteria specified in ASSMAC (1998) Guidelines. Full laboratory reports are provided in Appendix D.

The results confirmed that the samples tested are not AASS or PASS.

Table 7: Results of Laboratory Analysis for S_{cr}

Location No.	Depth (m)	Material Description	pH_{KCl} (1)	Chromium Reducible Sulphur (%w/w)
103A	4.0-4.1	Sandy Clay	4.3	<0.005
103A	5.0-5.1	Sandy Clay	4.2	<0.005
106	7.0-7.45	Clayey Sand	4.1	<0.005
Action Criteria* (1 to 1000 tonnes disturbed)		**Sand to Loamy Sands**	**< 4**	**0.03**
		Sandy loams to light clays	**< 4**	**0.06**
		Medium to heavy Clays and silty clays	**< 4**	**0.1**

Notes:

(1) pH_{KCl} = Non-oxidised pH

8. Proposed Development

Based on the preliminary information supplied by Fabcot it is understood that the proposed development will include the demolition of existing structures and construction of a multi-storey mixed-use development over a three-level basement. It is understood that a new Woolworths and BWS (liquor store) is to be incorporated into the development. Excavation for the basement is anticipated to extend to depths of about 9 m below existing surface levels. Locally, deeper excavation may be required for service trenches and crane pads. Given that no drawings were available at the time of writing this report, a bulk excavation level (BEL) of about RL 13 m AHD has been assumed for basement.

9. Geotechnical Model

The observed subsurface profile encountered at the boreholes has been grouped into five geotechnical units. Two geotechnical cross sections (Section A-A' and Section B-B') showing the interpreted subsurface profile between the borehole locations are shown on Drawings 2 and 3 in Appendix B, respectively. With respect to the interpreted geotechnical boundaries it is noted that the soil profile should be expected to vary away from and in between the boreholes.

The interpreted depth and RLs at the top of the various units at each test location is shown in Table 8. Reference should be made to the borehole logs for more detailed information and descriptions of the soil and rock profile. It was observed that the depth to top of rock was dipping downwards in a south-westerly direction, with the shallowest depth to rock encountered at the north-eastern corner (BH103, 4.2 m) of the site and deepest depth to rock at the south-western corner (BH106, 7.8 m) of the site.

Table 8: Summary of Geotechnical Model

Unit	Material	Depth [m] Reduced Level (m AHD) to Top of Each Unit					
		BH101	BH102	BH103	BH104	BH105	BH106
1	Fill	0.0 24.4	0.0 24.3	0.0 24.4	0.0 23.0	0.0 22.5	0.0 22.2
2	Sand / Clayey Sand (Aeolian Soil)	2.0 22.4	2.0 22.3	2.0 22.4	1.1 21.9	1.1 21.4	1.0 21.2
3	Residual Soil	6.6 17.8	5.5 18.8	4.2 20.2	4.0 19.0	5.5 17.0	7.5 14.7
4	VL & L Sandstone	N.E	N.E	5.7 18.7	5.5 17.5	7.0 15.5	8.2 14.0
5	M & H Sandstone	9.1 15.4	8.5 15.9	7.8 16.6	6.1 16.9	8.1 14.4	9.6 12.7

Notes: : EL = Extremely Low Strength, VL = Very Low Strength, L = Low Strength, M = Medium Strength, H = High Strength
N.E = Not Encountered

The groundwater measurements indicated a groundwater table at depths of about 3.1 m to 4.8 m (RL 20.9 m AHD to RL 17.4 m AHD). Groundwater levels will fluctuate with climatic conditions and may temporarily rise by at least 1 m (or more) following periods of prolonged rainfall. Data loggers were installed within the three existing groundwater wells (MW1, MW3 and MW6) for long term monitoring of groundwater levels at the site, at hourly intervals. Periodic site visits will be carried out to collect the monitoring data and a groundwater monitoring report with details of the recorded water levels will be provided in a separate report.

10. Comments

10.1 Geotechnical Issues

Some of the primary geotechnical issues that need to be considered for development are:

- Groundwater is shallow, and dewatering will be required for the construction of basement(s);
- Shoring walls will need to be designed to reduce inflow and control 'drawdown' of water levels on adjacent sites as this has the potential to cause settlement and damage to nearby structures;
- Excavation adjacent to McEvoy Street, which is an RMS asset;
- The shoring will need to be socketed into competent rock which can be problematic for some shoring systems and can result in 'decompression' and loosening of the surrounding soils;
- If cut-off walls into rock are successfully constructed to reduce inflow and drawdown of water levels, then it is technically feasible to construct a drained basement. This however will be subject to review and approval by both the Council and by Water NSW;
- Alternatively, a tanked basement could be constructed to reduce the need for long term collection and removal of groundwater 'upflow' through the excavated floor of the basement. A tanked basement will need to be designed for hydrostatic uplift pressures.

10.2 Dilapidation Surveys

Dilapidation surveys should be carried out on adjacent / existing buildings, pavements and infrastructure that may be affected by the excavation works. The dilapidation surveys should be undertaken before the commencement of any excavation work in order to document any existing defects so that claims for damage due to construction related activities can be accurately assessed.

10.3 Excavation Conditions

Based on the borehole logs, the proposed bulk excavation works are anticipated to extend through all the units outlined in Table 2. The excavatability of the materials that will be encountered during the bulk excavation works is summarised in Table 9. The detailed excavation for footings, services and side walls within low strength or stronger rock will generally require the use of a rotary rock saw or grinder, or hydraulic rock hammers.

The excavation rate that can be achieved, particularly within medium and high strength rock, varies considerably and is dependent upon the degree of jointing in the rock, the rock strength, and the type of machinery being used and the skill of the operator. It is suggested that bulk excavation tenderers be required to make their own assessment of the equipment required to carry out the work. Contractors may inspect the rock core samples at the DP office in West Ryde prior to submitting final tenders (rock cores are generally kept for 6 months after drilling unless longer holding times are requested).

Table 9: Summary of Soil and Rock Excavatability

Unit	Material	Material Strength	Excavatability
1, 2 & 3	Fill & Soil	Soil	Excavation using buckets of conventional earthmoving equipment and bulldozers. The presence of 'ironstone' (i.e. ferrugnised sandstone) bands of medium strength (or stronger) may necessitate rock hammering of residual soil and extremely weathered rock. Spoil will be saturated and difficult to handle.
4	VL & L Sandstone	Very Low and Low Strength Sandstone	The very low strength layers may be excavated using buckets of conventional earthmoving equipment, particularly if fitted with 'rock teeth'. Medium strength (or stronger) 'ironstone' bands may require localised rock hammering, as described above. However, hard ripping using a large 'bulldozer' (such as a D9 or larger plant), or excavators fitted with either ripping tynes or rock hammers will generally be required for removal of low strength rock or stronger. Rock hammers or saws / grinders are generally required for effective excavation of slightly fractured and unbroken rock. Some of the unbroken, high strength rock may be effectively 'unrippable' with very low productivity.
5	M & H Sandstone	Medium and High Strength Sandstone	

As noted above, the soil materials excavated below the water table will be saturated even after dewatering operations. Due consideration should be given to handling such 'water logged' material and whether progressive spreading and drying of the soil prior to removal is feasible.

10.4 Vibrations

During excavation, it will be necessary to use appropriate methods and equipment to keep ground vibrations at adjacent buildings and structures within acceptable limits. The level of acceptable vibration is dependent on various factors including the type of structure (e.g. reinforced concrete or brick structures etc.), its structural condition, the frequency range of vibrations produced by the construction equipment, the natural frequency of the structure and the vibration transmitting medium.

Ground vibration can be strongly perceptible to humans at levels above 2.5 mm/s vector sum peak particle velocity (VSPPV). This is generally much lower than the vibration levels required to cause structural damage to buildings. The Australian Standard AS2670.2-1990 "Evaluation of human exposure to whole-body vibrations – continuous and shock induced vibrations in buildings (1-80 Hz)" indicates an acceptable day time limit of 8 mm/s VSPPV for human comfort.

Some of the adjacent buildings are most likely supported on high level footings founded on loose sand. Vibrations have the potential to induce settlement of loose sands which may result in damage to adjacent buildings. For this reason, it is suggested that a maximum PPV of 3 mm/s (applicable at the foundation level of existing buildings) be provisionally employed at this site for both architectural and human comfort considerations. A higher limit of up to 8 mm/s may be adopted for buildings founded on dense sand or rock; however, this will be subject to further geotechnical review.

As the magnitude of vibration transmission is site specific, it is recommended that a vibration trial be undertaken during the use of heavy plant and particularly at the commencement of rock excavation. The trial may indicate that smaller or different types of excavation equipment should be used for bulk (or detailed) excavation purposes.

10.5 Disposal of Excavated Material

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014). This includes fill and natural materials that may be removed from the site. Reference should be made to the preliminary in-situ waste classification provided in the Arcadis Phase 2 report for the site.

10.6 Acid Sulphate Soils

The results of laboratory testing indicate that actual and potential acid sulphate soils are not present at the site.

10.7 Dewatering and Tanking

10.7.1 General

The proposed bulk excavation will likely extend below the groundwater table. If dewatering on the site results in excessive drawdown (i.e. lowering of the water level) beneath surrounding sites, then this has potential to induce settlement beneath surrounding structures, which could cause damage. Existing groundwater contamination on the site, if applicable, should also be considered in the planning.

Given that bedrock will be encountered either above or short distance below the bulk excavation level (refer Drawing 2 and 3 in Appendix B), it is anticipated that basement construction would logically comprise the construction of a water-tight perimeter 'cut-off' wall extended below the base of the bulk excavation and socketed at least 2 m into competent, medium to high strength bedrock in order to construct a 'fully-tanked' basement structure. This option would be expected to significantly reduce seepage flows as seepage will only occur though the relatively low permeability medium to high strength rock below the basement floor, unless there are through-going open joints, faults or other defects in the rock that could act as a conduit for groundwater to enter the basement. This option may effectively reduce inflow rates into the basement to the extent that a drained basement may be justified without significant impact on groundwater levels on surrounding sites.

Further detailed groundwater modelling would be required to predict seepage rates and drawdown in the short and long term. This would also be required to assess whether a cut-off wall into rock below the bulk excavation may be used to allow the adoption of a drained basement. However, a drained basement will be subject to review and approval by Council and by Water NSW.

If a drained basement slab is not possible then a water-tight 'tanked' basement will be required for the permanent basement structure. A tanked basement would need to be designed to resist uplift forces associated with (hydrostatic) groundwater pressures.

10.7.2 Drawdown and Settlement

It is suggested that the design and construction of the basement should be carried out to limit the lowering of the water table (i.e. 'drawdown') on adjacent properties to less than 1.5 m. As a minimum this will require perimeter cut-off walls socketed into rock below the bulk excavation level to 'cut off' horizontal flows through rock into the excavation. By doing this, the only potential for groundwater inflows (into the basement) would be where continuous defects in the bedrock (e.g. joints, faults, etc.) provide a hydraulic connection between the water table outside the basement perimeter, with that inside the exposed base of the basement. Although unlikely, the presence of such 'though-going' defects in the underlying bedrock is very difficult to detect until bedrock is exposed within the bulk excavation level.

Further modelling may indicate that a tanked basement is required to reduce long term drawdown to acceptable levels.

During construction, it is recommended that drawdown outside the excavation in the vicinity of the adjacent properties should be monitored in general accordance with the following:

- Install standpipes in accessible areas on adjacent properties (or roads) to monitor groundwater drawdown levels during dewatering;
- Measure groundwater levels on a weekly basis for three weeks prior to operation of the dewatering system to establish pre-construction levels;
- Measure groundwater levels twice per day during the first two days of dewatering, and then daily during the first week of dewatering and weekly until decommissioning of the dewatering pumps, or until a lesser frequency is advised by the geotechnical engineer;
- The measured values are to be provided to the geotechnical engineer on the day of measurement for review;
- Where drawdown levels exceed a 'trigger level' (to be set) below pre-construction groundwater levels, the reason for the change in groundwater level should be investigated and measures put in place to rectify the exceedance. These measures could include reduction of pumping rates or suspension of dewatering.

Design of the dewatering system will need to give due consideration to drawdown effects on adjacent properties. The dewatering of the site should be carried out by a contractor with demonstrated experience in similar conditions.

10.7.3 Groundwater Disposal

The groundwater removed from the site will require disposal. It is considered that a dewatering management plan (which includes a groundwater quality assessment) will likely be required later as part of the DA submission.

10.8 Excavation Support

Shoring / retention will be required around the perimeter of the site. It will generally be necessary to install cut off walls into rock below bulk excavation level.

10.8.1 Shoring and Retaining Wall Systems

The final basement structure should incorporate a watertight shoring / retaining wall system around the basement perimeter.

The following options may be considered:

- Diaphragm walls may be used as the permanent basement wall. These walls are associated with lower risk but are relatively slow to construct and consequently more expensive. Diaphragm walls are constructed using a large grab, which excavates the soil and rock in panels which are supported by bentonite fluid. Each panel is then cast using concrete tremmied into the bentonite supported excavation, with reinforcement cages installed prior to the concrete being tremmied. The joints between the panels are sealed with a waterstop so that a completely water-tight wall is achieved.
- Interlocking secant pile wall (temporary and permanent) – secant pile walls are typically formed by drilling alternate 'soft' grout or concrete piles and then installing 'hard' reinforced concrete piles by cutting into the previously drilled soft piles. This overlap typically ensures that piles are sealed, but even at relatively shallow depths, some misalignment can occur, and hence minor gaps appear in the wall. The potential for misalignment and therefore seepage and sand loss through gaps in deep secant pile walls is relatively high for basements of more than two level below ground. Drilling of piles into rock could also be problematic for secant piles and may result in 'decompression' of the surrounding sands, which can result in damage to adjacent buildings. The use of temporary segmental casing may be required to avoid issues associated with decompression.
- Cutter soil mix (CSM) wall (temporary) – CSM walls involve blending or mixing of grout with the site soils in situ to form cement stabilised soil panels with universal column sections "plunged" into the "wet" panel at regular intervals along the wall to provide bending stiffness. Experience with the CSM walls has indicated that the mixing consistency, and consequently the permeability and durability of the wall need to be carefully considered, particularly within clayey soils and rock. In addition, the construction of these walls become significantly more difficult should deep variable fill and / or second concrete slabs (as indicated in the previous report completed by Arcadis) be present at the site. This option is unlikely to be suitable at the site and may not achieve an effective seal at the rock interface.

10.8.2 Temporary Batter Slopes and Vertical Rock Faces

As a watertight retaining wall system is required for the proposed development, temporary batters are not considered feasible for the sides of the bulk excavation, and excavation support will therefore be required. Nevertheless, in the course of carrying out bulk excavations inside a supported excavation perimeter, the need for temporary cut batters may arise as the bulk excavation proceeds, such as for temporary earth ramps and the like, for which suggested temporary maximum batter slopes for slopes not higher than 4 m (and above the water table) are given in Table 10. If surcharge loads are applied near the crest of the slope, then further specific geotechnical review and probably flatter batters or stabilisation using rock bolts or soil nails may be required.

Table 10: Recommended Batter Slopes for Exposed Material above the Water Table

Unit	Material	Maximum Temporary Batter Slope (H : V)
1, 2 & 3	Fill & Soil	1.5 : 1
4	VL & L Sandstone	0.5 : 1*
5	M & H Sandstone	Vertical*

Note: VL = Very Low Strength, L = Low Strength, M = Medium Strength, H = High Strength
* Subject to jointing assessment by experienced Geotechnical Engineer/Engineering Geologist

Competent medium strength or stronger sandstone will generally be stable when cut vertically provided there are no adversely oriented joints or other defects present. Any vertical faces in rock for internal excavations (e.g. lift pits) should be inspected by an experienced geotechnical engineer or engineering geologist as the excavation progresses in depth intervals of no deeper than 1.5 m. The purpose of the inspections is to identify the extent of shotcrete face protection required and to check for the presence of any adverse defects daylighting into the excavation face which may require additional stabilisation measures (such as rock bolts and/or shotcrete).

10.8.3 Retaining Wall Design

The shoring will need to be supported by internal bracing and / or temporary 'tie-back' ground anchors to control deflections. It would be normal for the basement structure to prop the shoring / retaining walls for the permanent / long-term case.

Preferably, shoring walls should be in rock and at least 2 m below the bulk excavation level (possibly deeper to reduce water inflow and where rock is deeper below the BEL) in order to provide lateral restraint at the base of the excavation.

The preliminary design of shoring systems with one row of anchors may be based on the earth pressure coefficients provided in Table 11. 'Active' earth pressure coefficient (K_a) values may be used where some wall movement is acceptable, and 'at rest' earth pressure (K_o) values should be used where the wall movement needs to be reduced (e.g. adjacent to buildings along the southern site boundary)

It is recommended that prior to final design both the footing type and founding level of any adjoining buildings be confirmed to assess the need for underpinning of existing structures.

Table 11: Recommended Design Parameters for Shoring Systems

Unit	Material	Unit Weight (kN/m^3)	Earth Pressure Coefficient		Effective Cohesion c' (kPa)	Effective Friction Angle (Degrees)
			Active (K_a)	At Rest (K_o)		
1	Fill	20	0.4	0.6	0	25
2	Sand / Clayey Sand (Aeolian Soil)	20	0.35	0.5	0	28
3	Residual Soil	20	0.3	0.45	3	25
4	VL & L Sandstone	24	0.15	0.2	20	35
5	M & H Sandstone	24	0*	0*	100	40

VL = Very Low Strength, L = Low Strength, M = Medium Strength, H = High Strength

* Subject to jointing assessment by experienced Geotechnical Engineer/Engineering Geologist

It is expected that more than one level of restraint will be required for the shoring walls. The design for lateral earth pressures where multiple rows of anchors or propping are used (i.e. two rows or more of anchors or props) may be based on a trapezoidal earth pressure distribution. The following earth pressure magnitudes are considered appropriate, where H is the height of soil and very low to low strength rock to be retained, in metres:

- 4H kPa, where some lateral movement is allowed; and
- 6H to 8H kPa, where lateral movements need to be limited (e.g. next to buildings and services).

In each case the maximum pressure generally acts over the central 60% of the wall, reducing to zero at the top and base of the wall.

The design of the shoring should allow for all surcharge loads, including building footings, inclined slopes behind the wall, traffic, site sheds, and construction related activities. Hydrostatic pressure acting on the shoring walls should also be considered in the design and allowance should be made for the water table rising by say 1 m to 1.5 m to account for possible long-term climatic variations.

10.8.4 Passive Resistance

Passive resistance for piles founded in rock below the base of the bulk excavation (including allowance for services and/or footings) may be based on the ultimate passive restraint values provided in Table 12. This ultimate value represents the pressure mobilised at high displacements and therefore it will be necessary to incorporate a factor of safety of at least two (or more) to limit wall movement. The top 0.5 m of the socket should be ignored, where exposed at bulk excavation level, due to possible disturbance and over-excavation.

Table 12: Recommended Passive Resistance Values

Unit	Foundation Stratum	Maximum Allowable Passive Pressure (kPa)	Maximum Ultimate Passive Pressure (kPa)
4	VL & L Sandstone	250*	500*
5	M & H Sandstone	2,000*	4,000*

VL = Very Low Strength, L = Low Strength, M = Medium Strength, H = High Strength

* Subject to jointing assessment by experienced Geotechnical Engineer/Engineering Geologist

Detailed design of shoring should preferably be carried out using WALLAP, PLAXIS or other accepted computer analysis programs capable of modelling progressive excavation and anchoring, and predicting potential lateral movements, stresses and bending moments. PLAXIS (or similar) would be required if it is necessary to assess ground movements on surrounding properties (e.g. McEvoy Street) as WALLAP will only assess wall movements.

10.8.5 Ground Anchors

The design of temporary and permanent ground anchors for the support of shoring systems may be carried out on the basis of the maximum bond stresses given in Table 13. The anchors should preferably have their bond length within the low and medium strength and stronger rock. Anchors taken to rock may need to be more steeply inclined in the approximate southern half of the site where the depth to competent rock was observed to be generally deeper than the northern half of the site (refer Drawing 2 and 3 in Appendix B).

Table 13: Recommended Maximum Bond Stresses for Rock Anchor Design

Unit	Material Description	Maximum Allowable Bond Stress (kPa)	Maximum Ultimate Bond Stress (kPa)
4	VL & L Sandstone	100	200
5	M & H Sandstone	500	1,000

VL = Very Low Strength, L = Low Strength, M = Medium Strength, H = High Strength

The parameters given in Table 10 assume that the drilled holes are clean and adequately flushed. The anchors should be bonded behind a line drawn up at 33 degrees in sand and 60 degrees in rock from the base of the shoring wall or the top of free-standing medium strength or stronger rock, and "lift-off" tests should be carried out to confirm the anchor capacities. It is suggested that ground anchors should be proof loaded to 125% of the design Working load and locked-off at no higher than 80% of the Working load.

In normal circumstances the building will restrain the basement excavation over the long term and therefore ground anchors are expected to be temporary only. The use of permanent anchors would require careful attention to corrosion protection. Further advice on design and specification should be sought if permanent anchors are to be employed at this site.

It will be necessary to obtain permission from neighbouring landowners prior to installing anchors that will extend beyond the perimeter of the site. In addition, care should be taken to avoid damaging buried services and pipes, and possibly neighbouring piled footings, during anchor installation. Anchoring should only be carried out by an experienced contractor with demonstrated experience in similar ground conditions.

Vertical anchors for uplift support could also be designed using the parameters given in Table 13. The designer should check the cone-pull-out failure mechanism by assuming a 90-degree cone for the soil and rock.

10.9 Excavation Induced Ground Movement

10.9.1 RMS Infrastructure

McEvoy Street is a Roads and Maritime Services (RMS) owned asset. Reference should be made to the *RMS Geotechnical Technical Direction 2012/001 dated April 2012*, which outlines the requirements for excavations adjacent to RMS infrastructure and includes the level of geotechnical investigation required, dilapidation surveying, instrumentation and monitoring during construction, trigger levels and contingency plans.

A Geotechnical Impact Assessment (GIA), i.e. numerical modelling, will typically be required as part of the DA application (imposed by RMS). The purpose of the GIA is to assess the likely amount of excavation induced ground movement as a result of the proposed excavation at the RMS assets and surrounding strucures (where required). Such numerical modelling could be carried out using commercially available software such as Plaxis 2D.

Precise survey and / or inclinometer monitoring of excavation faces and nearby buildings/ structures should be carried out to assess vertical and horizontal movements during the excavation. The survey and/ or inclinometer monitoring should commence prior to excavation to provide a baseline and should continue every 1.5 m drop of the excavation. If deflections show an increase in the rate of movement or exceed the predicted movements, then the structural engineer and geotechnical engineer should be contacted for immediate review.

A geotechnical monitoring plan (GMP) will also be typically required by RMS prior to construction for this site. A GMP outlines how to monitor excavation induced movements and vibrations (if applicable) as a result of the proposed development and what to do if any prescribed limits are exceeded. In addition, the GMP typically includes hold points at key stages of construction works.

DP can assist with the numerical analysis, preparation of a geotechnical monitoring plan and on-going inclinometer surveying during the construction stage if required.

10.10 Foundations

It is expected Unit 5 medium to high and high strength sandstone will be exposed across most of the bulk excavation for the basement. In the approximate south-western corner of the site it is anticipated that Unit 3 residual soils and Unit 4 very and low strength sandstone is likely to be exposed (refer Drawing 3 in Appendix B).

It is recommended that all footings for the structures be uniformly founded in Unit 5 medium and high strength rock in order to provide uniform support of the proposed structures and to reduce the potential for differential settlements. Where rock is close to design level and subject to loads and settlement tolerances, shallow pad or strip footings founded in rock could be used. Alternatively, piles founded (i.e. socketed) in stronger rock could be used to reach competent rock and/ or to achieve higher capacities.

Footings may be designed using the values given in Table 14. For piles, if required, shaft adhesion values for uplift (tension) may be taken as being equal to 70% of the shaft adhesion values for compression in Table 14.

Table 14: Recommended Design Parameters for Foundation Design

Unit	Foundation Stratum	Maximum Allowable Pressure (Serviceability)		Maximum Ultimate Pressure (Ultimate)		Young's Modulus
		End Bearing (kPa) (1)	Shaft Adhesion (Compression) (kPa) (1)	End Bearing (kPa) (1)	Shaft Adhesion (Compression) (kPa) (1)	Young's Modulus E (MPa)
4	VL & L Sandstone	1,200	100	4,000	200	100
5	M & H Sandstone	6,000 (2)	600	60,000	1,200	1,000

Notes:

(1) End bearing and shaft adhesion values presume adequate shaft roughness / cleanliness and base cleanliness

(2) Spoon testing in at least one-third of the footings is required if this value is adopted

Higher allowable end bearing pressures of about 10,000 kPa could be adopted in the Unit 5 medium and high and high strength (or stronger) sandstone provided spoon testing is completed in all of the footings. Spoon testing involves drilling a 50 mm diameter hole below the base of the footing, to a depth of 1.5 times the footing width, followed by testing to check for the presence of weak/clay bands. If weak seams are detected, then footings may need to be taken deeper to reach suitable foundation material.

If spoon testing is not carried out (or is not preferred) for shallow footings, then a maximum allowable end bearing pressure of 3,500 kPa must be adopted for the Unit 5 medium and high strength sandstone.

Footings (i.e. pads or piles) founded on the edge or within the zone of influence of vertical rock excavations, would be subject to assessment of jointing in the rock. A scenario where this could occur would be if for example a stepped basement design were to be adopted at a future date.

Generally, the allowable bearing pressure for footings founded near the edge of vertical rock excavations on Unit 5 medium and high strength sandstone (or stronger) should be limited to about 1,000 kPa. If deeper excavation exposes adverse jointing in the rock below the footings, then stabilisation using rock bolts/anchors and or underpinning may be required. Alternatively, the footings may be taken down below the zone of influence of a vertical cut face, in which case there would be no need to reduce the bearing pressure.

Foundations proportioned on the basis of the allowable bearing pressure in Table 14 would be expected to experience total settlements of less than 1% of the footing width under the applied working load, with differential settlements between adjacent columns expected to be less than half of this value.

Footings designed using ultimate values and Limit State Design will need to consider serviceability which usually governs the design in this case. For pile design, a basic geotechnical strength reduction factor, Φ_{gb}, of about 0.52 (or possibly higher) calculated from Table 4.3.2 (A, B, and C) of AS2159-2009: Piling Design and Installation, is considered feasible. However, the structural engineer will need to make their own assessment with the final (Φ_{gb}) number being dependent on the design and installation method (and associated risk rating) adopted by the structural engineer. A Φ_{gb} of 0.4 is required if pile load testing is not carried out and the ARR is 2.5 or greater

All footings should be inspected by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters.

10.11 Seismic Design

In accordance with the Earthquake Loading Standard, AS1170.4, 2007, a hazard factor (z) of 0.08 and a site sub-soil class of $C_{e,}$ is applicable to the site.

10.12 Soil and Groundwater Aggressivity

The assessment of soil and groundwater aggressivity has been made with reference to the requirements for concrete and steel presented in AS 2159-2009, the Australian Standard for pile design and construction.

Based on the geo-chemical soil test types listed in Table 5, with reference to the requirements for concrete and steel piles presented in AS 2159-2009, an exposure classification of the tested soil samples is provided in Table 15.

Table 15: Aggressivity Results

Borehole ID	Depth (m)	Material	Aggressivity to Concrete	Aggressivity to Steel
MW3	-	Water	Mild	Non-Aggressive
101	4.0 – 4.45	Sand	Mild	Non-Aggressive
103	1.2 – 1.65	Fill	Mild	Mild
Aggressivity Levels as per AS 2159-2009			Very Severe	
			Severe	
			Moderate	
			Mild	
			Non-Aggressive	

11. Further Geotechnical Input

Below is a summary of the recommended additional works that should be carried out:

- Dilapidation surveys;
- Waste classification of all material to be excavated and transported off site;
- Groundwater modelling to assess drawdown and pumping rates;
- Preparation of a dewatering management plan;
- Numerical analysis of shoring wall adjacent to McEvoy Street (RMS asset) to satisfy RMS requirement;
- Preparation of a geotechnical monitoring plan (GMP) to satisfy RMS requirements;
- Inclinometer installation and monitoring during construction to satisfy RMS requirements; and
- Footing inspections during construction.

It is recommended that a meeting be held after the initial design has been completed to confirm that these recommendations have been interpreted correctly.

12. Limitations

Douglas Partners (DP) has prepared this report for this project at 923-935 Bourke Street, Waterloo (the site) in accordance with DP's proposal SYD190724.P.001.Rev0 dated 1 August 2019 and acceptance received from Michelle Chiu on behalf of Fabcot Pty Ltd dated 16 August 2019. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Fabcot Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DP's advice is based upon the conditions encountered during previous investigations completed by DP near the site. The geological model provided in the report is only indicative of the anticipated sub-surface conditions at the site. Sub-surface conditions can change abruptly due to variable geological processes and as a result of human influences, particularly as some of DP's field testing nearby was undertaken many years ago.

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

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

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials. Reference should be made to the previously prepared Phase 2 Environmental Site Assessment report for the site prepared by Arcadis Pty Ltd, reference 10020729RP01, dated 31 May 2018

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

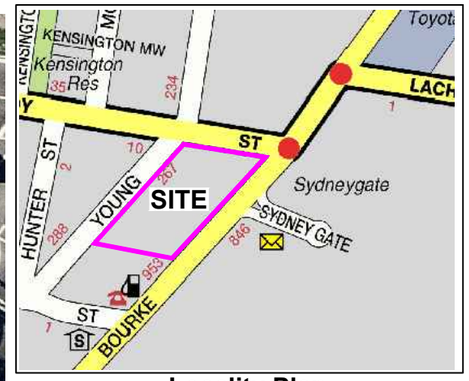
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawings



Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 1.9.2019)
2: Test locations are approximate only and are shown with reference to existing features.

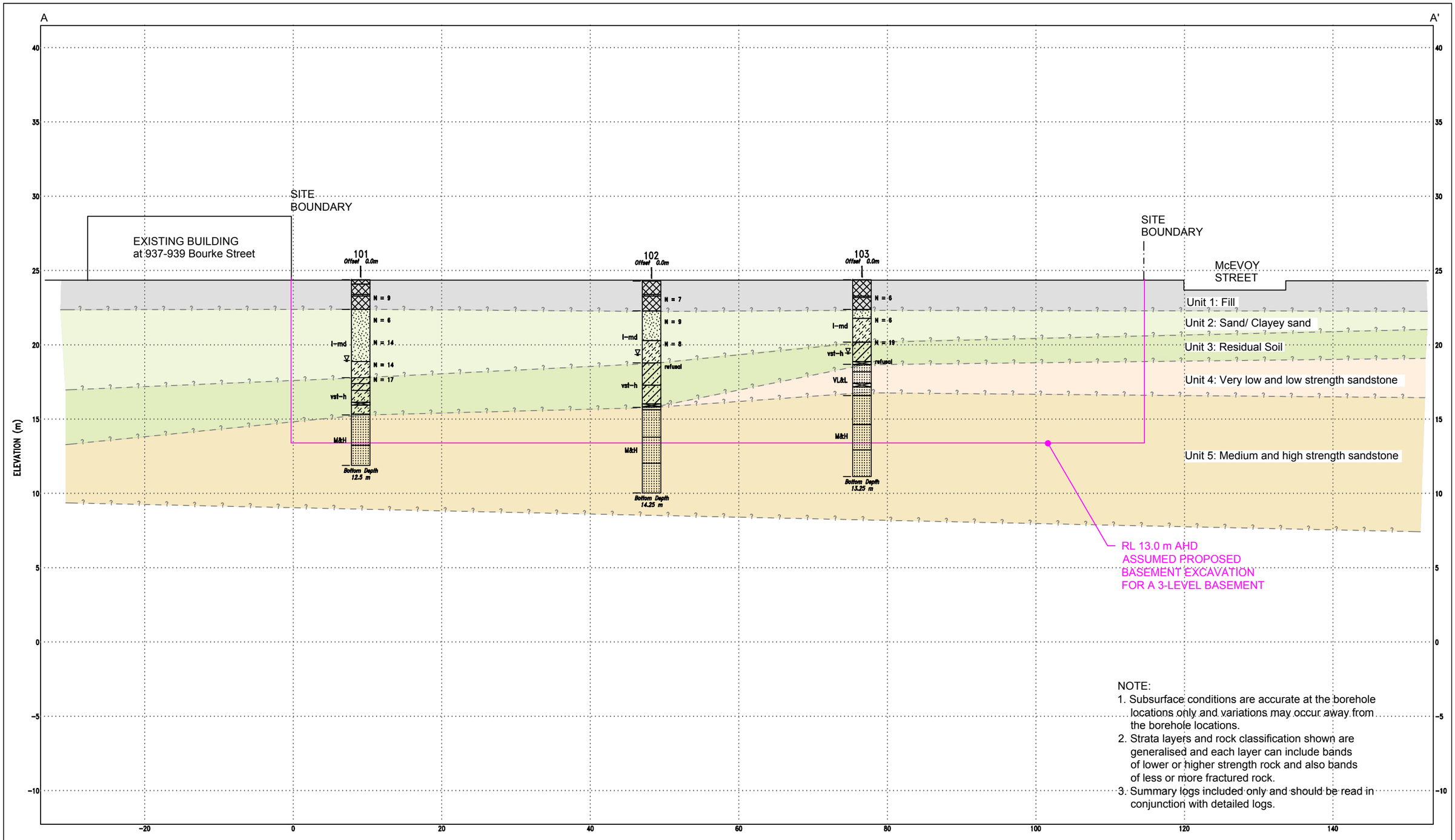
LEGEND

- Borehole location (DP 2019)
- Previous monitoring well location (ARCADIS 2018)
- Site boundary
- A A' Geotechnical Cross Section A-A'

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Fabcot Pty Ltd		TITLE: **Site Plan** **Proposed Woolworths Development** **923-935 Bourke Street, WATERLOO**
OFFICE: Sydney	DRAWN BY: PSCH / IT	
SCALE: 1:500 @ A3	DATE: 17.10.2019	

PROJECT No:	86864.00
DRAWING No:	1
REVISION:	0



NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs included only and should be read in conjunction with detailed logs.

LEGEND

- Filling
- Sand
- Sandy Clay/ Clayey Sand
- Sandstone

- Unit 1: Fill
- Unit 2: Sand/ Clayey sand
- Unit 3: Residual Soil
- Unit 4: Very low and low strength sandstone
- Unit 5: Medium and high strength sandstone

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL STRENGTH
vl - Very Loose
l - Loose
md - Medium Dense
d - Dense
vd - Very Dense
vs - Very Soft
s - Soft
st - Stiff
vst - Very Stiff
h - Hard

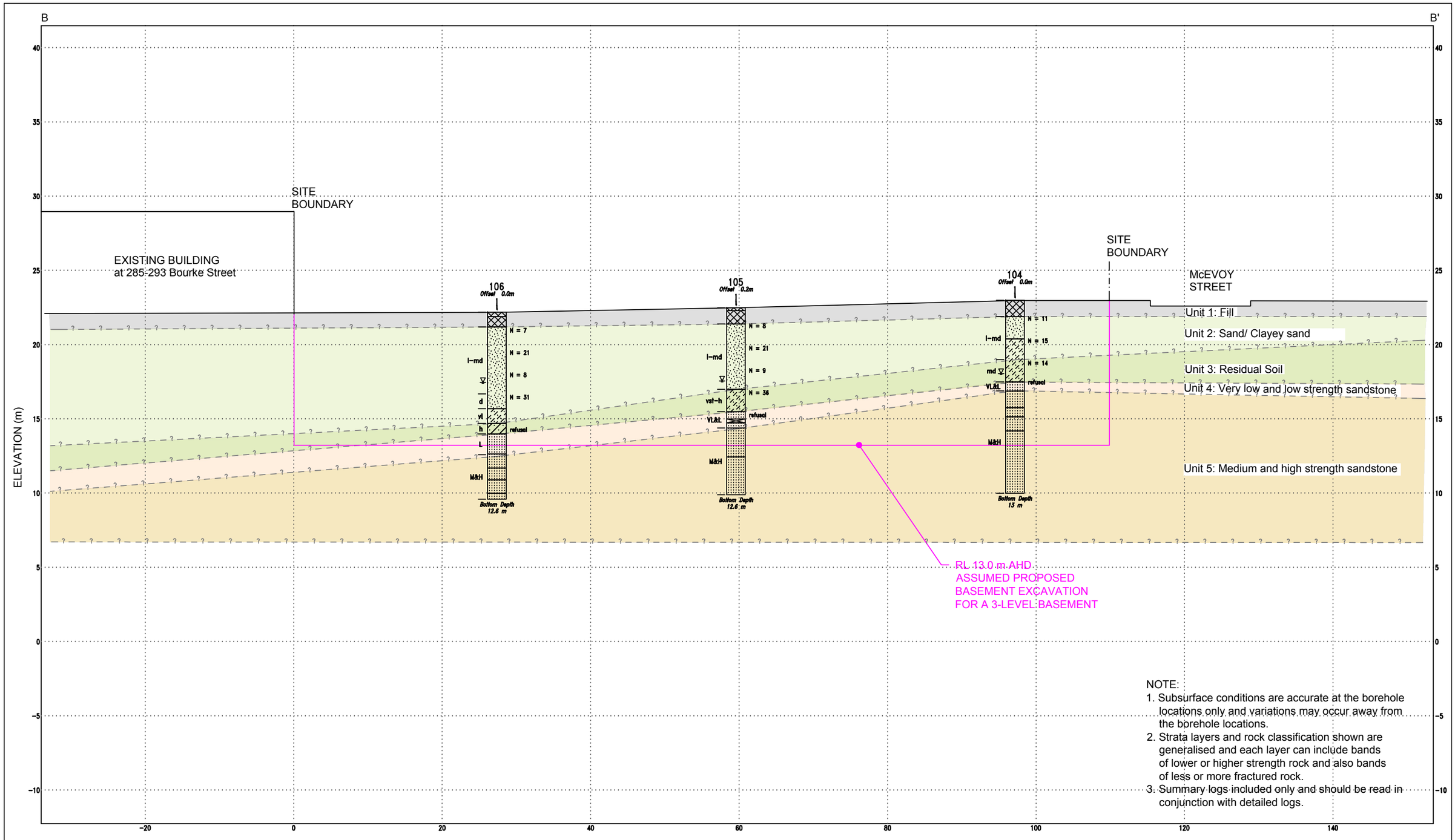
TESTS / OTHER
N - Standard penetration test value
Water level
— ? — — - Interpreted geotechnical boundary (see notes)

0 10
Horizontal Scale (metres)
Vertical Exaggeration = 2.0

605

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Fabcot Pty Ltd		TITLE: **Cross-section A-A'**	PROJECT No: 86864.00
OFFICE: Sydney	DRAWN BY: PSCH / IT	**Proposed Woolworths Development**	DRAWING No: 2
SCALE: 1:500 (H) 1:250 (V) @ A3	DATE: 17.10.2019	**923-935 Bourke St, WATERLOO**	REVISION: 0



NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs included only and should be read in conjunction with detailed logs.

LEGEND

- Filling
- Sand
- Sandy Clay/ Clayey Sand
- Sandstone

- Unit 1: Fill
- Unit 2: Sand/ Clayey sand
- Unit 3: Residual Soil
- Unit 4: Very low and low strength sandstone
- Unit 5: Medium and high strength sandstone

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL STRENGTH
vl - Very Loose
l - Loose
md - Medium Dense
d - Dense
vd - Very Dense
vs - Very Soft
s - Soft
st - Stiff
vst - Very Stiff
h - Hard

TESTS / OTHER
N - Standard penetration test value
- Water level
— ? — — - Interpreted geotechnical boundary (see notes)

0 10
Horizontal Scale (metres)
Vertical Exaggeration = 2.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Fabcot Pty Ltd		TITLE: **Cross-section B-B'**	PROJECT No: 86864.00
OFFICE: Sydney	DRAWN BY: PSCH / IT	**Proposed Woolworths Development**	DRAWING No: 3
SCALE: 1:500 (H) 1:250 (V) @ A3	DATE: 17.10.2019	**923-935 Bourke St, WATERLOO**	REVISION: 0

909

Appendix C

Field Work Results

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

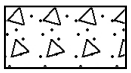
Symbols & Abbreviations

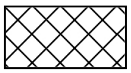
Graphic Symbols for Soil and Rock

General

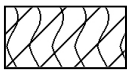

Asphalt

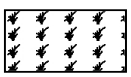

Road base

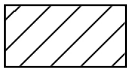

Concrete

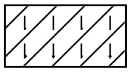

Filling

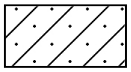
Soils


Topsoil

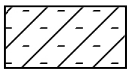

Peat

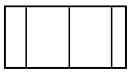

Clay

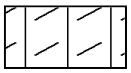

Silty clay

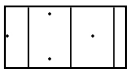

Sandy clay

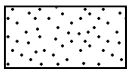

Gravelly clay

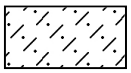

Shaly clay

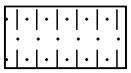

Silt


Clayey silt


Sandy silt

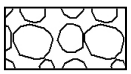

Sand

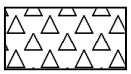

Clayey sand


Silty sand


Gravel

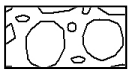

Sandy gravel


Cobbles, boulders

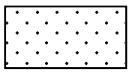

Talus

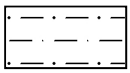
Sedimentary Rocks

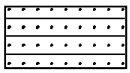

Boulder conglomerate

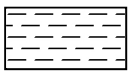

Conglomerate


Conglomeratic sandstone

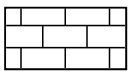

Sandstone


Siltstone

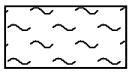

Laminite

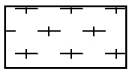

Mudstone, claystone, shale

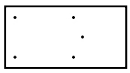

Coal


Limestone

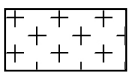
Metamorphic Rocks

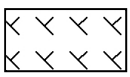

Slate, phyllite, schist

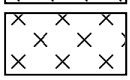

Gneiss

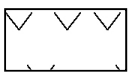

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

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

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

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

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

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.4 AHD
EASTING: 334385.8
NORTHING: 6247315.2
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 86864.00
DATE: 26/8/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
24	0.3	FILL/SAND SP: fine to medium grained, brown, with 30% bricks, moist, appears generally moderately compacted					
1	1.0	FILL/SAND SP: fine to medium grained, grey-brown, moist, appears generally moderately compacted					
	1.1	CONCRETE: 100 mm		S			2,4,5 N = 9
23		FILL/SAND SP: fine to medium grained, grey-brown, moist, appears generally moderately compacted					
2	2.0	SAND SP: medium grained, orange-brown, moist, loose, aeolian deposits					
22				S			2,2,4 N = 6
3							
21		From 3.5 m: yellow-pale brown, medium dense					
4				S			2,6,8 N = 14
20							
5							
19	5.5	Clayey SAND CS: fine to medium grained, pale grey and red, low plasticity clay, with 30% ferruginised seams, moist, medium dense, aeolian deposits		S			4,7,7 N = 14
6							
18	6.6	Sandy CLAY SC: medium plasticity, pale grey and red, fine to medium sand, wet, very stiff, extremely weathered material		S			4,7,10 N = 17
7	7.0	Sandy CLAY SC: medium plasticity, pale grey and red, fine to medium sand, with 10-20% high strength iron-cemented bands, moist, very stiff, extremely weathered material		C	100	0	
17	7.45	Clayey SAND SC: fine to medium grained, pale grey, low plasticity clay, wet, medium dense, extremely weathered material					PL(A) = 1.7
8	8.25 8.45	Clayey SAND SC: fine to medium grained, pale grey, low plasticity clay, moist, medium dense, extremely weathered material		C	91	73	PL(A) = 1.4
16	9.05						
9							
15							

Discontinuities: B - Bedding, J - Joint, S - Shear, F - Fault

8.25m: CORE LOSS: 200mm

9.25m: B,0-5°,un,ro,cln

9.6m: B,5-10°,un,ro,cln

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m, HQ 7.0m

TYPE OF BORING: Hand dug to 0.5m, Solid Flight Auger (TC-Bit) to 5.95m, Rotary (mud) to 7.0m, NMLC-coring to 12.5m

WATER OBSERVATIONS: Free groundwater observed at 5.5m whilst augering; borehole pumped dry on completion on 26/8/19 at 18:00hrs, Water level measured at 5.13m bgl on 27/8/19 at 07:00hrs

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.5m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.4 AHD
EASTING: 334385.8
NORTHING: 6247315.2
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 86864.00
DATE: 26/8/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE: medium to coarse grained, orange-brown, massive, high strength, slightly weathered, slightly fractured, Hawkesbury Sandstone *(continued)*							C	91	73	PL(A) = 1.7
								10.6m: B,0°,pl,ro,fe stn				
	11.15	SANDSTONE: medium to coarse grained, pale grey, <10% siltstone laminations, high strength, fresh, slightly fractured, Hawkesbury Sandstone							C	100	100	PL(A) = 1.1
								11.75m: B,0°,pl,ro,cln				
	12.5	Bore discontinued at 12.5m						12.45m: B,0°,pl,ro,cln				PL(A) = 1

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m, HQ 7.0m

TYPE OF BORING: Hand dug to 0.5m, Solid Flight Auger (TC-Bit) to 5.95m, Rotary (mud) to 7.0m, NMLC-coring to 12.5m

WATER OBSERVATIONS: Free groundwater observed at 5.5m whilst augering; borehole pumped dry on completion on 26/8/19 at 18:00hrs, Water level measured at 5.13m bgl on 27/8/19 at 07:00hrs

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.5m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 101 PROJECT: WATERLOO AUGUST 2019

7.00 – 11.00m

BORE: 101 PROJECT: WATERLOO AUGUST 2019

11.00 – 12.50m

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.3 AHD
EASTING: 334411.9
NORTHING: 6247344.4
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 86864.00
DATE: 27/8/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
24		FILL/SAND SP: medium grained, brown, with 30% bricks, moist, appears generally moderately compacted										
	0.9											
23	1.0	CONCRETE: 100 mm										
		FILL/SAND SP: fine to medium grained, grey, moist, appears generally moderately compacted							S			2,3,4 N = 7
		From 1.15m: brown										
22	2.0	SAND SP: fine to medium grained, orange-brown, moist, loose, aeolian deposits							S			4,4,5 N = 9
		From 2.7m: brown-dark brown										
21	4.0	Clayey SAND CS: fine to medium grained, pale grey and red, low plasticity clay, moist, loose, aeolian deposits							S			3,3,5 N = 8
20	5.5	Sandy CLAY CI: medium plasticity, pale grey, fine to medium sand, wet, hard, extremely weathered material							S			7,20,20/130B refusal
19	7.0	Sandy Clay CI: medium plasticity, pale grey and red, fine to medium sand, with 10-20% medium strength iron-cemented bands, wet, hard, extremely weathered material							C	100	0	PL(A) = 0.4
18	8.25							8.25m: CORE LOSS: 200mm				
17	8.45	SANDSTONE: medium to coarse grained, red-brown, massive, medium strength, moderately weathered, Hawkesbury Sandstone										PL(A) = 0.7
16	8.65							9m: J,45-80°,un,ro,fe stn	C	91	70	
15	9	SANDSTONE: fine to medium grained, pale grey, low and medium strength, moderately to slightly weathered, fractured then slightly fractured, Hawkesbury Sandstone										PL(A) = 0.1

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) 7.0m, NMLC-coring to 14.25m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.0m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.3 AHD
EASTING: 334411.9
NORTHING: 6247344.4
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 86864.00
DATE: 27/8/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
									C	91	70	PL(A) = 0.5
	10.5	SANDSTONE: medium to coarse grained, pale grey and orange, massive, high strength, slightly weathered, slightly fractured, Hawkesbury Sandstone						10.47m: B,5°,pl,ro,fe stn 10.55m: J,45°,pl,ro,fe stn 10.66m: J,10-45°,un,ro,fe stn 10.78m: DS, 50mm 11.36m: B,0°,pl,ro,cln 11.51m: B,0°,pl,ro,cln	C	100	100	PL(A) = 1.5
	12.25	SANDSTONE: medium to coarse grained, pale grey, with <20% siltstone laminations, high strength, fresh, slightly fractured, Hawkesbury Sandstone						12.42m: B,5°,pl,ro,cln 12.5m: B,5°,pl,ro,cln 12.66m: B,5°,pl,ro,cln 13.18m: B,5°,pl,ro,cln 13.67m: CS,10mm	C	100	100	PL(A) = 1.1 PL(A) = 1
	14.25	Bore discontinued at 14.25m										

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) 7.0m, NMLC-coring to 14.25m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.0m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

BORE: 102 PROJECT: WATERLOO AUGUST 2019

7.00 – 11.00m

BORE: 102 PROJECT: WATERLOO AUGUST 2019

11.00 – 14.25 m

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.4 AHD
EASTING: 334430.8
NORTHING: 6247365.5
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 86864.00
DATE: 27/8 - 28/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
24	0.0	FILL/SAND SP: medium grained, grey-brown, with 30% bricks, moist, appears generally moderately compacted										
23	1.1	CONCRETE: 100 mm							S			2,3,3 N = 6
	1.2	FILL/SAND SP: fine to medium grained, dark grey, moist, appears generally moderately compacted										
22	2.0	SAND SP: medium grained, yellow, moist, medium dense, aeolian deposits										
	2.6	Clayey SAND CS: fine to medium grained, pale grey, low plasticity clay, moist, loose, aeolian deposits							S			2,2,4 N = 6
21												
20	4.2	Sandy CLAY SC: medium plasticity, pale grey, fine to medium sand, moist, very stiff, extremely weathered material							S			5,8,11 N = 19
19	5.5					▼		5.5m: CORE LOSS: 230mm	S			5/10,B refusal
	5.73	SANDSTONE: fine to medium grained, orange-brown, thinly bedded, low strength with medium strength sandstone bands, moderately weathered, fractured, Hawkesbury Sandstone						6.15m: CS,130mm 6.35m: CS,100mm 6.55m: CS,310mm	C	84	0	PL(A) = 0.2 PL(A) = 0.4
18	6.97	SANDSTONE: fine to medium grained, pale grey and brown, thinly bedded, medium strength with extremely weathed material and medium strength sandstone bands, highly weathered, fractured, Hawkesbury Sandstone						6.94m: CS,30mm 6.97m: CORE LOSS: 250mm 7.27m: CZ,20mm 7.35m: B,5°,pl,ro,fe stn 7.6m: DS,50mm 7.65-8.15m: J60-90°,un,ro,cln				PL(A) = 0.2
17	7.8	SANDSTONE: fine to medium grained, pale grey and brown, thinly bedded, low strength, moderately weathered, fractured, Hawkesbury Sandstone										PL(A) = 0.8
16		SANDSTONE: medium grained, pale grey and orange, massive, medium strength, slightly weathered, slightly fractured, Hawkesbury Sandstone						8.43m: B,0-10°,un,ro,fe stn 8.6m: J,60°,pl,ro,cln	C	92	77	
15	9.75							9.67m: CS,30mm				PL(A) = 0.6

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 5.5m, HQ 5.5m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) to 5.5m, NMLC-coring to 13.25m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.0m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.4 AHD
EASTING: 334430.8
NORTHING: 6247365.5
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 86864.00
DATE: 27/8 - 28/7/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
14	11	SANDSTONE: medium to coarse grained, pale grey and orange, massive, high strength, slightly weathered, slightly fractured, Hawkesbury Sandstone *(continued)*	SW		High		0.10	10.1m: B,10°,pl,ro,cln 10.18m: B,10°,pl,ro,cln 10.52m: B,10°,pl,ro,cln 11.25m: B,0-5°,un,ro,cln				PL(A) = 1.5
13	11.45	SANDSTONE: medium to coarse grained, pale grey, cross bedded with <10% siltstone laminations, fresh, unbroken, Hawkesbury Sandstone	SW		High		0.10		C	100	100	PL(A) = 1.2
12	12											PL(A) = 1.3
11	13											
	13.25	Bore discontinued at 13.25m										
10	14											
9	15											
8	16											
7	17											
6	18											
5	19											

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 5.5m, HQ 5.5m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) to 5.5m, NMLC-coring to 13.25m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.0m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 103 PROJECT: WATERLOO AUGUST 2019

5.50 – 9.00m

BORE: 103 PROJECT: WATERLOO AUGUST 2019

9.00 – 13.25 m

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 23 AHD
EASTING: 334380.7
NORTHING: 6247392.2
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 86864.00
DATE: 28/8/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		B - Bedding J - Joint S - Shear F - Fault	EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00					
23		FILL/SAND SP: medium grained, grey-brown, with 20% fine gravel, moist, appears generally moderately compacted										
22	1											
	1.1	SAND SP: medium grained, orange-brown, moist, medium dense, aeolian deposits							S			4,4,7 N = 11
21	2	From 2m: red-brown										
	2.6	Clayey SAND SC: fine to medium grained, pale grey, low plasticity clay, medium dense, aeolian deposits							S			7,7,8 N = 15
20	3											
19	4								S			5,6,8 N = 14
18	5					▼						
	5.5	SANDSTONE: medium grained, pale grey, bedded, very low with medium strength sandstone bands, highly weathered, fractured, Hawkesbury Sandstone						5.5m: DS,10mm 5.6m: DS,10mm 5.76m: DS,10mm 5.9m: DS,100mm 6.04m: CS,70mm	S			5/20,B refusal PL(A) = 0.6
17	6											
	6.11	SANDSTONE: medium grained, pale grey, medium strength, slightly weathered, slightly fractured, Hawkesbury Sandstone							C	100	66	
16	7							6.72m: B,5°,pl,ro,fe stn				PL(A) = 0.4
	7.24	SANDSTONE: medium grained, pale grey, medium strength, slightly weathered, slightly fractured, Hawkesbury Sandstone										PL(A) = 0.5
	7.85	SANDSTONE: medium to coarse grained, pale brown, massive, high strength, slightly weathered, unbroken, Hawkesbury Sandstone						7.82m: B,5°,pl,ro,cly 5mm 7.85m: B,10°,pl,ro,fe stn				PL(A) = 1.7
15	8								C	100	100	
	8.8	SANDSTONE: medium grained, pale grey, with <10% siltstone laminations, high strength, fresh, slightly fractured, Hawkesbury Sandstone						9.18m: B,5-10°,un,ro,cln				PL(A) = 1.3
14	9							9.8m: B,5-10°,un,ro,cln				

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 5.5m, HQ 5.5m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) 5.5m, NMLC-coring to 13.00m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 23 AHD
EASTING: 334380.7
NORTHING: 6247392.2
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 86864.00
DATE: 28/8/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
13		SANDSTONE: medium grained, pale grey, with <10% siltstone laminations, high strength, fresh, slightly fractured, Hawkesbury Sandstone *(continued)*							C	100	100	PL(A) = 1.5
12	11							11.23m: B,0°,pl,ro,cly 8mm	C	100	100	PL(A) = 2
11	12							12.2m: J,30°,pl,ro,cln				PL(A) = 1.8
10	13 13.0	Bore discontinued at 13.0m						12.9m: J,70°,pl,ro,cln				
9	14											
8	15											
7	16											
6	17											
5	18											
4	19											

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 5.5m, HQ 5.5m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) 5.5m, NMLC-coring to 13.00m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 104 PROJECT: WATERLOO AUGUST 2019

5.50 – 10.00m

BORE: 104 PROJECT: WATERLOO AUGUST 2019

10.00 – 13.00 m

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 22.5 AHD
EASTING: 334355.2
NORTHING: 6247364.6
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 86864.00
DATE: 28 - 29/8/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00	B - Bedding J - Joint S - Shear F - Fault				
22.5	0.2	FILL/SAND SP: medium grained, brown, moist, appears generally moderately compacted										
		FILL/SAND SP: medium grained, pale grey, moist, appears generally moderately compacted										
22	1											
	1.1	SAND SP: fine to medium grained, orange-brown, moist, loose, aeolian deposits							S			4,4,4 N = 8
21	2	From 2m: pale brown-pale yellow, medium dense							S			5,8,13 N = 21
20	3											
19	4	From 3.5m: red-brown, loose							S			8,6,3 N = 9
18	5					▼						
	5.5	Clayey SAND SC: fine to medium grained, pale grey, dense, aeolian deposits							S			4,14,22 N = 36
17	6											
	7.0	SANDSTONE: fine to medium grained, pale grey, low strength, Hawkesbury Sandstone							S			7,14,30/110 refusal
16	7											
15	7.5							7.5m: CORE LOSS: 250mm				
	7.75	SANDSTONE: fine to medium grained, pale grey, bedded, low strength, moderately weathered, fractured, Hawkesbury Sandstone						7.75m: CS,30mm 7.78-8.30m: J,70-90°,un,ro,cln				
14	8							8.3m: CS,30mm 8.45m: B,5°,pl,ro,cln	C	88	66	PL(A) = 0.3
	8.1	SANDSTONE: medium grained, red and orange, bedded, medium strength, moderately weathered, unbroken, Hawkesbury Sandstone						8.75m: B,10-20°,un,ro,cln 8.8m: B,10°,pl,ro,cly 5mm				PL(A) = 0.6
13	9							9.45m: DS,70mm				
									C	100	100	

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m, HQ 6.0m

TYPE OF BORING: Hand dug to 0.5m, Solid Flight Auger (TC-Bit) to 6.0m, Rotary (mud) to 7.5m, NMLC-coring to 12.6m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.0m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 22.5 AHD
EASTING: 334355.2
NORTHING: 6247364.6
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 86864.00
DATE: 28 - 29/8/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	10.05	SANDSTONE: medium grained, pale grey, with <20% carbonaceous laminations, medium then heigh strength, fresh, unbroken, Hawkesbury Sandstone										PL(A) = 0.8
								10.8m: B,0°,pl,ro,cln	C	100	100	PL(A) = 1.5
								11.85m: B,5°,pl,ro,fe stn				PL(A) = 1.7
	12.6	Bore discontinued at 12.6m										

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m, HQ 6.0m

TYPE OF BORING: Hand dug to 0.5m, Solid Flight Auger (TC-Bit) to 6.0m, Rotary (mud) to 7.5m, NMLC-coring to 12.6m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Slight water loss during drilling below 8.0m. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 105 PROJECT: WATERLOO AUGUST 2019

7.50 – 12.00m

BORE: 105 PROJECT: WATERLOO AUGUST 2019

12.00 – 12.60 m

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 22.2 AHD
EASTING: 334333.6
NORTHING: 6247340.7
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 86864.00
DATE: 29/8/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
22	0.0	FILL/SAND SP: medium grained, grey-brown, with 20% fine gravel moist, appears generally moderately compacted										
	0.3	FILL/SAND SP: medium grained, brown, moist, appears generally moderately compacted										
21	1.0	SAND SP: fine to medium grained, orange-brown, moist, loose, aeolian deposits							S			1,3,4 N = 7
20	2	From 2.5m: pale brown-yellow, medium dense							S			8,9,12 N = 21
19	3											
18	4	From 4m: pale brown, loose				▼			S			1,5,3 N = 8
17	5	From 5.5m: dense							S			3,15,16 N = 31
16	6	From 5.8m: red-brown										
	6.5	Clayey SAND SC: fine to medium grained, pale grey, low plasticity clay, very loose, aeolian deposits							S			sunk under hammer weight
15	7											
	7.5	Sandy CLAY CI: medium plasticity, pale grey, fine to medium sand, moist, hard, extremely weathered material							S			17,13,3/20 refusal
14	8											
	8.2	SANDSTONE: medium to coarse grained, red-brown, massive, low strength with medium strength sandstone bands, moderately weathered, slightly fractured, Hawkesbury Sandstone						8.23m: B,0°,pl,ro,fe stn	C	100	90	PL(A) = 0.2
13	9							9.23m: B,0°,pl,ro,cly 2mm				PL(A) = 0.6
	9.55											

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m, HQ 6.0m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) to 6.0m, Rotary (mud) to 8.0m, NMLC-coring to 12.6m

WATER OBSERVATIONS: Free groundwater observed at 4.8m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 22.2 AHD
EASTING: 334333.6
NORTHING: 6247340.7
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 86864.00
DATE: 29/8/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
12		SANDSTONE: medium to coarse grained, pale grey and orange, medium strength, bedded,						10.03m: B,0-10°,un,ro,fe stn				PL(A) = 0.4
11	10.5	moderately weathered, slightly fractured, Hawkesbury Sandstone *(continued)*						10.65m: Cs, 200mm 10.9m: Cs, 150mm				
		SANDSTONE: medium to coarse grained, red-brown, medium										
11	11.3	strength, bedded, with <50% extremely low strength bands, highly weathered, fractured, Hawkesbury Sandstone						11.23m: J,30°,pl,ro,fe stn	C	100	83	PL(A) = 0.4
		SANDSTONE: medium to coarse grained, pale grey and brown,						11.68m: B,10°,pl,ro,fe stn 11.9m: Cs, 30mm				
10	12.2	medium strength, bedded, slightly weathered, slightly fractured, Hawkesbury Sandstone						12.02m: B,5-10°,pl,ro,cbs stn 12.1m: Ds, 30mm				PL(A) = 0.7
	12.6	SANDSTONE: medium to coarse grained, pale grey, medium strength, massive, fresh, slightly fractured, Hawkesbury Sandstone										
9	13	Bore discontinued at 12.6m										
8	14											
7	15											
6	16											
5	17											
4	18											
3	19											

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** HW 6.0m, HQ 6.0m

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) to 6.0m, Rotary (mud) to 8.0m, NMLC-coring to 12.6m

WATER OBSERVATIONS: Free groundwater observed at 4.8m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 106 PROJECT: WATERLOO AUGUST 2019

8.00 – 12.00m

BORE: 106 PROJECT: WATERLOO AUGUST 2019

12.00 – 12.60 m

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.4 AHD
EASTING: 334386.2
NORTHING: 6247315.5
DIP/AZIMUTH: 90°/--

BORE No: 101A
PROJECT No: 86864.00
DATE: 30/8/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
24	0	FILL/SAND SP: medium grained, brown, with 30% bricks, moist							A			
23	1	1.0 CONCRETE: 100 mm										
		1.1 FILL/SAND SP: medium grained, grey-brown, moist							A			
	2								A			
22		2.3 SAND SP: medium grained, yellow, damp, aeolian deposits										
	3								A			
21		3.2 SAND SP: medium grained, pale yellow, moist, aeolian deposits										
	4								A			
20		4.2 SAND SP: medium grained, yellow, moist, aeolian deposits										
	5								A			
19		5.8 Clayey SAND SC: fine to medium grained, pale grey, low plasticity clay, wet, aeolian deposits										
	6								A			
18		6.5 Sandy CLAY CI: medium plasticity, pale grey and red, fine to medium grained sand, moist, extremely weathered material										
	7	7.0 Bore discontinued at 7.1m							A			
17												
	8											
16												
	9											
15												

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** Nil

TYPE OF BORING: Hand dug to 0.5m, Solid Flight Auger (TC-Bit) to 7.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 24.4 AHD
EASTING: 334430.4
NORTHING: 6247365.2
DIP/AZIMUTH: 90°/--

BORE No: 103A
PROJECT No: 86864.00
DATE: 30/8/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
24	0.0	FILL/SAND SP: medium grained, grey-brown, with 30% bricks, moist							A			
1	1.0	CONCRETE: 100 mm										
	1.1	FILL/SAND SP: fine to medium grained, dark grey, moist							A			
23	1.8	SAND SP: medium grained, yellow, damp, aeolian deposits										
2									A			
22	2.5	Clayey SAND SC: fine to medium grained, pale grey, low plasticity clay, moist, aeolian deposits										
3									A			
21	3.3	SAND SP: medium grained, yellow, damp, aeolian deposits							A			
4	4.0	Sandy CLAY CI: medium plasticity, pale grey, fine to medium sand, moist							A			
20	4.5	Sandy CLAY CI: medium plasticity, pale grey and red, fine to medium sand, with <20% ferruginised seams, moist, extremely weathered material							A			
5	5.0	Sandy CLAY CI: low plasticity, pale grey, fine to medium sand, moist, extremely weathered material							A			
19												
6	6.0	SANDSTONE: medium to coarse grained, pale grey and red, very low to low strength, Hawkesbury Sandstone							A			
18	6.9	SANDSTONE: medium to coarse grained, brown, low to medium strength, Hawkesbury Sandstone							A			
7												
17												
8	8.0	Bore discontinued at 8.0m										
16												
9												
15												

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** Nil

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) to 8.0m

WATER OBSERVATIONS: Groundwater observed at 4.5m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Fabcot Pty Ltd
PROJECT: Proposed Woolworths Development
LOCATION: 923-935 Bourke Street, Waterloo

SURFACE LEVEL: 23 AHD
EASTING: 334380.9
NORTHING: 6247392.5
DIP/AZIMUTH: 90°/--

BORE No: 104A
PROJECT No: 86864.00
DATE: 30/8/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata
23	0.3	FILL/SAND SP: medium grained, grey-brown, with 20% fine gravel, moist
		FILL/SAND SP: medium grained, brown, damp, aeolian deposits
22	1	
	1.5	SAND SP: medium grained, orange-brown, damp, aeolian deposits
21	2	
	2.2	SAND SP: medium to coarse grained, red-brown, damp, aeolian deposits
	2.8	Clayey SAND SC: fine to medium grained, pale grey, low plasticity clay, moist, aeolian deposits
20	3	
	3.5	SAND SP: medium grained, pale grey, moist, aeolian deposits
19	4	
	4.8	SANDSTONE: medium grained, pale grey, low to medium strength, Hawkesbury Sandstone
18	5	
17	6	
	6.1	Bore discontinued at 6.1m
16	7	
15	8	
14	9	

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

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
A			
A			
A			
A			
A			
A			
A			

RIG: Geo205 **DRILLER:** GM **LOGGED:** JN **CASING:** Nil

TYPE OF BORING: Hand dug to 1.0m, Solid Flight Auger (TC-Bit) to 6.1m

WATER OBSERVATIONS: Free groundwater observed at 5.0m whilst augering

REMARKS: Location coordinates are in UTM Zone 56. Backfilled with drilling spoil.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix D

Laboratory Test Results

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Fax: (02) 9809 0666
Email: lujia.wu@douglaspartners.com.au

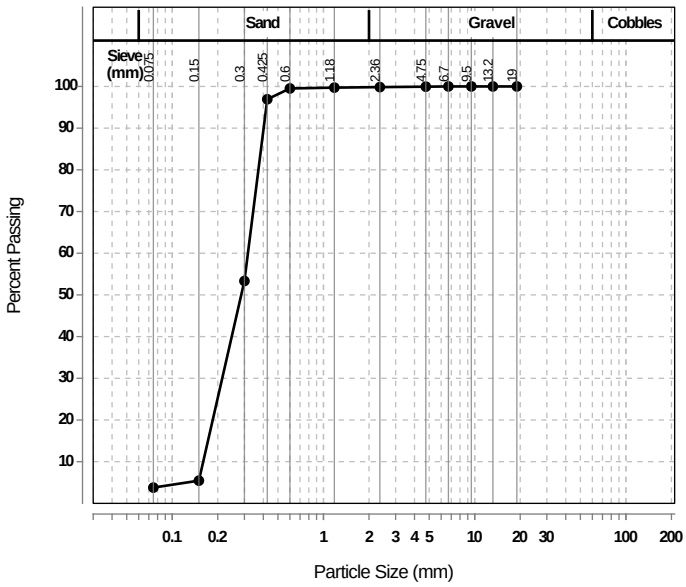
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Lujia Wu
soil technician
NATA Accredited Laboratory Number: 828

Report Number: **86864.00-1**
Issue Number: 1
Date Issued: 09/09/2019
Client: Fabcot Pty Ltd
1 Woolworths Way, Bella Vista NSW 2153
Contact: Michelle Chiu
Project Number: 86864.00
Project Name: Proposed Woolworths Development
Project Location: 923-935 Bourke Street, Waterloo
Work Request: 4890
Sample Number: 19-4890A
Date Sampled: 29/08/2019
Dates Tested: 04/09/2019 - 09/09/2019
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **105 (2.5-2.95m)**
Material: SAND : Brown sand, with trace silt

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**100**		
9.5 mm	**100**		
6.7 mm	**100**		
4.75 mm	**100**		
2.36 mm	**100**		
1.18 mm	**100**		
0.6 mm	**100**		
0.425 mm	**97**		
0.3 mm	**53**		
0.15 mm	**5**		
0.075 mm	**4**		

Particle Size Distribution



638

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CERTIFICATE OF ANALYSIS 225369

Client Details

Client	Douglas Partners Pty Ltd
Attention	Shahin Falahati, Julian Ng
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86864.00, Waterloo**
Number of Samples	1 Water, 2 Soil
Date samples received	04/09/2019
Date completed instructions received	04/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	11/09/2019
Date of Issue	06/09/2019

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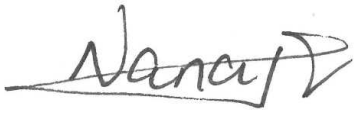
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics		
Our Reference		225369-1
Your Reference	UNITS	BH-MW3
Date Sampled		28/08/2019
Type of sample		Water
Date prepared	-	04/09/2019
Date analysed	-	04/09/2019
pH	pH Units	6.6
Electrical Conductivity	µS/cm	190
Chloride, Cl	mg/L	22
Sulphate, SO4	mg/L	5

Misc Inorg - Soil			
Our Reference		225369-2	225369-3
Your Reference	UNITS	BH103 (1.2-1.65m)	BH101 (4.0-4.45m)
Date Sampled		27/08/2019	26/08/2019
Type of sample		Soil	Soil
Date prepared	-	05/09/2019	05/09/2019
Date analysed	-	05/09/2019	05/09/2019
pH 1:5 soil:water	pH Units	7.9	8.1
Electrical Conductivity 1:5 soil:water	µS/cm	240	17
Chloride, Cl 1:5 soil:water	mg/kg	58	<10
Sulphate, SO4 1:5 soil:water	mg/kg	280	<10

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			04/09/2019	[NT]	[NT]	[NT]	[NT]	04/09/2019	[NT]
Date analysed	-			04/09/2019	[NT]	[NT]	[NT]	[NT]	04/09/2019	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	117	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			05/09/2019	3	05/09/2019	05/09/2019		05/09/2019	[NT]
Date analysed	-			05/09/2019	3	05/09/2019	05/09/2019		05/09/2019	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	3	8.1	8.0	1	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	3	17	17	0	104	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	3	<10	<10	0	110	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	3	<10	<10	0	117	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Report Comments

Tests/Analytes PH have exceeded the recommended technical holding times, Envirolab Group form 347 "Recommended Preservation and Holding Times" can be provided on request (available on the Envirolab website)

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CERTIFICATE OF ANALYSIS 225382

Client Details

Client	Douglas Partners Pty Ltd
Attention	Julian Ng
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86864.00, Waterloo**
Number of Samples	8 SOIL
Date samples received	04/09/2019
Date completed instructions received	04/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	11/09/2019
Date of Issue	10/09/2019

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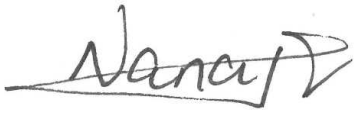
Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

sPOCAS field test						
Our Reference		225382-1	225382-2	225382-3	225382-4	225382-5
Your Reference	UNITS	BH104A	BH104A	BH104A	BH104A	BH104A
Depth		0.0-0.1	1.1-1.2	2.0-2.1	3.0-3.1	4.0-4.1
Date Sampled		30/08/2019	30/08/2019	30/08/2019	30/08/2019	30/08/2019
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	06/09/2019	06/09/2019	06/09/2019	06/09/2019	06/09/2019
Date analysed	-	06/09/2019	06/09/2019	06/09/2019	06/09/2019	06/09/2019
pH_F (field pH test)*	pH Units	7.1	7.1	6.4	6.5	6.5
pH_{FOX} (field peroxide test)*	pH Units	5.8	6.5	6.6	6.8	5.2
Reaction Rate*	-	Moderate	Slight	Slight	Slight	Slight

sPOCAS field test		
Our Reference		225382-6
Your Reference	UNITS	BH104A
Depth		5.0-5.1
Date Sampled		30/08/2019
Type of sample		SOIL
Date prepared	-	06/09/2019
Date analysed	-	06/09/2019
pH_F (field pH test)*	pH Units	6.0
pH_{FOX} (field peroxide test)*	pH Units	5.3
Reaction Rate*	-	Slight

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

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CERTIFICATE OF ANALYSIS 225384

Client Details

Client	Douglas Partners Pty Ltd
Attention	Julian Ng
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86864.00, Waterloo**
Number of Samples	10 SOIL
Date samples received	04/09/2019
Date completed instructions received	04/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	11/09/2019
Date of Issue	11/09/2019

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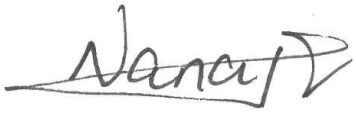
Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

sPOCAS field test						
Our Reference		225384-1	225384-2	225384-3	225384-4	225384-5
Your Reference	UNITS	BH103A	BH103A	BH103A	BH103A	BH103A
Depth		0.0-0.1	1.1-1.2	2.0-2.1	3.0-3.1	4.0-4.1
Date Sampled		30/08/2019	30/08/2019	30/08/2019	30/08/2019	30/08/2019
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	09/09/2019	09/09/2019	09/09/2019	09/09/2019	09/09/2019
Date analysed	-	09/09/2019	09/09/2019	09/09/2019	09/09/2019	09/09/2019
pH_F (field pH test)*	pH Units	7.2	10.8	8.0	5.6	4.9
pH_{FOX} (field peroxide test)*	pH Units	5.3	9.2	4.2	4.6	2.7
Reaction Rate*	-	Moderate	Vigorous	Slight	Slight	Slight

sPOCAS field test		
Our Reference		225384-6
Your Reference	UNITS	BH103A
Depth		5.0-5.1
Date Sampled		30/08/2019
Type of sample		SOIL
Date prepared	-	09/09/2019
Date analysed	-	09/09/2019
pH_F (field pH test)*	pH Units	5.4
pH_{FOX} (field peroxide test)*	pH Units	3.8
Reaction Rate*	-	Slight

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

Result Definitions

NT	Not tested
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Laboratory Acceptance Criteria

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Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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CERTIFICATE OF ANALYSIS 225384-A

Client Details

Client	Douglas Partners Pty Ltd
Attention	Shahin Falahati
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86864.00, Waterloo**
Number of Samples	10 SOIL
Date samples received	04/09/2019
Date completed instructions received	17/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	24/09/2019
Date of Issue	24/09/2019

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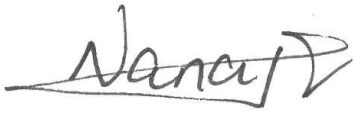
Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

sPOCAS + %S w/w			
Our Reference		225384-A-5	225384-A-6
Your Reference	UNITS	BH103A	BH103A
Depth		4.0-4.1	5.0-5.1
Date Sampled		30/08/2019	30/08/2019
Type of sample		SOIL	SOIL
Date prepared	-	22/09/2019	22/09/2019
Date analysed	-	22/09/2019	22/09/2019
pH $_{kcl}$	pH units	4.3	4.2
TAA pH 6.5	moles H^+ /t	39	36
s-TAA pH 6.5	%w/w S	0.06	0.06
pH $_{Ox}$	pH units	4.3	4.9
TPA pH 6.5	moles H^+ /t	78	55
s-TPA pH 6.5	%w/w S	0.12	0.09
TSA pH 6.5	moles H^+ /t	39	19
s-TSA pH 6.5	%w/w S	0.06	0.03
ANC_E	% $CaCO_3$	<0.05	<0.05
a-ANC_E	moles H^+ /t	<5	<5
s-ANC_E	%w/w S	<0.05	<0.05
S_{KCl}	%w/w S	0.008	0.005
S_P	%w/w	0.009	0.007
S_{POS}	%w/w	<0.005	<0.005
a-S_{POS}	moles H^+ /t	<5	<5
Ca_{KCl}	%w/w	0.03	0.008
Ca_P	%w/w	0.03	0.009
Ca_A	%w/w	<0.005	<0.005
Mg_{KCl}	%w/w	0.010	0.016
Mg_P	%w/w	0.006	0.013
Mg_A	%w/w	<0.005	<0.005
S_{HCl}	%w/w S	0.008	0.005
S_{NAS}	%w/w S	<0.005	<0.005
a-S_{NAS}	moles H^+ /t	<5	<5
s-S_{NAS}	%w/w S	<0.01	<0.01
Fineness Factor	-	1.5	1.5
a-Net Acidity	moles H^+ /t	39	38
s-Net Acidity	%w/w S	0.06	0.06
Liming rate	kg $CaCO_3$ /t	2.9	2.8
s-Net Acidity without -ANCE	%w/w S	0.063	0.060
a-Net Acidity without ANCE	moles H^+ /t	39	38
Liming rate without ANCE	kg $CaCO_3$ /t	2.9	2.8

SCr			
Our Reference		225384-A-5	225384-A-6
Your Reference	UNITS	BH103A	BH103A
Depth		4.0-4.1	5.0-5.1
Date Sampled		30/08/2019	30/08/2019
Type of sample		SOIL	SOIL
Date prepared	-	23/09/2019	23/09/2019
Date analysed	-	23/09/2019	23/09/2019
Chromium Reducible Sulfur	%w/w	<0.005	<0.005
a-Chromium Reducible Sulfur	moles H^+ /t	<3	<3

Method ID	Methodology Summary
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			22/09/2019	[NT]	[NT]	[NT]	[NT]	22/09/2019	[NT]
Date analysed	-			22/09/2019	[NT]	[NT]	[NT]	[NT]	22/09/2019	[NT]
pH $_{kcl}$	pH units		Inorg-064	[NT]	[NT]	[NT]	[NT]	[NT]	89	[NT]
TAA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	95	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pH $_{Ox}$	pH units		Inorg-064	[NT]	[NT]	[NT]	[NT]	[NT]	94	[NT]
TPA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	120	[NT]
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
TSA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
ANC_E	% $CaCO_3$	0.05	Inorg-064	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-ANC_E	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-ANC_E	%w/w S	0.05	Inorg-064	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{POS}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-S_{POS}	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ca_{KCl}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ca_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ca_A	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Mg_{KCl}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Mg_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Mg_A	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-S_{NAS}	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-S_{NAS}	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fineness Factor	-	1.5	Inorg-064	<1.5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity without -ANCE	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: sPOCAS + %S w/w					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: SCr						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			23/09/2019	[NT]	[NT]	[NT]	[NT]	23/09/2019	[NT]
Date analysed	-			23/09/2019	[NT]	[NT]	[NT]	[NT]	23/09/2019	[NT]
a-Chromium Reducible Sulfur	moles H^+/t	3	Inorg-068	[NT]	[NT]	[NT]	[NT]	[NT]	110	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

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Measurement Uncertainty estimates are available for most tests upon request.

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CERTIFICATE OF ANALYSIS 225385

Client Details

Client	Douglas Partners Pty Ltd
Attention	Shahin Falahati, Julian Ng
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86864.00, Waterloo**
Number of Samples	9 Soil
Date samples received	04/09/2019
Date completed instructions received	04/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	11/09/2019
Date of Issue	10/09/2019

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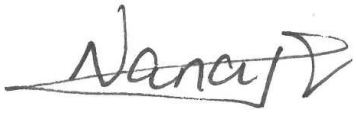
Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

sPOCAS field test						
Our Reference		225385-1	225385-2	225385-3	225385-4	225385-5
Your Reference	UNITS	BH101A 0.0-0.1m	BH101A 1.1-1.2m	BH101A 2.0-2.1m	BH101A 3.0-3.1m	BH101A 4.0-4.1m
Depth		0.0-0.1	1.1-1.2	2.0-2.1	3.0-3.1	4.0-4.1
Date Sampled		30/08/2019	30/08/2019	30/08/2019	30/08/2019	30/08/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	09/09/2019	09/09/2019	09/09/2019	09/09/2019	09/09/2019
Date analysed	-	09/09/2019	09/09/2019	09/09/2019	09/09/2019	09/09/2019
pH_F (field pH test)*	pH Units	7.2	10.6	8.3	8.3	8.3
pH_{FOX} (field peroxide test)*	pH Units	6.3	7.2	6.4	6.4	6.3
Reaction Rate*	-	Moderate	High	Moderate	Slight	Slight

sPOCAS field test			
Our Reference		225385-6	225385-7
Your Reference	UNITS	BH101A 5.0-5.1m	BH101A 6.0-6.1m
Depth		5.0-5.1	6.0-6.1
Date Sampled		30/08/2019	30/08/2019
Type of sample		Soil	Soil
Date prepared	-	09/09/2019	09/09/2019
Date analysed	-	09/09/2019	09/09/2019
pH_F (field pH test)*	pH Units	7.8	7.2
pH_{FOX} (field peroxide test)*	pH Units	6.3	6.0
Reaction Rate*	-	Slight	Slight

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
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NEPM	National Environmental Protection Measure
NR	Not Reported

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Laboratory Acceptance Criteria

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CERTIFICATE OF ANALYSIS 225386

Client Details

Client	Douglas Partners Pty Ltd
Attention	Julian Ng
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86864.00, Waterloo**
Number of Samples	8 SOIL
Date samples received	04/09/2019
Date completed instructions received	04/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	11/09/2019
Date of Issue	10/09/2019

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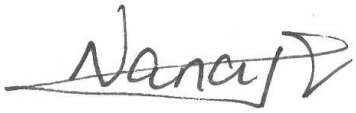
Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

sPOCAS field test						
Our Reference		225386-1	225386-2	225386-3	225386-4	225386-5
Your Reference	UNITS	BH106	BH106	BH106	BH106	BH106
Depth		0.0-0.1	1.0-1.45	2.5-2.95	4.0-4.45	5.5-5.95
Date Sampled		30/08/2019	30/08/2019	30/08/2019	30/08/2019	30/08/2019
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	09/09/2019	09/09/2019	09/09/2019	09/09/2019	09/09/2019
Date analysed	-	09/09/2019	09/09/2019	09/09/2019	09/09/2019	09/09/2019
pH_F (field pH test)*	pH Units	6.5	7.5	8.0	7.6	7.3
pH_{FOX} (field peroxide test)*	pH Units	4.7	6.2	6.3	6.3	6.2
Reaction Rate*	-	High	Slight	Slight	Slight	Slight

sPOCAS field test		
Our Reference		225386-6
Your Reference	UNITS	BH106
Depth		7.0-7.45
Date Sampled		30/08/2019
Type of sample		SOIL
Date prepared	-	09/09/2019
Date analysed	-	09/09/2019
pH_F (field pH test)*	pH Units	6.1
pH_{FOX} (field peroxide test)*	pH Units	3.8
Reaction Rate*	-	Moderate

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

Result Definitions

NT	Not tested
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PQL	Practical Quantitation Limit
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RPD	Relative Percent Difference
LCS	Laboratory Control Sample
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NEPM	National Environmental Protection Measure
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Laboratory Acceptance Criteria

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CERTIFICATE OF ANALYSIS 225386-A

Client Details

Client	Douglas Partners Pty Ltd
Attention	Shahin Falahati
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86864.00, Waterloo**
Number of Samples	8 SOIL
Date samples received	04/09/2019
Date completed instructions received	17/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	24/09/2019
Date of Issue	24/09/2019

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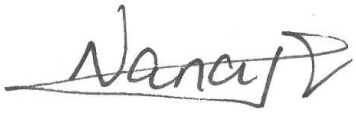
Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

sPOCAS + %S w/w		
Our Reference		225386-A-6
Your Reference	UNITS	BH106
Depth		7.0-7.45
Date Sampled		30/08/2019
Type of sample		SOIL
Date prepared	-	22/09/2019
Date analysed	-	22/09/2019
pH $_{kcl}$	pH units	4.1
TAA pH 6.5	moles H^+ /t	21
s-TAA pH 6.5	%w/w S	0.03
pH $_{Ox}$	pH units	4.6
TPA pH 6.5	moles H^+ /t	22
s-TPA pH 6.5	%w/w S	0.04
TSA pH 6.5	moles H^+ /t	<5
s-TSA pH 6.5	%w/w S	<0.01
ANC_E	% $CaCO_3$	<0.05
a-ANC_E	moles H^+ /t	<5
s-ANC_E	%w/w S	<0.05
S_{KCl}	%w/w S	<0.005
S_P	%w/w	<0.005
S_{POS}	%w/w	<0.005
a-S_{POS}	moles H^+ /t	<5
Ca_{KCl}	%w/w	<0.005
Ca_P	%w/w	<0.005
Ca_A	%w/w	<0.005
Mg_{KCl}	%w/w	0.016
Mg_P	%w/w	0.014
Mg_A	%w/w	<0.005
S_{HCl}	%w/w S	<0.005
S_{NAS}	%w/w S	<0.005
a-S_{NAS}	moles H^+ /t	<5
s-S_{NAS}	%w/w S	<0.01
Fineness Factor	-	1.5
a-Net Acidity	moles H^+ /t	22
s-Net Acidity	%w/w S	0.04
Liming rate	kg $CaCO_3$ /t	1.7
s-Net Acidity without -ANCE	%w/w S	0.036
a-Net Acidity without ANCE	moles H^+ /t	22
Liming rate without ANCE	kg $CaCO_3$ /t	1.7

SCr		
Our Reference		225386-A-6
Your Reference	UNITS	BH106
Depth		7.0-7.45
Date Sampled		30/08/2019
Type of sample		SOIL
Date prepared	-	23/09/2019
Date analysed	-	23/09/2019
Chromium Reducible Sulfur	%w/w	<0.005
a-Chromium Reducible Sulfur	moles H^+ /t	<3

Method ID	Methodology Summary
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			22/09/2019	[NT]	[NT]	[NT]	[NT]	22/09/2019	[NT]
Date analysed	-			22/09/2019	[NT]	[NT]	[NT]	[NT]	22/09/2019	[NT]
pH $_{kcl}$	pH units		Inorg-064	[NT]	[NT]	[NT]	[NT]	[NT]	89	[NT]
TAA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	95	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pH $_{Ox}$	pH units		Inorg-064	[NT]	[NT]	[NT]	[NT]	[NT]	94	[NT]
TPA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	120	[NT]
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
TSA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
ANC_E	% $CaCO_3$	0.05	Inorg-064	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-ANC_E	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-ANC_E	%w/w S	0.05	Inorg-064	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{POS}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-S_{POS}	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ca_{KCl}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ca_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ca_A	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Mg_{KCl}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Mg_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Mg_A	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-S_{NAS}	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-S_{NAS}	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fineness Factor	-	1.5	Inorg-064	<1.5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity without -ANCE	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: sPOCAS + %S w/w					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: SCr						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			23/09/2019	[NT]	[NT]	[NT]	[NT]	23/09/2019	[NT]
Date analysed	-			23/09/2019	[NT]	[NT]	[NT]	[NT]	23/09/2019	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Chromium Reducible Sulfur	moles H^+ /t	3	Inorg-068	<3	[NT]	[NT]	[NT]	[NT]	110	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.