REPORT TO

FABCOT PTY LTD

ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED WOOLWORTHS FACILITY

AT

250-266 VICTORIA STREET,
WETHERILL PARK, NSW

Date: 25 January 2021
Ref: 31888AH2rpt

JKGeotechnics
www.jkgeotechnics.com.au

T: +61 2 9888 5000
JK Geotechnics Pty Ltd
ABN 17 003 550 801

Report prepared by:

Adrian Hulskamp
Senior Associate l Geotechnical Engineer

Report reviewed by:

Andrew Jackaman
Principal | Geotechnical Engineer

For and on behalf of
JK GEOTECHNICS
PO BOX 976
NORTH RYDE BC NSW 1670

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1 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed Woolworths Facility at 250-266 Victoria Street, Wetherill Park, NSW. The location of the site is shown on Figure 1.

Based on the supplied 'For Information' civil design drawings (Drawing Nos. CO13738.01-EW10, CO13738.01-EW20, CO13738.01-EW21, CO13738.01-EW25, CO13738.01-EW30, CO13738.01-EW31, CO13738.01-EW35, CO13738.01-EW36, CO13738.01-EW60, CO13738.01-EW61 and CO13738.01-EW65, Issue A, dated 14 July 2020) and structural design drawings (Drawing Nos. CO13738.01-SK01 to CO13738.01-SK05, Issue A, dated 11 September 2020) prepared by Costin Roe, and our discussions with Mr Xavier Cure of Costin Roe on 21 January 2021, we understand that a new Woolworths warehouse facility is proposed, with heavy duty truck loading pavements and light duty car parking. A two level basement car park is proposed below the southern end of the proposed warehouse. The supplied cut/fill plan by Costin Roe shows four building pads (1 to 4) will be created across the site, the outlines of which are shown on Figure 2. The proposed bulk earthworks levels (BEL) of the pads range from RL33.2m (Pad 1) to RL41.3m (Pad 2). The survey datum is the Australian Height Datum (AHD). A temporary sediment basin is proposed at the eastern end of Pad 1, as shown on Figure 2. To achieve the proposed levels, cut and fill earthworks to a maximum depth and height of about 8m and 9m, respectively, will be required. The civil drawings indicate that the proposed earthworks levels could vary by ±500mm, subject to the final design.

Structural loads for this type of development have been assumed.

Based on an annotated retaining wall plan prepared by Costin Roe and sent to us on 21 January 2021, retaining walls (such as contiguous piles walls, as shown on the structural drawings), are envisaged along the eastern and western sides of the site, and along the western end of the southern boundary, where excavation will extend up against the boundary. Temporary batters are envisaged along the southern, eastern and northern sides of proposed Pad 2.

In 2018, JK Geotechnics investigated the site when the project was at a concept design stage (report Ref. 31888AHrpt, dated 18 October 2018). At that time, the location of the proposed warehouse and finished surface levels were unknown. We have used the factual results of our previous investigation in the preparation of the current report.

The purpose of the investigation was to assess the subsurface conditions across the site and, based on the information obtained, to present our comments and recommendations on excavation, shoring design, earthworks, footings, slab-on-grade and external pavements.

This geotechnical investigation was carried out in conjunction with an environmental site assessment by our environmental division, JK Environments (JKE). Reference should be made to the separate report by JKE, Ref: EP31888BRrpt.

2 INVESTIGATION PROCEDURE

The fieldwork was carried out on 26, 27 & 28 September 2018 and 2 & 3 October 2018, and comprised the drilling of 29 boreholes (BH1 to BH22, and BH24 to BH30) to depths between 1.8m and 7.5m below original grade. The boreholes were drilled using our truck and track mounted drill rigs, which were equipped for site investigation purposes. Prior to the commencement of drilling, a specialist sub-consultant scanned the borehole locations for buried services using electro-magnetic techniques.

The borehole locations, which are shown on Figure 2, were recorded using a Topcon GRS-1 differential GPS unit. The grid coordinates (to MGA) and surface RL (to AHD) are shown on the borehole logs. The accuracy of the survey system is about 50mm in all directions. Figure 2 is based on the supplied survey plan of the site (Reference No. 50469 001DT, dated 12 September 2018), prepared by LTS Lockley.

The existing concrete pavements at BH7, BH8, BH11, BH15, BH19, BH20, BH21, BH24 and BH30 were diatube cored with water flush. The relative compaction/strength of the soil profile were assessed from the Standard Penetration Test (SPT) 'N' values, augmented by hand penetrometer readings on cohesive samples obtained in the SPT split spoon sampler, and by tactile examination. The strength of the underlying bedrock profile was assessed by observation of auger penetration resistance when using a tungsten carbide (TC) bit, together with examination of the recovered rock cuttings and correlation with subsequent laboratory moisture content test results. Groundwater observations were also made in the boreholes. Further details of the methods and procedures employed in the investigation are presented in the attached Report Explanation Notes.

Our geotechnical engineers were present full time during the fieldwork to set out and survey the borehole locations, direct the electro-magnetic scanning, nominate the testing and sampling, and prepare the attached borehole logs. The Report Explanation Notes define the logging terms and symbols used.

Selected soil and rock cutting samples were returned to a NATA accredited laboratory (Soil Test Services Pty Ltd [STS]) for moisture content, Atterberg Limits, linear shrinkage, Standard Compaction and four day soaked CBR testing. The test results are summarised in the attached STS Tables A and B.

Additional soil samples were returned to another NATA accredited laboratory (Envirolab Services Pty Ltd) for soil pH, sulfate, chloride and resistivity testing. The test results are summarised in the attached Envirolab Services 'Certificate of Analysis 202411'.

3 RESULTS OF THE INVESTIGATION

3.1 Site Description

The following site description was prepared at the time of our fieldwork in June 2018. With reference to recent Nearmap aerial images, the site currently appears essentially the same as it was when the fieldwork was carried out.

The site is located in relatively flat to slightly undulating topography. The majority of the site has an overall slope down to the east at about 4°, however, the north-western corner of the site slopes down to the north-east at about 2°. The site is rectangular in plan area being about 374m to 382m long (north-south) and about 228m wide (east-west). Redfern Street and Victoria Street bound the site to the north and south, respectively.

At the time of the fieldwork, the southern portion of the site contained a single storey brick building, a two storey rendered building, a metal awning, three demountable buildings and a large concrete panel warehouse, all of which appeared to be in generally good external condition based on cursory inspections. The remaining areas of the site were undeveloped. Surrounding the existing structures, the ground surface was predominantly covered with asphaltic concrete (AC) and concrete pavements, with isolated grass, gravel or gravelly sand covered areas. There were several gardens beds located over the southern portion of the site, containing scattered small to medium sized trees. In 2018, the AC pavements in the vicinity of BH9, BH10, BH13, BH14, BH17 and BH18 (ie. mid-length along the western side of the site) were being demolished and stockpiled on site. The recent Nearmap aerial image appears to indicate that the previous AC pavements had been demolished. In general, the pavements at the site were in good condition, though there were some minor crocodile and longitudinal cracking in the AC surfaces at the southern end of the site.

Mid-length along the eastern site boundary in the vicinity of BH12, was a batter slope between about 2.2m and 2.5m high, which sloped down to the east between 25° and 28°. The toe of the fill batter was within the site. The southern end of the batter returned in a westerly direction in the vicinity of BH16. A second batter slope up to 4.5m high and oriented north-south, was located in the vicinity of BH7, BH11 and BH15, and generally graded down to the east at between 8° and 30°. A batter slope, about 1m to 2m high, was located just inside the southern end of the eastern site boundary, which sloped down to the east at about 19°. No obvious signs of batter slope instability, such as slumping, tension cracks, etc were observed. In the vicinity of BH20, the eastern side of the site was supported by a 1m high brick retaining wall, which appeared to be in good condition.

On the western side of the warehouse located at the south-eastern corner of the site, was a 2.3m to 3.3m deep cut batter slope, covered with patchy vegetation and sloped down to the east at between 16° and 38°. In some areas, residual silty clays were exposed along the cut batter slope. No obvious signs of cut batter slope instability were observed, though we note our observations were limited by the vegetation cover.

Located off the northern half of the western site boundary, were several neighbouring brick warehouses which either abutted, or were within about 1.5m, of the common boundary. All of these neighbouring warehouses appeared to be in good condition, based on a cursory inspection from within the site. Located off the southern half of the western site boundary was an on-grade car park on an elevated fill platform. The eastern side of the fill platform sloped down at 22°. The toe of the fill batter was located just inside the neighbouring property to the west along its northern portion, and just inside the subject site along its southern portion.

Located off the southern half of the eastern site boundary, was a heavy vehicle checking station comprising concrete pavements and a steel framed and metal clad warehouse, which was set back about 17m from the

common boundary. Located off the northern half of the eastern site boundary, was a two storey office and warehouse, which abutted the common boundary and appeared to be in good condition, when viewed from within the site. A lined drainage channel oriented north-east/south-west was located on the eastern side of the heavy vehicle checking station.

Apart from where described above, ground surface levels directly across the site boundaries were similar.

3.2 Subsurface Conditions

The 1:100,000 Geological Map of Penrith (Geological Survey of NSW, Geological Series Sheet 9030) indicates that the site is underlain by Bringelly Shale of the Wianamatta Group. Bringelly Shale comprises "shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal and tuff".

Generally, the boreholes encountered pavements and/or fill overlying predominantly residual silty clays then weathered claystone, siltstone and to a lesser extent, sandstone bedrock, at shallow to moderate depths. Apart from one borehole, groundwater was not encountered. Reference should be made to the attached borehole logs for details at each specific location. A summary of the encountered subsurface characteristics is provided below:

Pavements

AC wearing surfaces between 30mm and 60m thick were encountered at BH3, BH4, BH5, BH10, BH14 and BH22. Reinforced concrete pavements were encountered at BH7, BH8, BH11, BH15, BH19, BH20, BH24 and BH30 and were between 130mm and 525mm thick. A 130mm thick concrete pavement with no observed reinforcement was encountered at BH21.

A granular base/sub-base layer between 105mm (BH20) and 675mm (BH30) thick was encountered below the AC wearing surface/concrete in each borehole, with the exception of BH5, BH15 and BH21.

Fill

Fill comprising silty clay, gravelly sand, gravelly silty sand and silty sand was encountered from the surface in BH1, BH2, BH6, BH9, BH12, BH13, BH16, BH17, and BH25 to BH29, and below most of the pavements in the remaining boreholes to depths between 0.2m (BH25) and 3.4m (BH12). Inclusions of sandstone, ironstone and igneous gravel, glass, AC, brick and tile fragments, slag and ash were found in the fill.

The fill in twenty of the boreholes was less than 0.5m thick. The deeper fill was predominantly encountered in the boreholes located over the eastern portion of the site. Based on the SPT results and limited hand penetrometer readings, the deeper fill was assessed to be mostly moderately compacted, however, the upper fill profile in BH12 was assessed to be poorly compacted.

Alluvial Soils

A 0.9m thick layer of alluvial silty clay of medium plasticity and of soft to firm strength was encountered below the fill in BH29.

Residual Soils

Residual soils comprising predominantly silty clay and to a lesser extent sandy clay and clayey sand were encountered below the pavements/fill/alluvial silty clay in each borehole. The residual silty clay and sandy clay were assessed to be of medium or high plasticity, and predominantly of stiff, very stiff and hard strength. The residual clayey sand in BH15 was assessed to be medium dense.

Weathered Bedrock

Claystone, siltstone and, to a lesser extent, sandstone bedrock was encountered in each borehole at depths between 0.5m (BH19) and 5.8m (BH12). We note that BH19 was located in a cut area, whilst BH12 was located just behind the crest of a 2.5m high fill batter.

At first contact, the bedrock was generally extremely weathered and of hard (soil) strength. This 'weak' bedrock profile was of limited thickness. The bedrock then improved rapidly to distinctly and slightly weathered and of very low, low, medium and occasionally, high strength. The rock strength generally increased with depth.

Auger refusal occurred within medium or high strength bedrock in BH7, BH11, BH13, BH15, BH19, BH22, BH26 and BH30.

Groundwater

With the exception of BH22, all boreholes were 'dry' during and on completion of drilling. In BH22, groundwater seepage was encountered during drilling at 4.1m depth, with groundwater measured at 4.3m depth on completion of drilling. We note that groundwater levels may not have stabilised within the short observation period. No long-term groundwater level monitoring was carried out.

3.3 Laboratory Test Results

The Atterberg Limits and linear shrinkage test results indicated the residual silty clay samples from BH5 and BH25 to be of high plasticity and to have a high potential for shrink-swell reactivity with changes in moisture content. The results of the Atterberg Limits and linear shrinkage test carried out on a residual silty clay sample from BH20 indicated the sample to be of medium plasticity and to have a moderate potential for shrink-swell reactivity.

The results of the moisture content tests carried out recovered rock cutting samples correlated well with our field assessment of bedrock strength.

The four day soaked CBR tests carried out on a silty clay fill sample from BH12 and residual silty clay samples from BH1, BH22 and BH25 resulted in values of 2.5%, 6%, 2.0% and 3.0%, respectively, when compacted to 98% or 99% of Standard Maximum Dry Density (SMDD) and surcharged with 9kg. The insitu moisture contents of the samples were 2.4% 'wet' (BH12), 5.0% 'wet' (BH1), 0.1% 'dry' (BH22) and 5.1% 'dry' (BH25) of their respective Standard Optimum Moisture Contents (SOMC). Swells of between 1.0% (BH12) and 3.0% (BH22) were measured on the samples during the four day soaking period.

A summary of the soil aggression test results is provided in the table below:

Borehole	Sample Depth (m)	Description	pH	Sulfate (mg/kg)	Chloride (mg/kg)	Resistivity (ohm m)
BH1	0.5 – 0.95	Residual Silty Clay	4.6	170	290	26
BH4	0.5 – 0.78	Residual Silty Clay	5.1	56	97	94
BH16	0.5 – 0.95	Silty Clay Fill	8.9	130	34	39
BH22	0.5 – 0.95	Residual Silty Clay	6.2	900	900	15
BH29	0.5 – 0.95	Silty Sand Fill	8.5	280	10	41

4 COMMENTS AND RECOMMENDATIONS

4.1 Additional Geotechnical Investigation

Our previous boreholes drilled within the proposed cut areas, all extended below the bulk earthworks levels, with the exception of the boreholes located at the south-western corner of the site (i.e. BH21, BH25 and BH26), where excavation to a maximum depth of 9.0m is envisaged.

We therefore recommend that prior to finalising the structural design and the tender package for the earthworks, four additional cored boreholes be completed toward the western end of Pad 1 to confirm the subsurface conditions below bulk earthworks level. The additional work would reduce the potential for latent conditions, and therefore time and cost variations, in relation to rock excavation. Furthermore, if bearing pressures are to be optimised for footing design, then additional cored boreholes would also be required. The number and location of the additional boreholes would be best assessed after the preliminary structural design has been completed. We can provide a fee proposal for this additional work, if requested to do so.

We understand that the development is still at a pre-DA stage, and as such this report should be considered preliminary and generalised, and will need to be reviewed and updated as appropriate once the development details have been finalised.

4.2 Existing Fill

No details on the existing fill (ie. placement method, compaction specification, density test records, etc.) have been provided to us. The deeper fill was predominantly assessed to be moderately compacted, however, we note that poorly compacted fill was present in the upper profile of BH12. We therefore consider that the existing fill is 'uncontrolled' and not a 'structural' fill, as defined in Clause 1.2.13 of AS3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments'.

Where present, we consider that the existing fill to be an unsuitable bearing stratum for the proposed warehouse building footings. We recommend that the proposed new warehouse building be supported on footings which penetrate the existing fill and are founded in the underlying weathered bedrock, as discussed further below in Section 4.8.

Similarly, the existing fill is considered to be an unsuitable subgrade for heavy duty pavements and heavily loaded floor slabs, and will require excavation and replacement as an engineered fill. However, the existing fill may be suitable to support lightly loaded floor slabs and light duty external pavements, on condition that the subgrade preparation works as outlined in Section 4.7.2 below are carried out.

4.3 Existing Trees

We expect that proposed development will require removal of all of the existing trees at the southern end of the site.

We note that the existing trees have likely caused localised 'drying out' of the surrounding clay soils. Removal of the trees will therefore lead to the recovery of the clay soil moisture content, resulting in differential swell movements in the vicinity of the trees. The swell movements generated by the removal of the trees are differential to the shrink-swell movements, which can occur in the clay soils due to weather related natural moisture changes and by the reduction in surface evaporation subsequent to covering the site with the proposed warehouse and pavements.

It is likely that moisture equilibrium in the clay soils, following removal of the tree stumps and roots, could take one to two years to develop. In order to reduce the effects that removal of the trees will have on the proposed warehouse and pavements, we recommend they be removed as early as possible ahead of construction.

4.4 Dilapidation Surveys

Prior to the commencement of demolition and excavation, dilapidation surveys should be completed on the neighbouring structures and pavements to the west of the site. In addition, Council may also require that dilapidation survey reports be completed on their assets lining the street frontages, such as footpaths, road surfaces and kerbs and gutters.

The dilapidation survey reports can be used as a benchmark against which to set vibration limits for rock excavation, and for assessing possible future claims for damage arising from the works.

The respective owners of the adjoining properties should be asked to confirm in writing that the dilapidation survey report on their property presents a fair assessment of existing conditions. As dilapidation survey reports are relied upon for the assessment of potential future damage claims, they must be carried out thoroughly with all defects rigorously described (ie. defect type, defect location, crack width, crack length etc) and photographed.

4.5 Excavation

All excavation recommendations should be complemented by reference to the NSW Government 'Code of Practice Excavation Work' dated January 2020.

4.5.1 Site Preparation and Excavation Conditions

Following demolition of the existing buildings and pavements, we recommend that the existing base/sub-base materials be stripped. These materials could be stockpiled separately for possible reuse as select engineered fill, subject to geotechnical inspection.

All grass, topsoil (if present), root affected soils and any deleterious fill or contaminated soil should be stripped from below the proposed warehouse and pavement footprints. Stripped topsoil and root affected soils should be stockpiled separately as they are considered unsuitable for reuse as engineered fill. They may however be reused for landscaping purposes, subject to approval from JKE. Reference should be made to the JKE report for guidance on the offsite disposal of soil and rock.

Care must be taken not to undermine or remove support from the site boundaries during site stripping and excavation, particularly at the northern end where neighbouring buildings abut the boundaries.

The areas of the site requiring excavation will extend through fill, residual (and possibly some alluvial) soils and into weathered bedrock of up to high strength. The majority of the rock excavation will be along the western boundary adjacent to Pads 2 and 4, and within the western half of Pad 1.

Excavation of the soils and extremely weathered rock profiles, and much of the very low and low strength bedrock, could be carried out using a 'digging bucket' fitted to a large hydraulic excavator (say, at least 30 tonnes), using a ripping tyne for stronger or more consistent bands of rock, and/or by using a dozer. 'Hard ripping' or 'hard rock' excavation conditions should be expected for the medium and high strength bedrock. Through the high strength bedrock, ripping may only just be possible with a Caterpillar D11R dozer, and a generous allowance would need to be made for rock hammer assistance to the ripping. Notwithstanding, rock hammers will need to be used for detailed excavations such as for footings, lift pits and trenches, and for trimming of rock faces.

Excavation production rates through medium and high strength bedrock are likely to be low.

The excavation contractor must be provided with a copy of this report (and any future geotechnical investigation reports), including the borehole logs, so they can make their own assessment of the conditions with respect to the capabilities of their plant.

4.5.2 Potential Vibration Risks

Excavation will need to be strictly monitored as there may be direct transmission of ground vibrations to nearby neighbouring structures.

We recommend that full-time quantitative vibration monitoring be carried out on all neighbouring structures which abut the site. The vibration monitoring should be carried out from the start of demolition up until the completion of bulk excavation, to reduce the potential for vibration induced damage.

Vibration monitors should be set up on the abutting neighbouring structures and the monitors should be fitted with flashing warning lights and sirens which would warn if vibrations exceed the pre-set limits. The vibration limits should be set by the structural engineer following their review of the dilapidation survey reports so that any particular sensitivities of the nearby structures can be accounted for. However, unless any of the structures are particularly sensitive, we expect that a peak particle velocity no higher than 20mm/sec would be applied. It should be noted that when vibration limits are exceeded, they should be assessed against the attached Vibration Emission Design Goals sheet, as higher vibrations may be acceptable depending on the associated vibration frequency. If it is confirmed that the transmitted vibrations are excessive, then it would be necessary to modify the excavation techniques, such as by using smaller rock hammers.

The following procedures are recommended to reduce vibrations if rock hammers are used:

- Rock saw the faces of the proposed excavations. This will increase the path and effectively reduce ground borne vibrations. The base of the rock saw slot must be maintained at a lower level than the adjacent excavation at all times.
- Maintain the rock hammer oriented towards the face and enlarge the excavation by breaking small wedges off the face.
- Operate the hammer in short bursts only, to reduce amplification of vibrations.
- Use excavation contractors with appropriate experience and a competent supervisor who is aware of vibration damage risks, etc. The contractor must have all appropriate statutory and public liability insurances.

4.5.3 Drainage

Groundwater inflows into the proposed excavations are expected to occur as local seepage flows at the fill/natural soil interface, at the soil/rock interface and through joints and bedding partings within the bedrock profile.

A toe drain should be formed at the base of all cut faces to collect seepage and direct to a sump for pumped or gravity fed discharge to the stormwater system. Piped discharge from the excavations into the stormwater system can only be completed once the necessary approvals have been obtained.

The completed excavations should be inspected by the hydraulic consultant to assess if the designed drainage system is adequate for the seepage flows encountered.

Where bedrock is exposed within the footprint of the excavations, we recommend that under-floor drainage be provided. The under-floor drainage should comprise perimeter drains comprising a geofabric wrapped perforated drainage pipes in a gravel filter. The under-floor drainage must connect to the stormwater system for disposal.

4.6 Shoring Design

4.6.1 Batter Slopes

Where space permits, temporary batter slopes through cut and fill profiles are feasible and should be cut no steeper than 1 Vertical (V) on 1 Horizontal (H), provided surcharge loads are kept well clear from the crest of the batters. All temporary batters in excess of 4m in height should be provided with a mid-slope bench no less than 1.5m wide in order to reduce the overall grade of the slope. Retaining walls can then be constructed along the toes of the temporary batters and subsequently backfilled.

We forewarn that if temporary batter slopes are adopted, particular care must be made with respect to appropriately backfilling between the temporary batter slopes and proposed retaining wall. Backfill which has not been placed as engineered fill to an appropriate specification may settle, which may result in damage to structures and/or paved surfaces which rely on support from the backfill. Recommendations on engineered backfill are presented below in Section 4.7.3.

If permanent batter slopes are proposed and can be accommodated within the site, these should generally be graded at no steeper than 1V on 2H. For permanent batter slopes in excess of 4m in height, we strongly recommend that global stability analyses be completed to confirm the geometric design.

Surface erosion protection, for example, quick establishing grass and/or proprietary systems (such as those provided by Geofabrics Australasia or Global Synthetics) should be provided to the permanent batter slopes. Dish drains should also be provided along the crest and toe of all permanent batter slopes to intercept surface water run-off. Discharge should be piped to the stormwater system.

Where the proposed excavations extend to the site boundary, an engineered shoring wall, as discussed in Section 4.6.2 below, will be required.

4.6.2 Piled Retaining Walls

Where the excavations extend up against a site boundary, it will not be feasible to batter the sides. We therefore recommend that the proposed vertical cuts through the soil and weathered bedrock profiles be supported by an engineered shoring system.

The siltstone, claystone and sandstone bedrock can contain continuous inclined joints with very low shear strengths. If the shoring piles are not founded below bulk excavation level and such a defect is encountered in the excavation face, a catastrophic collapse could occur before additional stabilisation measures can be implemented. Therefore, we recommend that the piles be founded below bulk excavation level to satisfy stability and founding considerations.

The shoring system must be installed prior to the commencement of excavation. We recommend that the wall designer calculate the deflections associated with a cantilevered piled wall and confirm whether those deflections are tolerable for the adjoining structures. Cantilevered piled walls may only be feasible for wall

heights up to about 3m. Where the structural engineer confirms that the deflections are not tolerable, then the wall will need to be anchored and/or propped as excavation proceeds to reduce the deflections. Careful control of the construction sequence will be required to reduce potential movements. Such lateral restraint must be installed progressively as each restraining point is uncovered. We assume permanent lateral support of the shoring system will be provided by the floor slabs of the new warehouse.

Based on the investigation results, a suitable shoring system includes a soldier pile wall with reinforced shotcrete infill panels. However, due to the close proximity of the neighbouring structures located off the northern end of the western site boundary, contiguous pile walls may be more appropriate along the western sides of Pads 2 and 4 in order to limit deflections. Notwithstanding, soldier piles are not recommended immediately adjacent to neighbouring structures, which be supported on high level footings, as there would be an increased likelihood of settlement of the footings and cracking of the structure above. Conventional bored piles may be used, but some groundwater seepage may occur requiring pumping of the collected seepage. Piles deeper than about 3m should be tremie poured, to reduce the potential for concrete segregation.

4.6.3 Retaining Wall Design Parameters

All cantilevered retaining walls should be uniformly founded in bedrock below bulk excavation level. For free-standing cantilever walls or cantilevered pile walls which are supporting areas where movement is of little concern, a triangular lateral earth pressure distribution may be adopted with an 'active' earth pressure coefficient, K_a, of 0.35, assuming a horizontal retained surface. For cantilever walls restrained by the permanent structure or which support areas where only minor movements can be tolerated, a triangular lateral earth pressure distribution should be adopted with an 'at rest' earth pressure coefficient, K_o, of 0.55, assuming a horizontal retained surface.

Propped or anchored retaining walls should be tentatively designed based on a trapezoidal lateral earth pressure distribution of 8H kPa for the soils and weathered bedrock profiles, where 'H' is the retained height in metres. This pressure should be assumed to be uniform over the central 50% of the pressure distribution, tapering to zero at the crest and toe. This advice should be reviewed and updated following completion of the cored boreholes recommended in Section 4.1.

An average bulk unit weight of 21kN/m^3 should be adopted for the soil and weathered bedrock profiles. Any surcharge affecting the walls (e.g. construction loads, adjacent footings, inclined backfill, etc) should be allowed for in the design using the appropriate earth pressure coefficient from above. For a propped or anchored retaining wall, the above K_o value should be adopted.

The retaining walls should be designed as drained and measures taken to induce complete and permanent drainage of the ground behind the wall. Subsurface drains should incorporate a non-woven geotextile filter such as Bidim A34 to control subsoil erosion. For soldier pile walls, strip drains should be provided behind the shotcrete infill panels with weep hole outlets just above bulk excavation level. For contiguous pile walls, weep hole outlets should be provided just above bulk excavation level at a horizontal spacing no greater than

about 1.2m. All weep hole outlets should incorporate a non-woven geotextile filter fabric (at the inserted end) to reduce subsoil erosion. All drainage water should be piped into the drainage system.

For lateral toe restraint, piles embedded into low strength or stronger bedrock below bulk excavation level may be tentatively designed for an allowable lateral toe resistance of 250kPa. The piles should be socketed at least 1m below bulk excavation level, including local excavations for buried services, footings, trenches, etc. However, a greater pile embedment may be required for stability of the wall. The upper 0.3m of socket must be ignored in the embedment calculation to account for possible over-excavation or fracturing.

Temporary anchors bonded into at low strength or stronger bedrock may be tentatively designed for an allowable bond stress of 200kPa, unless anchor testing shows a higher bond is possible. The anchors should have a bond length of at least 3m and free length of at least 4m, with the bond located fully beyond a 45° line inclined up from bulk excavation level. All anchors should be proof-tested to 1.3 times the working load under the direction of an experienced engineer independent of the anchor contractor, with anchors 'locked off' at about 85% of the design working load. Lift-off tests should be carried out on at least 10% of the anchors 3-4 days following locking off to confirm that the anchors are holding their load. We recommend that only experienced contractors be considered for the anchor installation.

As the temporary anchors will extend below the neighbouring properties, permission must be sought from the respective owners prior to installation. We recommend that requests for permission commence early in the construction process as our experience has shown that it can take significant time for such permission to be granted. If permission is not forthcoming, then the alternative is to provide lateral support by internal bracing or propping.

Retaining walls independent of the proposed warehouse and founded in engineered fill (to Level 1 control) and/or stiff (or stronger) residual clays may be designed for an allowable bearing pressure of 100kPa. The passive lateral toe resistance for footings founded in these materials may be estimated using a 'passive' earth pressure coefficient (K_p) of 3.0 (but with a Factor of Safety of at least 2.0 to limit deformations), assuming horizontal ground in front of the wall.

If bedrock is encountered along a retaining wall footing excavation, then construction joints should be provided to permit independent movement. Notwithstanding, further geotechnical advice should be sought.

4.7 Earthworks

All earthworks recommendations provided below should be complemented by reference to AS3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments'.

4.7.1 Site Drainage

The clay subgrade at the site is expected to undergo substantial loss in strength when wet as evident from the low CBR values. Furthermore, the clay subgrade is expected to have a moderate to high shrink-swell

reactive potential. Therefore, it is important to provide good and effective site drainage both during construction and for long-term site maintenance. The principle aim of the drainage is to promote run-off and reduce ponding. A poorly drained clay subgrade may become untraffickable when wet. The earthworks should be carefully planned and scheduled to maintain good cross-falls during construction.

Due to the low CBR characteristics of the clay subgrade, consideration should be given to the provision of a select subgrade layer comprising well graded, durable granular material (such as crushed sandstone) in order to provide a 'working platform'.

4.7.2 Subgrade Preparation

Following site stripping and bulk excavation, and prior to commencement of filling, we recommend that the clay subgrade be proof rolled with at least six passes of a static (non-vibratory) smooth drum roller of at least 12 tonnes deadweight. The final pass of proof rolling should be carried out under the direction of an experienced geotechnical engineer for the detection of any 'unstable' areas.

Subgrade heaving during proof rolling may occur in areas where the clays have become 'saturated' and/or where under-compacted existing fill exists. Small areas can typically be improved by locally removing the heaving material to a stable base and replacing with engineered fill, as outlined below. If the area is large, then a 'bridging' layer may be required. Options and detailed design of subgrade improvement works must be provided by the geotechnical engineer following the proof rolling inspection.

If soil softening occurs after rainfall periods, then the clayey subgrade should be over-excavated to below the depth of moisture softening and replaced with engineered fill. If the clayey subgrade exhibits shrinkage cracking, then the surface must be moistened with a water cart and rolled until the shrinkage cracks are no longer evident. Care must be taken not to over-water the subgrade as this will result in softening.

Engineered fill must be used where site levels are to be raised.

4.7.3 Engineered Fill

General

From a geotechnical perspective, the stripped base/sub-base and the excavated fill and alluvial/residual soils are considered suitable for reuse as engineered fill, on condition the materials are 'clean', free of organic matter, and contain a maximum particle size not exceeding 100mm. Based on the investigation results, the clay soils at the site will require moisture conditioning in order to conform to the specification provided below. The stripped granular base/sub-base materials and granular fill could be blended with the clayey soils to improve the workability of the latter soil type.

If there is a short fall in site-won materials, then all imported material must comprise well-graded Virgin Excavated Natural Material (VENM), contain a maximum particle size not exceeding 100mm, and have a

soaked CBR value of at least 20% (when compacted to at least 98% of SMDD). Ideally, this material should be placed as a uniformly thick working platform layer.

Engineered fill comprising excavated soil and rock should be compacted in maximum 300mm thick loose layers using a large static pad-foot roller (say, at least 15 tonnes deadweight) to a density ratio strictly between 98% and 102% of SMDD and at a moisture content within 2% of SOMC. Engineered fill comprising well graded 'inert' granular material, such as imported crushed sandstone, should be compacted in maximum 300mm thick loose layers to achieve a minimum density ratio of 98% of SMDD. If lighter compaction plant are proposed, then thinner placement layers will be required. Further geotechnical advice should be sought in this respect.

Our preference is for static (non-vibratory) rolling, so as to reduce the potential for vibration induced damage to neighbouring structures. If the earthworks contractor wishes to employ vibratory rolling, then we recommend trials be completed at the commencement of work using vibration monitors affixed to the neighbouring structures to the east and west to assess the exclusion zone widths where static rolling would need to be undertaken.

Edge Compaction

In order to achieve adequate edge compaction where fill platforms are proposed, we recommend that the outer edge of each fill layer extend a horizontal distance of at least 1m beyond the design geometry. The roller must extend just over the edge of each placed layer in order to seal the batter surface. On completion of filling, the excess under-compacted edge fill should be trimmed back to the design geometry.

Service Trenches

Backfilling of service trenches must be carried out using engineered fill in order to reduce post-construction settlements. Due to the reduced energy output of compaction plant that can be placed in trenches, backfilling should be carried out in maximum 150mm thick loose layers and compacted using a trench roller, a pad-foot roller attachment fitted to an excavator and/or a vertical rammer compactor, also known as a 'Wacker Packer'. Due to the reduced loose layer thickness, the maximum particle size of the backfill material should also reduce to 50mm. The compaction specifications provided above are applicable.

Retaining Wall Backfill

Backfilling behind retaining walls must also be carried out using engineered fill in order to reduce post-construction settlements. Noting the size of the site, compaction of the engineered backfill should be carried out using a small static roller or trench roller. Backfilling should be carried out in maximum 150mm thick loose layers and the maximum particle size of the backfill material should be no more than 50mm. The compaction specifications provided above are applicable.

Compaction of engineered fill behind retaining walls is very difficult. The use of a single sized durable aggregate, such as 'blue metal' or recycled concrete (free of fines), which do not require significant compactive effort is often preferred if good performance is a priority; at least in the lower layers. Such material should be nominally compacted using a vibrating plate (sled) compactor in maximum 200mm thick

loose layers. A non-woven geotextile filter fabric (such as Bidim A34) should be placed as a separation layer immediately on top of the temporary batter slope prior to backfilling, to control subsoil erosion. Provided the aggregate backfill is placed as recommended above, density testing of the aggregate backfill would not be required. The geotextile should then be wrapped over the surface of the aggregate backfill and capped with at least a 0.3m thick compacted layer of engineered fill.

Earthworks Inspection and Testing

Density tests should be carried out on all engineered fill to confirm the above compaction specifications are being achieved. Tentatively, the frequency of testing should be in accordance with the guidelines provided in Table 8.1 in AS3798-2007.

Based on the low CBR characteristics of the clayey subgrade, the depth of fill to be placed and the nature of the proposed development, we recommend that Level 1 control of fill placement and compaction in accordance with AS3798-2007 be carried out, including for the trench and retaining wall backfill. Due to a potential conflict of interest, the geotechnical inspection and testing authority (GITA) should be directly engaged by Fabcot Pty Ltd or their representative, and not by the earthworks contractor.

Pouring of the warehouse floor slab and construction of external pavements should only be completed once the Level 1 earthworks report has been submitted by the GITA and reviewed and approved by the Project Superintendent and/or JK Geotechnics.

4.8 Footings

4.8.1 Geotechnical Design

Based on the nature of the proposed development and for uniformity of support, we recommend that all footings be founded in the underlying bedrock. Pad and strip footings would be appropriate where the depth to the bedrock is relatively shallow, say less than 1.2m depth. However, conventional bored piles would be required elsewhere.

Pad/strip footings founded in very low strength or stronger bedrock may be tentatively designed for an allowable bearing pressure of 700kPa. Similarly, bored piles socketed at least 0.3m into very low strength or stronger bedrock may be tentatively designed for an allowable bearing pressure of 700kPa. Pile sockets formed below the nominal 0.3m requirement may be designed for allowable shaft adhesion values of 70kPa (in compression) and 35kPa (in tension), on condition that the pile shaft is suitably roughened using a grooving tool fitted to the side of the auger. Higher bearing pressures on the deeper more competent bedrock may be justified following completion of the additional investigation recommended in Section 4.1.

Pad and strip footings and conventional bored piles should be cleaned-out, 'dry', inspected by a geotechnical engineer and poured on the same day as excavation/drilling.

4.8.2 Earthquake Design Parameters

A Hazard Factor (Z) of 0.08 and a Site Subsoil Class C_e should be adopted for earthquake design in accordance with AS1170.4-2007 ('Structural Design Actions, Part 4: Earthquake Actions in Australia', including Amendment Nos 1 & 2).

4.8.3 Durability

Based on the soil aggression test results, concrete piles and concrete footings should be designed for a 'mild' and A2 exposure classification, respectively, in accordance with AS2159-2009 'Piling – Design and Installation' and AS3600:2018 'Concrete Structures'.

4.9 Slab-On-Grade

Slab-on-grade construction for the proposed warehouse is considered feasible provided the subgrade is prepared as discussed above in Section 4.7.2 and all fill used to raise ground levels comprises engineered fill as per the recommendations above. Slabs-on-grade should be constructed independent of the warehouse footings and walls (ie. designed as 'floating' slabs) to permit relative movements. Slab joints should be designed to resist shear forces but not bending moments by providing dowelled or keyed joints.

Based on the laboratory test results, we recommend that the proposed slab-on-grade be designed for a CBR value of 2% for the compacted clay subgrade or a Short-Term Young's Modulus of 17MPa or a Long-Term Young's Modulus of 10MPa.

We assume that the proposed warehouse will be surrounded by concrete pavements. If not, we recommend that the warehouse be surrounded by a concrete footpath that is at least 2m wide, in order to protect the slab, unless the slab is supported by a retaining wall.

The gap between the proposed warehouse and any perimeter concrete pavements (at the same level as the warehouse floor slab) must be appropriately sealed to prevent water ingress. Landscaping must be kept well away from the warehouses as they provide a source of moisture ingress below the slab. If landscaping features are required, then further geotechnical advice should be sought.

If the slabs-on-grade are supported on an unbound sub-base layer, then it should comprise at least a 100mm thick layer of good quality fine crushed rock such as DGB20 (TfNSW QA Specification 3051 unbound granular material) and compacted to a minimum density ratio of 98% of Modified Maximum Dry Density (MMDD). Adequate moisture conditioning to within 2% of Modified Optimum Moisture Content (MOMC) should be provided during placement so as to reduce the potential for material breakdown during compaction. The sub-base material would provide more uniform slab support and would reduce 'pumping' of subgrade 'fines' at joints due to vehicular movements and is therefore recommended.

Density tests should be carried out on all unbound granular pavement materials to confirm the above specification is achieved, in accordance with the guidelines presented in Table 8.1 in AS3798-2007. Level 2

testing of fill compaction is the minimum permissible in AS3798-2007. The geotechnical testing authority (GTA) should be directly engaged by Fabcot Pty Ltd or their representative.

4.10 External Pavements

The design parameters for on-grade floor slabs provided in Section 4.6 above are appropriate for the design of the external pavements.

4.10.1 Concrete Pavements

If the concrete pavements are to be supported on an unbound granular sub-base, then it should comprise at least a 100mm thick layer of good quality fine crushed rock such as DGB20 (TfNSW QA Specification 3051 unbound granular material) and compacted using a large static smooth drum roller to a minimum density ratio of 98% of MMDD. Adequate moisture conditioning to within 2% of MOMC should be provided during placement. The sub-base material would provide more uniform slab support and would reduce 'pumping' of subgrade 'fines' at joints due to vehicular movements. Slab joints should be designed to resist shear forces but not bending moments by providing dowelled or keyed joints.

4.10.2 Flexible Pavements

We recommend that all base course materials comprise DGB20 (TfNSW QA Specification 3051). The base course material should be compacted in maximum 200mm thick loose layers using a large static smooth drum roller to at least 98% of MMDD. Adequate moisture conditioning to within 2% of MOMC should be provided during placement.

All sub-base materials should comprise either DGS20 or DGS40 (TfNSW QA Specification 3051). The sub-base material should be compacted in maximum 200mm thick loose layers using a large static smooth drum roller to at least 95% of MMDD. Again, adequate moisture conditioning to within 2% of MOMC should be provided during placement. If required, we can provide alternatives to DGS20 and DGS40 and complete the flexible pavement layer thickness design once the design traffic loads are finalised and depending on the availability of suitable alternative materials.

4.10.3 Density Testing

Density tests should be carried out on the granular pavement materials to confirm the above specifications are achieved, in accordance with Table 8.1 in AS3798-2007. Level 2 testing of fill compaction is the minimum permissible in AS3798-2007. The GTA should be directly engaged by Fabcot Pty Ltd or their representative.

4.10.4 Subsoil Drains

In order to protect the pavement edge, subsoil drains should be provided along the perimeter of all proposed new external pavement areas, particularly in areas of cut, with invert levels of at least 200mm below

subgrade level. The drainage trenches should be excavated with a uniform longitudinal fall to appropriate discharge points so as to reduce the risk of water ponding. The subgrade should be graded to promote water flow towards the subsoil drains. Discharge from the subsoil drains should be piped to the stormwater system.

4.11 Further Geotechnical Input

The following is a summary of the further geotechnical input which is required and which has been detailed in the preceding sections of this report:

1 Additional geotechnical investigation.
2 Review and update of this report once the development details have been finalised.
3 Dilapidation surveys.
4 Vibration monitoring.
5 Global stability analyses of permanent batter slopes in excess of 4m height.
6 Proof-rolling inspections.
7 Vibratory rolling trials, if required.
8 Inspection and testing of all engineered fill to Level 1 control by a GITA.
9 Review of the Level 1 report.
10 Footing/pile inspections.
11 Density testing of all unbound granular pavement materials to at least Level 2 control by a GTA.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. As an example, special treatment of soft spots may be required as a result of their discovery during proof-rolling, etc. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The long term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater

conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, BC 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES

ABN 43 002 145 173

TABLE A
MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client: JK Geotechnics
Project: Due Diligence Investigation
Location: 250 Victoria Street, Wetherill Park, NSW

Ref No: 31888AH
Report: A
Report Date: 16/10/2018
Page 1 of 1

AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	DEPTH m	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	LINEAR SHRINKAGE %
1	3.60-3.80	12.6				
1	6.60-6.80	6.1				
3	5.50-6.00	7.4				
3	7.00-7.50	5.2				
5	0.50-0.95	23.1	61	21	40	15.0
7	2.50-3.00	9.3				
7	5.50-6.00	3.6				
10	5.20-5.40	8.0				
12	7.00-7.50	7.5				
13	4.00-4.50	10.1				
13	6.00-6.50	4.1				
17	4.00-4.50	7.0				
17	7.20-7.50	5.0				
19	0.50-0.58	9.4				
20	0.50-0.76	11.7	37	19	18	8.0
22	2.50-3.00	9.4				
22	4.50-5.00	3.6				
24	6.50-7.00	7.8				
25	0.50-0.95	19.2	63	22	41	16.0
26	4.00-4.50	7.3				
26	4.90-5.00	6.6				
28	5.50-6.00	7.7				
28	6.50-7.00	8.4				

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 26/9/18

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001
Email: dtreweek@jkgroup.net.au

SOIL TEST SERVICES
ABN 43 002 145 173

TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: JK Geotechnics
Project: Due Diligence Investigation
Location: 250 Victoria Street, Wetherill Park, NSW

Ref No: 31888AH
Report: B
Report Date: 10/10/2018
Page 1 of 1

BOREHOLE NUMBER		BH 1	BH 12	BH 22	BH 25
DEPTH (m)		0.50 - 1.00	0.50 - 1.00	0.50 - 1.00	0.50 - 1.00
Surcharge (kg)		9.0	9.0	9.0	9.0
Maximum Dry Density (t/m^3)		1.70 STD	1.84 STD	1.76 STD	1.68 STD
Optimum Moisture Content (%)		17.6	15.3	19.0	20.3
Moulded Dry Density (t/m^3)		1.67	1.80	1.73	1.67
Sample Density Ratio (%)		98	98	99	99
Sample Moisture Ratio (%)		105	99	100	94
Moisture Contents					
Insitu (%)		22.6	17.7	18.9	15.2
Moulded (%)		18.4	15.2	19.1	19.2
After soaking and					
After Test, Top 30mm(%)		25.7	20.4	28.2	27.4
	Remaining Depth (%)	19.4	18.1	22.6	20.9
Material Retained on 19mm Sieve (%)		0	0	0	0
Swell (%)		2.0	1.0	3.0	2.5
C.B.R. value:	@2.5mm penetration	2.5	6	2.0	3.0

NOTES: Sampled and supplied by others.
- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 04/10/2018.

NATA
NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025 - Testing.

Approved Signatory / Date
(D. Treweek)
10/10/18

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 202411

Client Details

Client	JK Geotechnics
Attention	Stephen Mosad
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**31888AH, Wethrill Park**
Number of Samples	5 Soil
Date samples received	05/10/2018
Date completed instructions received	05/10/2018

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	12/10/2018
Date of Issue	12/10/2018

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Jacinta Hurst, Laboratory Manager

Misc Inorg - Soil						
Our Reference		202411-1	202411-2	202411-3	202411-4	202411-5
Your Reference	UNITS	BH1	BH4	BH16	BH22	BH29
Depth		0.5-0.95	0.5-0.78	0.5-0.95	0.5-0.95	0.5-0.95
Date Sampled		02/10/2018	26/09/2018	27/09/2018	03/10/2018	28/09/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
pH 1:5 soil:water	pH Units	4.6	5.1	8.9	6.2	8.5
Sulphate, SO4 1:5 soil:water	mg/kg	170	56	130	900	280
Chloride, Cl 1:5 soil:water	mg/kg	290	97	34	900	10
Resistivity in soil*	ohm m	26	94	39	15	41

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 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	202411-2
Date prepared	-			09/01/2018	1	09/10/2018	09/10/2018		09/01/2018	09/01/2018
Date analysed	-			09/01/2018	1	09/10/2018	09/10/2018		09/01/2018	09/01/2018
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	4.6	4.8	4	102	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	170	170	0	102	71
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	290	230	23	94	#
Resistivity in soil*	ohm m	1	Inorg-002	<1	1	26	33	24	[NT]	[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.

Report Comments

Chloride
Percent recovery is not possible to report due to the inhomogeneous nature of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 1
1/2

Easting: 307159.3
Northing: 6253132

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK305

R.L. Surface: 38.34m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			FILL: Gravelly sand, fine to coarse grained, yellow brown, fine to coarse grained sandstone gravel.	D w≈PL			
					N = 5 2,2,3	1		CI-CH	as above, but dark grey. Silty CLAY: medium to high plasticity, brown mottled grey.	w>PL	VSt	330 260 350	RESIDUAL
					N = 16 5,5,11	2			Silty CLAY: medium to high plasticity, red brown and grey.		(VSt-Hd)		
								-	Extremely Weathered claystone: silty CLAY, medium plasticity, grey.	XW	(Hd)		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
						3			CLAYSTONE: brown and grey.	DW	VL-L		LOW RESISTANCE
						4		-	SILTSTONE: dark grey and dark brown.				
						5							
						6				SW	M		MODERATE RESISTANCE WITH HIGH BANDS
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 1 2/2

Easting: 307159.3
Northing: 6253132

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK305

R.L. Surface: 38.34m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									SILTSTONE: dark grey and dark brown.	SW	M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **2** 1/2

Easting: 307220.6
Northing: 6253127

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK305 **R.L. Surface:** 37.67m

Date: 2/10/18 **Datum:** AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■			■		0			FILL: Gravelly silty sand, fine to coarse grained, yellow brown, fine to coarse grained sandstone gravel, trace of sandstone cobbles.	D			
								CI-CH	Silty CLAY: medium to high plasticity, red and grey.	w>PL	VSt		RESIDUAL
	■			■	N = 9 4,4,5							350 330 340	
						1			Silty CLAY: medium to high plasticity, orange brown and grey.		Hd		
	■			■	N > 23 11,12 11/100mm							>600 >600 >600	
					REFUSAL	2			as above, but with extremely weathered claystone bands.				
				■				-	CLAYSTONE: brown and grey.	DW	L		BRINGELLY SHALE LOW 'TC' BIT RESISTANCE
						3							
				■		4		-	SILTSTONE: dark grey and dark brown, with medium strength bands.				BANDS OF MODERATE RESISTANCE
						5							
				■		6				SW	M		MODERATE RESISTANCE
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **2** 2/2

Easting: 307220.6
Northing: 6253127

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK305

Logged/Checked by: A.V./A.J.H.

R.L. Surface: 37.67m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey and dark brown.	SW	M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 3 1/2

Easting: 307293.8
Northing: 6253125

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 27/9/18
Method: SPIRAL AUGER JK305
Logged/Checked by: S.M./A.H.J.
R.L. Surface: 37.02m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0		-	ASPHALTIC CONCRETE: 60mm.t	D			
									FILL: Silty gravelly sand, fine to medium grained, dark grey, fine grained igneous gravel.				
								CH	Silty CLAY: high plasticity, light grey.	w≈PL	Hd		RESIDUAL
					N = 12 7,7,5							450 410 530	
						1							
					N = 26 7,13,13							>600 >600 >600	
						2							
									as above, but light grey mottled red brown, with ironstone gravel bands.				
					N = SPT 9/120mm REFUSAL	3						>600 >600 >600	
								-	Extremely Weathered claystone: silty CLAY, medium plasticity, light grey, with low strength iron indurated bands.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
						4							
									CLAYSTONE: dark grey and dark brown.	DW	VL		
						5		-	Interbedded CLAYSTONE and SILLTSTONE: dark grey and dark brown.		L		LOW RESISTANCE
						6							
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 3
2/2

Easting: 307293.8
Northing: 6253125

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 27/9/18

Method: SPIRAL AUGER
JK305

Logged/Checked by: S.M./A.H.J.

R.L. Surface: 37.02m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					Interbedded CLAYSTONE and SILLTSTONE: dark grey and dark brown.	SW	M		MODERATE TO HIGH RESISTANCE
									END OF BOREHOLE AT 7.5m				

8
9
10
11
12
13
14

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **4** 1/2

Easting: 307358.9
Northing: 6253114

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK305 **R.L. Surface:** 36.66m

Date: 26/9/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0		-	ASPHALTIC CONCRETE: 30mm.t	D			
	■								FILL: Silty sandy gravel, fine grained, igneous, dark grey, fine to coarse grained sand.				
				■	N > 18 9,18/ 130mm REFUSAL			CH	Silty CLAY: high plasticity, red brown, with sub angular fine grained ironstone gravel.	w≒PL	Hd	>600 >600 >600	RESIDUAL
						1			as above, but light grey.				
								-	Extremely Weathered claystone: silty CLAY: medium to high plasticity, light grey, with low strength iron indurated bands.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE WITH LOW BANDS
				■	N = SPT 15/90mm REFUSAL	2							
						3						>600 >600 >600	
						4			CLAYSTONE: light grey	DW	VL		LOW RESISTANCE
						5							
						6							
				■					as above, but dark grey		VL-L		
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 4 2/2

Easting: 307358.9
Northing: 6253114

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 26/9/18

Method: SPIRAL AUGER JK305

Logged/Checked by: S.M./A.J.H.

R.L. Surface: 36.66m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									CLAYSTONE: dark grey.	DW	VL-L		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 5
1/2

Easting: 307157.8
Northing: 6253089

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 40.27m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0		-	ASPHALTIC CONCRETE: 50mm.t	D			
								CH	FILL: Silty sand, fine to coarse grained, dark grey, with fine grained igneous gavel.	w>PL	St		RESIDUAL
					N = 8 3,4,4				Silty CLAY: high plasticity, brown.			160	
									as above, but red brown.			160	
						1			as above, but red brown mottled brown and light grey, with rounded fine grained ironstone gravel.	w≈PL	VSt-Hd	180	
					N = 20 5,7,13				Silty CLAY: high plasticity, light grey, with ironstone gravel bands.			300 430 520	
						2		-	Extremely Weathered siltstone: silty CLAY: medium plasticity, dark grey mottled yellow brown.	XW	HD		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
									SILTSTONE: dark grey.	DW	VL		LOW RESISTANCE
						3							
						4							
						5				SW	L-M		MODERATE RESISTANCE
						6							
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **5** 2/2

Easting: 307157.8
Northing: 6253089

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 40.27m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	SW	L-M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 6
1/2

Easting: 307208.1
Northing: 6253079

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK305

R.L. Surface: 39.23m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■					0			FILL: Gravelly silty sand, fine to coarse grained, brown and grey, fine to medium grained sandstone gravel.	D			
				■	N = 10 3,4,6			CI-CH	FILL: Silty clay, medium to high plasticity, red and grey.	w>PL	VSt	300	RESIDUAL
	■					1			Silty CLAY: medium to high plasticity, grey and brown mottled red brown.			300 350	
				■	N = 26 6,10,16				Silty CLAY: medium to high plasticity, orange brown and grey mottled dark grey.	w<PL	Hd	400 420 500	
						2		-	CLAYSTONE: brown and grey, with extremely weathered bands.	DW	VL		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
						3							
				■		4			CLAYSTONE: brown and grey.		L		LOW RESISTANCE
						5							
				■		6		-	SILTSTONE: dark grey.	SW	M		MODERATE RESISTANCE
											H		HIGH RESISTANCE
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 6 2/2

Easting: 307208.1
Northing: 6253079

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK305

Logged/Checked by: A.V./A.J.H.

R.L. Surface: 39.23m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	SW	H		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 7
1/1

Easting: 307293.3
Northing: 6253069

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 27/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 36.23m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			CONCRETE: 248mm.t				10mm DIA. REINFORCEMENT
	■							-	FILL: Silty gravelly sand, fine to coarse grained, dark grey, fine grained igneous gravel.	D			208mm TOP COVER
	■			■	N = 7 2,3,4					w>PL		200 170 180	APPEARS MODERATELY COMPACTED
				■		1		CH	FILL: Silty clay, high plasticity, red brown mottled light grey and brown, trace of fine grained ironstone gravel and slag.	w>PL	St	200 190 150	RESIDUAL
									Silty CLAY: high plasticity, brown mottled dark grey, trace of ash.		VSt		
	■			■	N = 12 5,4,8				as above, but light grey mottled yellow brown, with sandy clay nodules and fine grained ironstone gravel.			300 280 270	
						2		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, light grey mottled dark grey.	XW	Hd		BRINGELLY SHALE
								-	Interbedded SILTSTONE and CLAYSTONE: dark grey and dark brown.	DW	L		VERY LOW 'TC' BIT RESISTANCE
				■		3							LOW RESISTANCE
						4					L-M		
						5				SW	M-H		MODERATE TO HIGH RESISTANCE
				■		6			END OF BOREHOLE AT 6.0m				'TC' BIT REFUSAL
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 8
1/1

Easting: 307361.8
Northing: 6253060

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 27/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 35.75m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			CONCRETE: 495mm.t				8mm DIA. REINFORCEMENT 270mm TOP COVER
					N = SPT 10/70mm REFUSAL			-	FILL: Silty gravelly sand, fine to coarse grained, dark grey, fine grained igneous gravel.	D			APPEARS WELL COMPACTED
						1			FILL: Silty clay, high plasticity, red brown mottled grey and brown, trace of slag and glass fragments.				
								CH	Silty CLAY: high plasticity, red brown mottled light grey.	w>PL	VSt		RESIDUAL
					N = 13 4,4,9				as above, but light grey mottled yellow brown.			230 290 260	
						2							
								-	Extremely Weathered claystone: silty CLAY, medium to high plasticity, light grey mottled red brown, with low strength bands.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
					N = SPT 19/150mm REFUSAL	3						600 >600 >600	
						4							
								-	Interbedded CLAYSTONE and SILLTSTONE: dark grey and dark brown,	DW	L		LOW RESISTANCE
						5				SW	M		MODERATE RESISTANCE
						6					H		HIGH RESISTANCE
						7			END OF BOREHOLE AT 7.0m				

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 9
1/2

Easting: 307149.9
Northing: 6253026

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 42.52m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■					0			FILL: Silty gravelly sand, fine to coarse grained, yellow brown and brown, fine to medium grained sandstone gavel.	D			
				■	N = 4 2,1,3			CH	Silty CLAY: high plasticity, red brown mottled light grey, trace of rounded fine grained ironstone gravel.	w>PL	St		RESIDUAL
	■					1			Silty CLAY: high plasticity, light grey, with ironstone gravel bands.	w<PL	Hd		
				■	N > 12 8,12/ 120mm REFUSAL			-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
				■		2			SILTSTONE: dark grey.	DW	VL-L		LOW RESISTANCE
				■		3							
				■		4				SW	L-M		MODERATE RESISTANCE
				■		5							
				■		6		-	SANDSTONE: fine to medium grained, grey, with siltstone bands.	SW	L-M		
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **9** 2/2

Easting: 307149.9
Northing: 6253026

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 42.52m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SANDSTONE: fine to medium grained, grey, with siltstone bands.	SW	L-M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 10 1/2

Easting: 307203.5
Northing: 6253004

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 39.94m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0		-	ASPHALTIC CONCRETE: 50mm.t FILL: Gravelly sand, fine to coarse grained, dark grey, fine grained igneous gravel.	D			
					N = 16 7,8,8	1		CI-CH	Silty CLAY: medium to high plasticity, grey mottled brown.	w<PL	Hd	>600 >600 >600	RESIDUAL
					N = 39 5,13,26	2			as above, but with extremely weathered claystone bands.			>600 >600 >600	
					N = SPT 12/100mm REFUSAL	3		-	Extremely Weathered claystone: silty CLAY, medium to high plasticity, grey mottled orange brown.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
						4			CLAYSTONE: brown mottled light grey.	DW	VL L		LOW RESISTANCE
						5		-	SIILTSTONE: dark grey.				
						6				SW	M		MODERATE RESISTANCE
						7					H		HIGH RESISTANCE

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **10** 2/2

Easting: 307203.5
Northing: 6253004

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 39.94m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SIILTSTONE: dark grey.	SW	H		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **11** 1/1

Easting: 307284.5
Northing: 6253007

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 36.15m

Date: 27/9/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			CONCRETE: 205mm.t				8mm DIA. REINFORCEMENT 165 TOP COVER
	■							-	FILL: Silty gravelly sand, fine to coarse grained, dark grey, fine grained igneous gravel, with slag.	D			
	■			■	N = 10 4,4,6			CH	Silty CLAY: high plasticity, light grey mottled red brown.	w>PL	VSt	290 280 260	RESIDUAL
						1							
	■			■	N = 21 5,9,12			CI-CH	Silty CLAY: medium to high plasticity, light grey mottled red brown.	w≈PL	Hd	>600 >600 >600	
				■		2		-	CLAYSTONE: dark grey and dark brown.	DW	VL-L		BRINGELLY SHALE
				■							L-M		VERY LOW 'TC' BIT RESISTANCE
				■		3		-	SILTSTONE: dark grey.	SW			LOW RESISTANCE
				■						SW	H		MODERATE RESISTANCE
						5			END OF BOREHOLE AT 5.0m				'TC' BIT REFUSAL
						6							
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 12
1/2

Easting: 307351.8
Northing: 6252997

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 3/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 36.24m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			FILL: Silty sandy gravel, fine to coarse grained igneous gravel, dark grey, fine to coarse grained sand, with concrete fragments.	D w>PL			GRAVEL COVER APPEARS POORLY COMPACTED
					N = 4 1,2,2				FILL: Silty clay, high plasticity, brown mottled red brown and grey, with fine grained igneous and ironstone gravel.			150 270 300	
					N = 12 3,5,7	1 2			as above, but with sandy gravel bands.			400 430 190	APPEARS WELL COMPACTED
					N = 22 5,13,9	3						520 550 >600	
								CH	Silty CLAY: high plasticity, red brown mottled yellow brown, with fine grained ironstone gravel.	w>PL	VSt	300 360	RESIDUAL
						4			as above, but light grey mottled yellow brown, with ironstone gravel bands.	w≒PL	Hd		
					N = 28 7,13,15	5						>600 >600 >600	
					N = SPT 10/70mm REFUSAL	6		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey.	XW	Hd		BRINGELLY SHALE
						7		-	SILTSTONE: dark grey.	DW	VL-L		VERY LOW 'TC' BIT RESISTANCE LOW RESISTANCE

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **12** 2/2

Easting: 307351.8
Northing: 6252997

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 3/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 36.24m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	DW	VL-L		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. 13 1/1

Easting: 307142.7
Northing: 6252967

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK205 **R.L. Surface:** 43.14m

Date: 2/10/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■					0			FILL: Silty gravelly sand, fine to coarse grained, grey and yellow brown, fine to medium grained sandstone gravel, trace of asphaltic concrete fragments, igneous gravel and slag.	D			
	■			■	N = 5 2,2,3			CH	Silty CLAY: high plasticity, red brown.	w>PL	St	160 180 180	RESIDUAL
						1			as above, but light grey, with low strength iron indurated bands.		Hd		
				■	N = 15 5,7,8							440 470 440	
						2		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, dark grey.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
				■		3			SILTSTONE: dark grey.	DW	VL		
				■		4							
						5			as above, but with fine to medium grained sandstone bands.		L-M		MODERATE RESISTANCE
				■		6							
										SW	M		HIGH RESISTANCE
						7			END OF BOREHOLE AT 6.6m				'TC' BIT REFUSAL

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 14 1/2

Easting: 307192.1
Northing: 6252961

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 40.16m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0		-	ASPHALTIC CONCRETE: 50mm.t	D	St		
								-	FILL: Gravelly sand, fine to coarse grained, dark grey, fine to coarse grained igneous gravel.				
								CI-CH	Silty CLAY: medium to high plasticity, red brown.	w≒PL	VSt		RESIDUAL
					N = 13 5,6,7							250 300 260	
						1			Silty CLAY: medium to high plasticity, yellow brown.				
					N = 22 6,9,13						VSt-Hd	440 380 >600	
						2							
								-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey and brown, with clay bands.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
					N > 10 14,10/ 100mm REFUSAL	3			SILTSTONE: grey.	DW	VL		
											L		LOW RESISTANCE
						4							
									SILTSTONE: dark grey and brown.	SW	M		MODERATE RESISTANCE
						5							
						6			as above, but dark brown.		M-H		
											H		HIGH RESISTANCE
						7							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **14** 2/2

Easting: 307192.1
Northing: 6252961

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

Logged/Checked by: A.V./A.J.H.

R.L. Surface: 40.16m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	SW	H		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. 15 1/1

Easting: 307275.9
Northing: 6252950

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 27/09/18
Method: SPIRAL AUGER JK350
Logged/Checked by: S.M./A.J.H.
R.L. Surface: 34.60m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			CONCRETE: 248mm.t				8mm DIA. REINFORCEMENT
	■							CI-CH	Silty sandy CLAY: medium to high plasticity, light grey mottled yellow brown, fine to medium grained sand.	w>PL	(St)		148mm TOP COVER
	■			■	N = 14 10,8,6			SC	Clayey SAND: fine to medium grained, light grey and yellow brown, with sandy clay bands.	M	MD	410 320 >600	RESIDUAL
						1							
				■	N > 13 6,13/ 150mm							340 350 340	
					REFUSAL			-	Extremely Weathered sandstone: clayey SAND: fine to medium grained, light grey and yellow brown.	XW	D		BRINGELLY SHALE
				■		2			as above, but with quartz gravel.				VERY LOW 'TC' BIT RESISTANCE
									as above, but without quartz gravel and with low strength bands.				
				■				-	Interbedded CLAYSTONE and SILTSTONE: dark grey and dark brown, with extremely weathered seams.	DW	VL-L		VERY LOW TO LOW RESISTANCE
						3		-	SILTSTONE: dark grey.		L		
				■						SW	L-M		MODERATE RESISTANCE
				■		4					H		HIGH RESISTANCE
									END OF BOREHOLE AT 4.5m				'TC' BIT REFUSAL
						5							
						6							
						7							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **16** 1/2

Easting: 307316.7
Northing: 6252941

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK205 **R.L. Surface:** 35.43m

Date: 3/10/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			FILL: Silty gravelly sand, fine to coarse grained, grey brown, fine grained ironstone and igneous gravel.	D w>PL			APPEARS MODERATELY COMPACTED
					N = 11 4,5,6				FILL: Silty clay, high plasticity, brown mottled light grey, yellow brown and red brown, with fine grained ironstone and igneous gravel, sand, trace of ash.			130 130 150	
						1			as above, but with gravelly sand bands.				
					N = 19 3,10,9							270 270 280	APPEARS WELL COMPACTED
						2		CH	Silty CLAY: high plasticity, dark brown mottled orange brown, with fine grained ironstone gravel.	w>PL	Hd	400 >600	RESIDUAL
									Silty sandy CLAY: high plasticity, red brown mottled yellow brown and light grey, fine to medium grained sand.				
						3		-	Extremely Weathered sandstone: clayey SAND, fine to medium grained, light grey, with low strength iron indurated bands.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
						4			SANDSTONE: fine to medium grained, light grey, with medium strength iron indurated bands.	DW	L		MODERATE RESISTANCE
									as above, but with siltstone bands.		VL-L		LOW TO MODERATE RESISTANCE
						5							
						6		-	SILTSTONE: dark grey.	SW	L-M		
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **16** 2/2

Easting: 307316.7
Northing: 6252941

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 3/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 35.43m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	SW	L-M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **17** 1/2

Easting: 307146.1
Northing: 6252933

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK205 **R.L. Surface:** 42.67m

Date: 2/10/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■					0			FILL: Silty gravelly sand, fine to coarse grained, grey and yellow brown, medium to coarse grained sandstone gravel, trace of asphaltic concrete fragments and slag.	D			
								CH		w>PL	VSt		RESIDUAL
	■			■	N = 7 3,3,4	1			Silty CLAY: high plasticity, red brown mottled light grey, trace of fine grained ironstone gravel.			330 290 330	
									as above, but light grey.				
				■	N > 12 7,12/90mm REFUSAL	2		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, light grey mottled yellow brown.	XW	Hd	>600 >600 >600	BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
				■					SILTSTONE: dark grey.	DW	VL-L		LOW RESISTANCE
				■		3		-	SANDSTONE: fine to medium grained, grey.	DW	L		
				■		4							
				■		5				SW	L-M		MODERATE RESISTANCE
				■		6			as above, but with siltstone bands.		M		MODERATE TO HIGH RESISTANCE
				■		7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 17
2/2

Easting: 307146.1
Northing: 6252933

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

Logged/Checked by: S.M./A.J.H.

R.L. Surface: 42.67m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SANDSTONE: fine to medium grained, grey, with siltstone bands.	SW	M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **18** 1/2

Easting: 307183.3
Northing: 6252930

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 40.15m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0		-	ASPHALTIC CONCRETE: 50mm.t	D			
									FILL: Gravelly sand, fine to coarse grained, dark grey, fine to medium grained igneous gravel.				
								CI-CH	Silty CLAY: medium to high plasticity, red brown mottled grey.	w≈PL	VSt		RESIDUAL
					N = 9 4,4,5							240 250 300	
						1							
					N = 26 7,11,15							290 350 300	
						2							
								-	Extremely Weathered sandstone: clayey SAND, fine to medium grained, brown, with clay bands.	XW	D		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
					N = SPT 10/150mm REFUSAL	3							
									CLAYSTONE: brown and light grey and yellow brown.	DW	L		LOW RESISTANCE
						4							
									SILTSTONE: dark grey.	SW	M		MODERATE RESISTANCE
						5							
						6							
						7							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **18** 2/2

Easting: 307183.3
Northing: 6252930

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

Logged/Checked by: A.V./A.J.H.

R.L. Surface: 40.15m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									SILTSTONE: dark grey.	SW	M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. **19** 1/1

Easting: 307255.5
Northing: 6252908

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 27/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 33.27m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			CONCRETE: 205mm.t				8mm DIA. REINFORCEMENT 105mm TOP COVER
-	■							-	FILL: Sandy gravelly sand, fine to coarse grained, dark grey, fine grained igneous gravel, with slag.	D			
	■			■	N = SPT 8/80mm REFUSAL			-	Extremely Weathered sandstone: clayey SAND, fine to medium grained, light grey and yellow brown.	XW	D		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
				■		1			SANDSTONE: fine to medium grained, light grey.	SW	M		MODERATE RESISTANCE
				■							H		HIGH RESISTANCE
						2			END OF BOREHOLE AT 1.8m				'TC' BIT RESISTANCE
						3							
						4							
						5							
						6							
						7							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **20** 1/2

Easting: 307313.1
Northing: 6252907

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 32.52m

Date: 28/9/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			CONCRETE: 195mm.t				8mm DIA. REINFORCEMENT
								-	FILL: Silty gravelly sand, fine to	D			110mm TOP COVER
								CH	coarse grained, dark grey, fine	w>PL	(VSt)		RESIDUAL
					N > 15 15,15/ 110mm			CI	grained igneous gravel.	w<PL	Hd	>600	
					REFUSAL				Silty CLAY: high plasticity, yellow brown mottled light grey.			>600	
						1			Silty CLAY: medium plasticity, light grey, with fine grained ironstone gravel.			>600	
									as above, but with sandy clay nodules.		VSt- Hd	530	
					N = 15 5,5,10							300	
						2			Sandy CLAY: medium plasticity, light grey mottled yellow brown, fine to medium grained sand.			380	
					N > 13 6,13/ 130mm	3						490	
					REFUSAL			-	Extremely Weathered sandstone: clayey SAND, fine to medium grained, light grey and yellow brown.	XW	D	430 280	BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
								-	SILTSTONE: dark grey.	SW	L-M		LOW TO MODERATE RESISTANCE
						4							
						5							
						6					M		MODERATE RESISTANCE
						7							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **20** 2/2

Easting: 307313.1
Northing: 6252907

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 32.52m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									SILTSTONE: dark grey.	SW	M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 21 1/2

Easting: 307128.9
Northing: 6252848

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 20/9/18
Method: SPIRAL AUGER JK205
Logged/Checked by: A.V./A.J.H.
R.L. Surface: 41.02m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■					0			CONCRETE: 130mm.t				NO OBSERVED REINFORCEMENT
								-	FILL: Silty clay, medium to high plasticity, grey mottled brown, trace of organic matter.	w>PL	VSt		APPEARS WELL COMPACTED
				■	N = 11 3,5,6							300 400 250	
						1		CH	Silty CLAY: high plasticity, grey mottled dark grey and red brown.	w<PL	Hd		RESIDUAL
				■	N > 16 6,16/ 130mm							>600 >600 >600	
					REFUSAL			-	CLAYSTONE: brown.	DW	VL		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
						2							
						3		-	SILTSTONE: dark grey.	DW	L		LOW RESISATANCE
				■		4							
										SW	M		MODERATE RESISTANCE
				■		5							
						6							
											H		HIGH RESISTANCE
						7							

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BOREHOLE LOG

Borehole No. **21** 2/2

Easting: 307128.9
Northing: 6252848

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 20/9/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 41.02m
Datum: AHD

Logged/Checked by: A.V./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	SW	H		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. **22** 1/1

Easting: 307218.7
Northing: 6252881

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 3/10/18
Method: SPIRAL AUGER JK350
Logged/Checked by: S.M./A.J.H.
R.L. Surface: 36.6m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0		-	ASPHALTIC CONCRETE: 40mm.t	D			
								CH	FILL: Silty gravelly sand, fine to coarse grained, dark grey, fine grained igneous gravel.	w>PL	St-VSt		RESIDUAL
	■			■	N = 8 2,3,5				Silty CLAY: high plasticity, yellow brown mottled dark grey, with fine grained ironstone gravel.			190 240 240	
	■					1			as above, but light grey.		VSt		
									as above, but mottled yellow brown.				
				■	N > 26 6,16, 10/80mm			-	Extremely Weathered siltstone: silty CLAY, low to medium grained, dark grey.	XW	Hd	300 360 370	BRINGELLY SHALE
				■	REFUSAL	2			SILTSTONE: dark grey.	DW	VL		VERY LOW 'TC' BIT RESISTANCE LOW RESISTANCE
				■		3							
				■				-	SANDSTONE: fine to medium grained, grey.	SW	L-M		MODERATE RESISTANCE
▶▼ ON COMPLET-ION				■		4					H		HIGH RESISTANCE
						5			END OF BOREHOLE AT 5.0m				'TC' BIT REFUSAL
						6							
						7							

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BOREHOLE LOG

Borehole No. **24** 1/2

Easting: 307322
Northing: 6252811

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18
Method: SPIRAL AUGER JK350
Logged/Checked by: S.M./A.J.H.
R.L. Surface: 32.53m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			CONCRETE: 130mm.t				8mm DIA. REINFORCEMENT 80mm TOP COVER
	■			■	N = 6 2,3,5			-	FILL: Silty gravelly sand, fine to coarse grained, dark grey, fine grained igneous gravel, trace of glass fragments and slag.	D			
										w>PL		230 240 220	APPEARS MODERATELY COMPACTED
						1			FILL: Silty clay, high plasticity, red brown mottled grey and yellow brown, trace of fine grained ironstone gravel, ash and slag.				
				■	N = 7 2,3,4							170 180 130	
						2							
								CH	Silty CLAY: high plasticity, light grey mottled yellow brown, with fine grained ironstone gravel bands and sandy clay nodules.	w>PL	VSt		RESIDUAL
	■			■	N = 11 12,5,6	3						340 280 380	
						4			as above, but without ironstone gravel bands.	w≒PL	VSt-Hd		
				■	N = 22 7,10,12							340 360 410	
						5							
								-	Extremely Weathered siltstone: silty CLAY, medium plasticity, light grey mottled yellow brown.	XW	Hd		BRINGELLY SHALE
				■					SILTSTONE: dark grey.	DW	VL		VERY LOW 'TC' BIT RESISTANCE
						6				SW	L-M		LOW RESISTANCE
				■									
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **24** 2/2

Easting: 307322
Northing: 6252811

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 32.53m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									SILTSTONE: dark grey.	SW	L-M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. **25** 1/2

Easting: 307121.5
Northing: 6252796

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 41.45m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			FILL: Silty sand, fine to medium grained, dark brown, with root fibres.	D			GRASS COVER
								CH	Silty CLAY: high plasticity, red brown, trace of fine grained ironstone gravel.	w<PL	Hd		RESIDUAL
					N = 13 6,6,7				as above, but mottled red brown and light grey.			>600 >600 >600	
						1							
					N = 28 9,12,16				as above, but mottled yellow brown, with ironstone gravel bands.			450 530 550	
						2							
								-	Extremely Weathered siltstone: silty CLAY: low to medium plasticity, dark grey.	XW	Hd		BRINGELLY SHALE
					N = SPT 20/120mm REFUSAL	3		-	SILTSTONE: dark grey.	DW	VL-L		VERY LOW 'TC' BIT RESISTANCE LOW RESISTANCE
										SW	L-M		LOW TO MODERATE RESISTANCE
						4							
						5							
											M		MODERATE RESISTANCE
						6							
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **25** 2/2

Easting: 307121.5
Northing: 6252796

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 2/10/18

Method: SPIRAL AUGER
JK205

R.L. Surface: 41.45m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	SW	M		
											H		HIGH RESISTANCE
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **26** 1/1

Easting: 307163.8
Northing: 6252791

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 38.78m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			FILL: Silty sand, fine to medium grained, dark brown, with fine grained igneous and ironstone gravel, clay nodules and slag.	M			GRASS COVER
					N = 12 1,6,6			CH	Silty CLAY: high plasticity, yellow brown mottled red brown, with fine grained ironstone gravel.	w≒PL	Hd	>600 >600 >600	RESIDUAL
						1			as above, but light grey mottled red brown.				
					N = 19 6,9,10							>600 >600 >600	
						2		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, light grey.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
									SILTSTONE: dark grey.	DW	L		LOW RESISTANCE
						3							
									SANDSTONE: fine to medium grained, light grey.	SW	M		MODERATE RESISTANCE
						4							
											H		HIGH RESISTANCE
						5			END OF BOREHOLE 5.0m				'TC' BIT REFUSAL
						6							
						7							

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BOREHOLE LOG

Borehole No. 27 1/2

Easting: 307224.1
Northing: 6252778

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 35.17m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■					0			FILL: Silty sand, fine to medium grained, dark brown, with ironstone gravel, clay nodules and slag.				GRASS COVER APPEARS WELL COMPACTED
				■	N = 11 5,6,5							>600 >600 >600	
						1		CH	Silty CLAY: high plasticity, dark yellow brown mottled red brown, with fine grained ironstone gravel.	w≒PL	Hd	>600 >600 >600	RESIDUAL
	■			■	N = 11 5,6,5				Silty CLAY: high plasticity, light grey mottled yellow brown.			>600 >600 >600	
						2			as above, but with ironstone gravel bands.				
				■	N > 6 9,6/50mm	3		-	Extremely Weathered siltstone: silty CLAY, high plasticity, light grey mottled yellow brown.	XW	Hd		BRINGELLY SHALE VERY LOW 'TC' BIT RESISTANCE
					REFUSAL				SILTSTONE: dark grey.	DW	L		LOW RESISTANCE
				■		4							
						5							
				■		6							
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **27** 2/2

Easting: 307224.1
Northing: 6252778

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 35.17m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■					SILTSTONE: dark grey.	DW	L		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **28** 1/2

Easting: 307265.3
Northing: 6252773

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18
Method: SPIRAL AUGER JK350
R.L. Surface: 33.73m
Datum: AHD
Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			FILL: Silty sand, fine to medium grained, brown, with root fibres.	D			APPEARS WELL COMPACTED
					N = 18 8,10,8				FILL: Silty clay, medium to high plasticity, light grey mottled yellow brown and red brown, with fine grained ironstone gravel and sand.	w≈PL		>600 >600 >600	
						1							
					N = 8 5,4,4			CH	Silty CLAY: high plasticity, dark yellow brown mottled yellow brown, trace of fine grained ironstone gravel and ash.	w>PL	VSt- Hd	420 370 380	RESIDUAL
						2			as above, but yellow brown mottled orange brown.				
									as above, but light grey and yellow brown.		VSt		
					N = 9 4,4,5	3						240 290 280	
						4			as above, but with ironstone bands.		Hd		
					N > 15 13,15/ 50mm							>600 >600 >600	
					END	5		-	Extremely Weathered siltstone: silty CLAY, low to medium plasticity, dark grey.	XW	Hd		BRINGELLY SHALE
									SILTSTONE: dark grey.	DW	L		VERY LOW 'TC' BIT RESISTANCE
													LOW RESISTANCE
										SW	L-M		MODERATE RESISTANCE
						6					M		
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **28** 2/2

Easting: 307265.3
Northing: 6252773

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18

Method: SPIRAL AUGER
JK350

Logged/Checked by: S.M./A.J.H.

R.L. Surface: 33.73m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									SILTSTONE: dark grey.	SW	M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 29 1/2

Easting: 307310.6
Northing: 6252768

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 32.09m

Date: 28/9/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■					0			FILL: Silty sand, fine to medium grained, brown, with clay nodules, slag and root fibres.	M			GRASS COVER APPEARS MODERATELY COMPACTED
				■	N = 8 4,4,4	1			FILL: Silty sand, fine to coarse grained, red brown and brown, with fine grained igneous gravel, brick and tile fragments and slag.				
		■		■	N = 9 5,4,5	2							
	■			■	N = 7 2,2,5	3		CI	Silty CLAY: medium plasticity, dark grey mottled yellow brown, trace of ash.	w>PL	S-F		ALLUVIAL
	■			■				CH	Silty CLAY: high plasticity, light grey mottled yellow brown.		VSt	50 40 70	RESIDUAL
						4						300 320 260	
				■	N > 22 10,13, 9/120mm			CI	Silty sandy CLAY: medium plasticity, light grey mottled yellow brown, fine to medium grained sand.			200 290 250	
					REFUSAL	5		-	Extremely Weathered sandstone: clayey SAND, fine to medium grained, light grey and yellow brown.	XW	D	>600	BRINGELLY SHALE
				■						DW	L		VERY LOW 'TC' BIT RESISTANCE
									SANDSTONE: fine to medium grained, light grey and yellow brown.				LOW RESISTANCE
						6				SW	M		MODERATE RESISTANCE
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **29** 2/2

Easting: 307310.6
Northing: 6252768

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH
Date: 28/9/18

Method: SPIRAL AUGER
JK350

R.L. Surface: 32.09m
Datum: AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
									SANDSTONE: fine to medium grained, light grey and yellow brown.	SW	M		
									END OF BOREHOLE AT 7.5m				
						8							
						9							
						10							
						11							
						12							
						13							
						14							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 30 1/1

Easting: 307302.3
Northing: 6253026

Client: FABCOT PTY LTD

Project: PROPOSED HIGHBAY DISTRIBUTION WAREHOUSE

Location: 250-266 VICTORIA STREET, WETHERILL PARK, NSW

Job No. 31888AH **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 36.35m

Date: 27/9/18 **Datum:** AHD

Logged/Checked by: S.M./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION						0			CONCRETE: 525mm.t				8mm DIA. REINFORCEMENT 405mm + 85mm TOP COVER
					N = SPT 11/80mm REFUSAL	1		-	FILL: Silty gravelly sand, fine to coarse grained, dark grey, angular fine grained igneous gravel, with glass fragments and slag.	D			APPEARS WELL COMPACTED
					N = 14 5,6,8				FILL: Silty clay, high plasticity, brown mottled red brown and grey, trace of slag.	w>PL		380 480 270	
						2		CH	Silty CLAY: high plasticity, light grey mottled yellow brown.	w≒PL	Hd	500 460 450	RESIDUAL
						3		-	Extremely Weathered siltstone: silty CLAY, medium to high plasticity, light grey and red brown.	XW	Hd		BRINGELLY SHALE
									SILTSTONE: dark grey.	SW	L-M		VERY LOW 'TC' BIT RESISTSANCE LOW RESISTANCE
						4							
						5					H		HIGH RESISTANCE
									END OF BOREHOLE AT 5.4m				'TC' BIT REFUSAL
						6							
						7							

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SITE LOCATION PLAN**

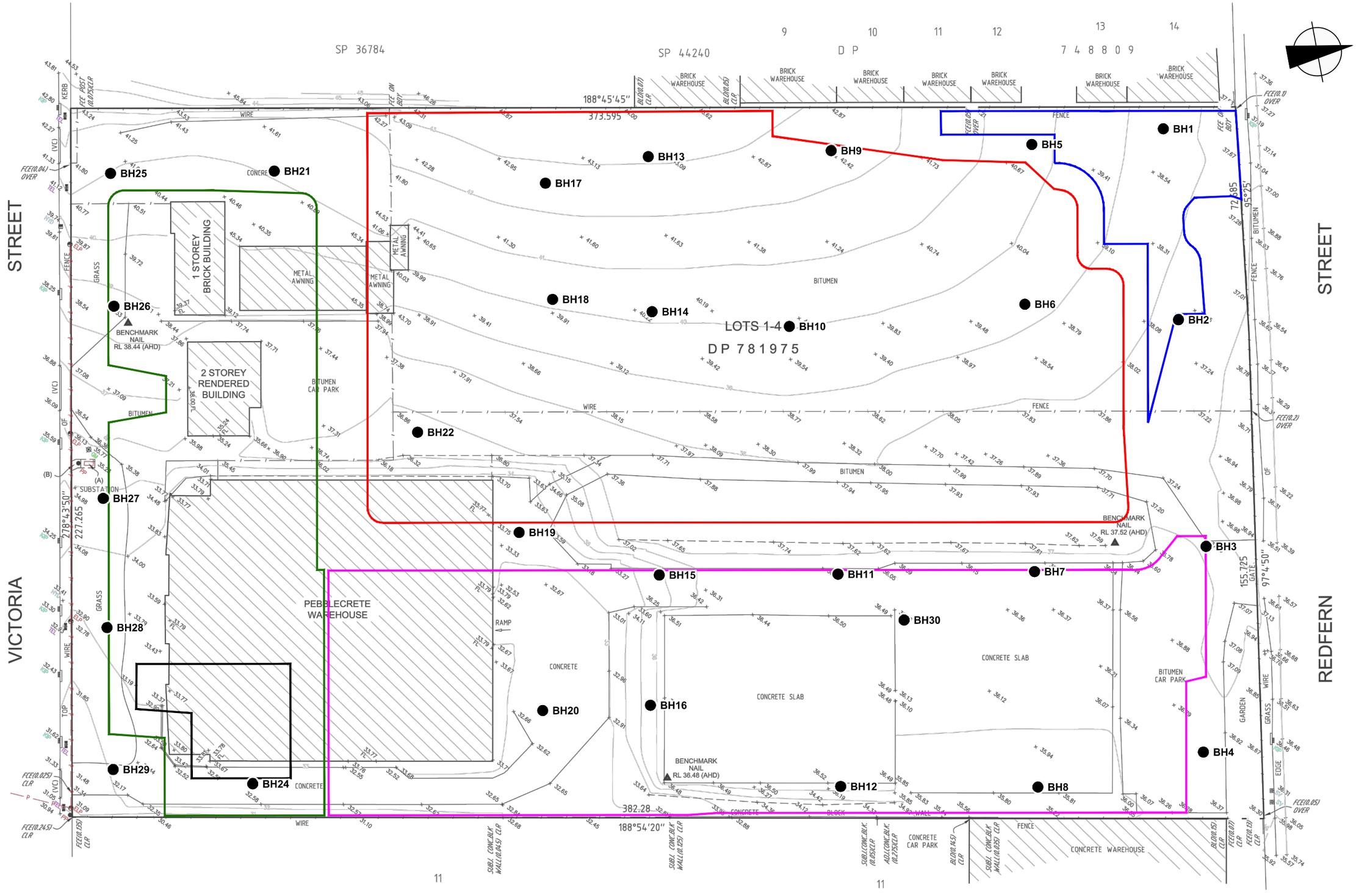
Location: 250 VICTORIA STREET
WETHERILL PARK, NSW

Report No: 31888AH2

Figure No: 1

JKGeotechnics

PLOT DATE: 21/01/2021 11:33:37 AM DWG FILE: Y:\31000\S\31888AH WETHERILL PARK\CAD\31888AH2.DWG



LEGEND

- PROPOSED PAD 1 BEL RL33.20m
- PROPOSED PAD 2 BEL RL41.30m
- PROPOSED PAD 3 BEL RL33.70m
- PROPOSED PAD 4 BEL RL37.30m
- PROPOSED SEDIMENT BASIN

0 12 24 36 48 60

SCALE 1:1200 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **BOREHOLE LOCATION PLAN**

Location: 250 VICTORIA STREET
WETHERILL PARK, NSW

Report No: 31888AH2

Figure No: 2

JKGeotechnics

PLOT DATE: 21/01/2021 11:50:49 AM DWG FILE: Y:\31000\S\31888AH WETHERILL PARK\CAD\31888AH2.DWG

VIBRATION EMISSION DESIGN GOALS

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

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structure.

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

Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration

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

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

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) is referred to as 'laminite'.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shrink-swell behaviour, strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm 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 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

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

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing (CPT) and Interpretation: The cone penetrometer is sometimes referred to as a Dutch Cone. The test is described in Australian Standard 1289.6.5.1–1999 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Static Cone Penetration Resistance of a Soil – Field Test using a Mechanical and Electrical Cone or Friction-Cone Penetrometer'*.

In the tests, a 35mm or 44mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm or 165mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck. The CPT does not provide soil sample recovery.

As penetration occurs (at a rate of approximately 20mm per second), the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa. There are two scales presented for the cone resistance. The lower scale has a range of 0 to 5MPa and the main scale has a range of 0 to 50MPa. For cone resistance values less than 5MPa, the plot will appear on both scales.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between CPT and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of CPT values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

There are limitations when using the CPT in that it may not penetrate obstructions within any fill, thick layers of hard clay and very dense sand, gravel and weathered bedrock. Normally a 'dummy' cone is pushed through fill to protect the equipment. No information is recorded by the 'dummy' probe.

Flat Dilatometer Test: The flat dilatometer (DMT), also known as the Marchetti Dilometer comprises a stainless steel blade having a flat, circular steel membrane mounted flush on one side.

The blade is connected to a control unit at ground surface by a pneumatic-electrical tube running through the insertion rods. A gas tank, connected to the control unit by a pneumatic cable, supplies the gas pressure required to expand the membrane. The control unit is equipped with a pressure regulator, pressure gauges, an audio-visual signal and vent valves.

The blade is advanced into the ground using our CPT rig or one of our drilling rigs, and can be driven into the ground using an SPT hammer. As soon as the blade is in place, the membrane is inflated, and the pressure required to lift the membrane (approximately 0.1mm) is recorded. The pressure then required to lift the centre of the membrane by an additional 1mm is recorded. The membrane is then deflated before pushing to the next depth increment, usually 200mm down. The pressure readings are corrected for membrane stiffness.

The DMT is used to measure material index (I_D), horizontal stress index (K_D), and dilatometer modulus (E_D). Using established correlations, the DMT results can also be used to assess the 'at rest' earth pressure coefficient (K_o), over-consolidation ratio (OCR), undrained shear strength (C_u), friction angle (ϕ), coefficient of consolidation (C_h), coefficient of permeability (K_h), unit weight (γ), and vertical drained constrained modulus (M).

The seismic dilatometer (SDMT) is the combination of the DMT with an add-on seismic module for the measurement of shear wave velocity (V_s). Using established correlations, the SDMT results can also be used to assess the small strain modulus (G_o).

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod with a 20mm diameter cone end with a 9kg hammer dropping 510mm. The test is described in Australian Standard 1289.6.3.2–1997 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – 9kg Dynamic Cone Penetrometer Test'*.

The results are used to assess the relative compaction of fill, the relative density of granular soils, and the strength of cohesive soils. Using established correlations, the DCP test results can also be used to assess California Bearing Ratio (CBR).

Refusal of the DCP can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Vane Shear Test: The vane shear test is used to measure the undrained shear strength (C_u) of typically very soft to firm fine grained cohesive soils. The vane shear is normally performed in the bottom of a borehole, but can be completed from surface level, the bottom and sides of test pits, and on recovered undisturbed tube samples (when using a hand vane).

The vane comprises four rectangular blades arranged in the form of a cross on the end of a thin rod, which is coupled to the bottom of a drill rod string when used in a borehole. The size of the vane is dependent on the strength of the fine grained cohesive soils; that is, larger vanes are normally used for very low strength soils. For borehole testing, the size of the vane can be limited by the size of the casing that is used.

For testing inside a borehole, a device is used at the top of the casing, which suspends the vane and rods so that they do not sink under self-weight into the 'soft' soils beyond the depth at which the test is to be carried out. A calibrated torque head is used to rotate the rods and vane and to measure the resistance of the vane to rotation.

With the vane in position, torque is applied to cause rotation of the vane at a constant rate. A rate of 6° per minute is the common rotation rate. Rotation is continued until the soil is sheared and the maximum torque has been recorded. This value is then used to calculate the undrained shear strength. The vane is then rotated rapidly a number of times and the operation repeated until a constant torque reading is obtained. This torque value is used to calculate the remoulded shear strength. Where appropriate, friction on the vane rods is measured and taken into account in the shear strength calculation.

LOGS

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

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it 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 and may not be the same at the time of construction.
- 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 be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to 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 perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soils for Engineering Purposes'* or appropriate NSW Government Roads & Maritime Services (RMS) test methods. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.
- Details of the development that the Company could not reasonably be expected to anticipate.

If these occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

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, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Where information obtained from this investigation 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. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. Licence to use the documents may be revoked without notice if the Client is in breach of any obligation to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a joint design review which involves an experienced geotechnical engineer/engineering geologist.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types and appropriate footing or pile founding depths, or

iii) full time engineering presence on site.

SYMBOL LEGENDS

SOIL


FILL


TOPSOIL


CLAY (CL, CI, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CI, CH)


SILTY CLAY (CL, CI, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CI, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML, MH)


PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK


CONGLOMERATE


SANDSTONE


SHALE/MUDSTONE


SILTSTONE


CLAYSTONE


COAL


LAMINITE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

OTHER MATERIALS


BRICKS OR PAVERS


CONCRETE


ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
Fine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

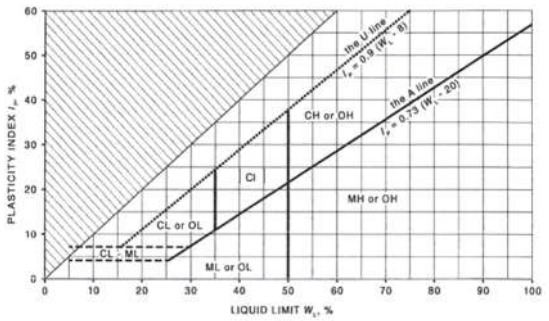
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

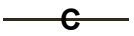
3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
		Extent of borehole/test pit collapse shortly after drilling/excavation.
		Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of undrained shear strength.
	PID = 100	Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL	Moisture content estimated to be greater than plastic limit.
	$w \approx$ PL	Moisture content estimated to be approximately equal to plastic limit.
	w < PL	Moisture content estimated to be less than plastic limit.
	$w \approx$ LL	Moisture content estimated to be near liquid limit.
	w > LL	Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D	DRY – runs freely through fingers.
	M	MOIST – does not run freely but no free water visible on soil surface.
	W	WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – unconfined compressive strength ≤ 25kPa.
	S	SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.
	F	FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.
	St	STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.
	VSt	VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.
	Hd	HARD – unconfined compressive strength > 400kPa.
	Fr	FRIABLE – strength not attainable, soil crumbles.
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	VERY LOOSE – ≤ 15 – 0 – 4
	L	LOOSE – > 15 and ≤ 35 – 4 – 10
	MD	MEDIUM DENSE – > 35 and ≤ 65 – 10 – 30
	D	DENSE – > 65 and ≤ 85 – 30 – 50
	VD	VERY DENSE – > 85 – > 50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other assessment.
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.

Log Column	Symbol	Definition
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil.

Classification of Material Weathering

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Abbreviations Used in Defect Description

Cored Borehole Log Column		Symbol Abbreviation	Description
Point Load Strength Index		• 0.6	Axial point load strength index test result (MPa)
		x 0.6	Diametral point load strength index test result (MPa)
Defect Details	– Type	Be	Parting – bedding or cleavage
		CS	Clay seam
		Cr	Crushed/sheared seam or zone
		J	Joint
		Jh	Healed joint
		Ji	Incipient joint
		XWS	Extremely weathered seam
	– Orientation	Degrees	Defect orientation is measured relative to normal to the core axis (ie. relative to the horizontal for a vertical borehole)
	– Shape	P	Planar
		C	Curved
		Un	Undulating
		St	Stepped
		Ir	Irregular
	– Roughness	Vr	Very rough
		R	Rough
		S	Smooth
		Po	Polished
		Sl	Slickensided
	– Infill Material	Ca	Calcite
		Cb	Carbonaceous
		Clay	Clay
		Fe	Iron
		Qz	Quartz
		Py	Pyrite
	– Coatings	Cn	Clean
		Sn	Stained – no visible coating, surface is discoloured
		Vn	Veneer – visible, too thin to measure, may be patchy
		Ct	Coating ≤ 1mm thick
		Filled	Coating > 1mm thick
	– Thickness	mm.t	Defect thickness measured in millimetres