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Acid Sulphate Soil Management Plan

Proposed Residential Development
7 Concord West, Concord West

Prepared for
F.T.D Holdings (Concord West) Pty Ltd
& Floridana Pty Ltd

Project 84964.02
September 2016

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	84964.02	Document No.	R.002.Rev0
Document title	Acid Sulphate Soil Management Plan		
Site address	7 Concord Avenue, Concord West		
Report prepared for	F.T.D. Holdings (Concord West) & Floridana Pty Ltd		
File name	84964.02.R.002.Rev0		

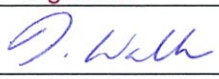
Document status and review

Revision	Prepared by	Reviewed by	Date issued
Draft A	David Walker	Tim Wright	8 February 2016
Revision 0	David Walker	Tim Wright	8 September 2016

Distribution of copies

Revision	Electronic	Paper	Issued to
Draft A	1	0	F.T.D. Holdings (Concord West) & Floridana Pty Ltd
Revision 0	1	0	F.T.D. Holdings (Concord West) & Floridana Pty Ltd

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

	Signature	Date
Author		8 September 2016
Reviewer		8 September 2016

bsi. ISO 9001 Quality Management

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1. Introduction

This report comprises an acid sulphate soil management plan (ASSMP) for the proposed residential development at 7 Concord Avenue, Concord West. The ASSMP was commissioned by F.T.D Holdings (Concord West) Pty Ltd & Floridana Pty Ltd to support a development application.

Acid sulphate soils (ASS) comprise naturally occurring soils that produce sulphuric acid when they react with oxygen (which can also mobilise metals in soils). Sulphuric acid and metals can have negative impacts on ecosystems and construction materials. The purpose of this ASSMP is to detail the strategies to be implemented to manage these potential negative impacts, given the presence of ASS at the site.

This ASSMP describes the proposed development, previous acid sulphate soils (ASS) assessment results, potential impacts, responsibilities, and management requirements such as groundwater and surface water protection.

2. Site Identification and Proposed Development

The site has street address 7 Concord Avenue, Concord West and comprises Lot 1 Deposited Plan 219742. Drawing 1, Appendix A shows a locality plan for the site.

At the time of preparing this report, a broadly rectangular, two-storey, mainly brick building occupied the southern two-third of the site and was used for commercial purposes. Car parking spaces and strip gardens were located on the southern and eastern sides of the building and were accessible from Station Avenue. The rear (west) of the property was mainly grassed. The northern portion of land was vacant and separated from the remainder of the site by chain-link fencing. The adjacent land uses include:

- Residential properties to the east and north:;
- Vacant land to the north-west;
- Homebush Bay Drive to the west; and
- Commercial premises to the south.

According to the Planning Proposal (Antoniades Architects, November 2015), the proposed development of the site is for multistorey residential apartment buildings over one level of common basement car parking covering much of the site. The proposed basement does not extend to any of the site boundaries and mainly landscaping with footpaths is proposed at the periphery of the site. An

overland flow path (for stormwater) running east to west will be constructed above the basement car parking level and across peripheral landscaping.

The proposed basement level will be at approximately RL -0.8 and -1.5 m. According to the site survey plan (Project Surveyors, March 2010) provided by the client, the current site level is at approximately 1.7 m AHD. Therefore, excavations for the proposed basement are anticipated to be to depths of between 2.5 m and 3.5 m below the current ground level. Some filling may occur at peripheral areas of the site. Groundwater was measured at depths of between 0.76 m and 2.16 m below the current ground level (on 22 October 2007), and, therefore some excavation below the groundwater table is expected. [It is noted that surface levels shown in the survey plan provided by the client differ to those presented in DP (2015). Levels presented in DP (2015) were sourced from the survey by S. McN. Bland Pty Ltd, 19 May 2006]. Planning Proposal plans are provided in Appendix A.

3. Previous Assessment and Remediation Action Plan

An ASS assessment was conducted as part of intrusive investigations conducted at the site and the neighbouring property to the south in 2007. Assessment results relevant to the proposed development have been reported in:

- Douglas Partners Pty Ltd (DP), *Report on Detailed Site Investigation for Contamination, 7 Concord Avenue, Concord West* (Project 84964.01), November 2015 (DP, 2015).

Pertinent information from the above report is included in relevant sections of this report.

At the time of preparing this ASSMP, a *Remediation Action Plan* (DP reference 784964.02.R.001) (RAP) was being prepared and should be referenced for site remediation requirements associated with contamination which are not addressed in this ASSMP.

4. Guidelines

This ASSMP is devised on the basis of the following guidelines endorsed by NSW Government:

- Stone Y, Ahern C R and Blunden B, *Acid Sulfate Soils Assessment Manual,* Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, 1998;
- Ahern C R, McElnea A E and Sullivan L A, *Acid Sulfate Soils Laboratory Methods Guidelines*, Queensland Department of Resources, Mines and Energy, Indooroopilly, 2004; and
- NSW Environment Protection Authority (EPA), *Waste Classification Guidelines,* 2014.

5. Topography, Geology and Groundwater

5.1 Topography

The site is relatively level on low laying land (see Section 2 for reference levels). The adjacent land to the east slopes up from the site. Powells Creek is located approximately 200 m to the west of the site.

5.2 Geology

Reference to the Sydney 1:100 000 Geological Sheet indicates that the site lies on the boundary of areas indicated as underlain by man-made fill over alluvial and estuarine sediment including silty to peaty quartz sand, silt, and clay (western side); and Ashfield Shale comprising black to dark-grey shale and laminite (eastern side).

During investigation works reported in DP (2015), various filling materials were identified to a typical depth of approximately 1 m, although deeper at some locations (including to a depth of 2.6 m at Test Bore 229). Natural materials observed to underlie filling typically included a layer of peaty clay (up to 0.9m thick) underlain by silty clays and, in turn, shale. Typically, the peaty clay layer tended to be relatively soft, as well as an underlying layer of silty clay. Silty clays, at greater depths, tended to be relatively stiffer and were usually mottled grey and brown (red or red-brown). Trace amounts of (ironstone) gravel were noted in some of the Test Bores, typically in the relatively stiffer silty clays. Natural materials at Test Bores 217, 216 and 105 were observed to be slightly different to the typical natural soil profiles at the site, with:

- Trace amounts of gravel and sand noted in the silty clay at Test Bore 217;
- Trace amounts of gravel, sand and rootlets in the silty clay at Test Bore 216; and
- Slightly sandy silty clay with ironstone gravel and a gravely clay observed at Test Bore 105.

Test bore logs (from DP, 2015) are provided in Appendix B. Test locations are shown on Drawing 1, Appendix A.

5.3 Groundwater

During fieldwork reported in DP (2015), free groundwater was observed whilst augering at numerous test bores. Free groundwater was commonly, but not always, observed in the relatively softer layers of natural soils (typically peaty clay and silty clay).

Groundwater wells were installed at Test Bores 203, 204, 207 and 213 for DP (2015). Well construction details are presented in the test bore logs in Appendix B. On 22 October 2012, measured groundwater depths varied across the site as follows: 0.75 m at Test Bore 204, 1.08 m at Test Bore 213, 1.16 m at Test Bore 203 and 2.16 m at Test Bore 207.

The inferred groundwater flow direction is shown on Drawing 1, Appendix A, and is towards Powells Creek to the west. It was considered, in DP (2015), that the direction of groundwater flow is influenced by what appears to be an old creek channel which may have been present prior to the importation of filling for site development. Based on the natural soil profile observed at Test Bores 105 and 216

compared to other test bores (noted in Section 5.2), the possible old creek channel flowed from the vicinity of Test Bore 105, in the approximate direction of Test Bore 216 and then to Homebush Bay.

5.4 Acid Sulphate Soils

ASS are naturally occurring sediments that contain iron sulphides, primarily pyrite, commonly deposited in estuarine environments. The occurrence of ASS is associated with areas or regions that have previously been or are currently estuarine environments. Due to changes in sea level or geomorphologic changes to coastal systems, these sediments are often overlain by terrestrial sediments.

When ASS are exposed to air (e.g. due to bulk excavation or dewatering), the oxygen reacts with iron sulphides in the sediment, producing sulphuric acid. This acid can be produced in large quantities and is highly mobile in water. The sulphuric acid can drain into waterways causing severe short and long term socio-economic and environmental impacts, including damage to man-made structures and natural ecosystems.

ASS can either be classified as 'actual acid sulphate soils' (AASS) which are soils that have already reacted with oxygen to produce acid, or 'potential acid sulphate soils' (PASS). PASS are soils containing iron sulphide that have not been exposed to oxygen (e.g. soils below the water table). PASS therefore have not produced sulphuric acid, but have the potential to do so if exposure to oxygen occurs.

According to the Canada Bay Local Environmental Plan 2013 Acid Sulfate Soils Map (Sheet ASS_002), the site is in a "Class 2" area, where an acid sulphate soils assessment is required if works are undertaken below the natural ground surface or works are likely to lower the groundwater table. According to NSW Acid Sulfate Soil Risk mapping (1994-1998), the site is in an area of "Disturbed Terrain" which may include filled areas, which often occur during reclamation of low-lying swamps for urban development. Investigations are required to assess these areas for acid sulphate soils.

As part of the investigation reported in DP (2015), samples from Test Bores 203, 204, 207 and 213 were subject to ASS field screening tests (pH in water and pH in hydrogen peroxide). From the results of screening tests, three samples were subject to SPOCAS (suspension peroxide oxidation combined acidity and sulphate) analysis and then chromium reducible sulphur analysis. Results of field screening and laboratory analysis are summarised in Tables 1 and 2.

Table 1: Results of Field Screening for Acid Sulphate Soils

Sample Location (Test Bore / depth (m))	pH_F (in distilled water)	pH_{FOX} (oxidised in hydrogen peroxide)	Strength of Reaction	Notes
203 / 0.2-0.5	7.8	7.6	2 to 3 F	Odour
203 / 0.8-1.0	7.7	6.4	3 to 4 F	
203 / 1.0-1.3	8.0	5.9	4 F	
203 / 1.5-2.0	6.9	4.7	1	
203 / 2.5-3.0	6.1	4.6	1	
204 / 0.1-0.3	8.2	8.4	1	
204 / 0.5-1.0	4.9	3.6	1	
204 / 1.0-1.2	6.4	3.1	3 to 4 F	Odour
204 / 1.2-1.4	6.5	2.1	2 to 3 F	Strong odour and smoke
204 / 1.4-1.5	8.2	6.0	2 to 3 F	Odour and smoke
204 / 1.9-2.2	9.4	5.2	2 to 3 F	
207 / 0-0.5	4.4	2.3	1	
207 / 0.5-1.0	2.8	2.7	1	
207 / 1.0-1.5	3.7	2.7	1	
207 / 1.7-2.0	5.1	2.8	1 to 2	
213 / 0.2-0.5	5.8	5.4	1 to 2	
213 / 0.7-1.0	6.6	5.0	1 to 2 F	
213 / 1.1-1.5	6.5	2.5	1	
213 / 1.5-2.0	6.7	6.3	1	

Notes: Strength of Reaction: 1– denotes slight effervescence:
2 – denotes moderate reaction;
3 – denotes vigorous reaction;
4 – denotes very strong effervescence accompanied by escape of gas/heat
F - indicates a bubbly/frothy reaction (organics)

Table 2: Results of Laboratory Analysis for Acid Sulphate Soils

Sample ID (Test Bore/ depth (m))	Sample Description	Total Actual Acidity s-TAA % w/w	Chromium Reducible Sulfur S_{CR} % w/w
204/1.2-1.4	Grey silty clay (<0.5 m below observed groundwater level - 22/11/07)	0.028	**1.2**
207/1.0-1.5	Brown clay filling (<1 m above observed groundwater level – 22/11/07)	0.3	0.022
213/1.1-1.5	Red brown and grey silty clay (<0.5 m below observed groundwater level – 22/11/07)	0.036	**0.15**
Action Criterion (more than 1000 tonnes disturbed)			0.03

Natural soil samples (from Test Bore 204, depth 1.2-1.4 m and Test Bore 213 depth 1.1-1.5) show chromium reducible sulphur trail (S_{CR}) values to be significantly above the action criterion (adopted from Stone Y et al, 1998) for projects that disturb more than >1000 tonnes of ASS and therefore it is

considered that ASS (as PASS) are present at the site. These natural soil samples were taken from less than 0.5 m below the observed groundwater levels. When taking into account the initial screening results, it is considered that the natural soils at the site near the groundwater level are prone to being PASS.

The results for the filling sample from Test Bore 207, depth 1.0-1.5 m, indicates this filling to be susceptible to acid conditions. The chromium reducible sulphur trail (S_{CR}) value (0.022 % w/w) is below the action criterion which suggests that this filling material is not considered to be ASS.

6. ASS Management Options

Proposed works that have the potential to disturb or impact upon ASS include:

- Excavation into natural soils close to the groundwater table including for the basement (and for piling depending on the piling method adopted); and
- Dewatering for the basement which may lower the groundwater table within the basement footprint or beyond the basement footprint.

Stone Y et al (1998) recommends assessment and management of ASS where works involving the disturbance of more than one tonne of soil is proposed in an area identified to potentially be impacted by ASS. The applicable management options are discussed below. Whichever option is adopted, care must be taken to minimise impacts on the local environment.

6.1 Non-Excavation or Minimal Earthworks

Non-excavation or minimisation of invasive earthworks is the principal recommended management option for those areas where:

- Deep, bulk excavation is not required;
- ASS materials are too voluminous to remove and rebury;
- ASS materials are too difficult to remove and neutralise with lime; or
- There would be too much risk of contaminating groundwater or run-off.

Given the nature of the proposed development, deeper excavation is considered necessary, and non-excavation of ASS is therefore not considered suitable as a “stand-alone” measure. The potential for minimising disturbance/ excavation in ASS could be reviewed and implemented where possible.

6.2 Treatment – On-Site

This method of management involves the treatment of disturbed ASS by neutralising the acid producing potential. The neutralising agent (e.g. lime) is applied to neutralise any acid that may have been, or will be, produced because of aeration. Thorough mixing with the neutralising agent and ongoing monitoring to assess the success of treatment are necessary requirements for this option.

The treatment process is generally straightforward and this option is feasible for most sites, although it can be difficult on small sites with insufficient space/time for treatment. This option is considered feasible for the site although the volume of soil that can be treated at any one time will be limited by the site area that can be used for treatment.

The treated soils could then be re-used on-site or disposed of off-site to a suitably licenced waste management facility (such as a landfill).

6.3 Treatment – Off-Site

This method of management involves the treatment of disturbed ASS as described above, but with the ASS transported off-site for treatment. This option can be suitable for sites where there is insufficient time/ space for on-site treatment.

The treatment would need to occur at a facility licensed to undertake this activity. It is foreseen that the treated ASS would then be disposed of to a suitably licensed waste management facility (such as a landfill).

6.4 Reburial – On-Site (PASS only)

This method of management involves the rapid replacement of PASS below the water table at the site before it undergoes any significant oxidation. This option is not generally suitable for actual acid sulphate soil (AASS). This approach needs to be carefully managed to minimise oxidation of the PASS during disturbance and impact on water quality where the PASS is placed.

Given the proposed development, this option may be suitable in rare cases where works only disturb minor quantities of excavated PASS, but, overall, there are unlikely to be sufficient areas to rebury the PASS. For this reason, this method has not been adopted as part of this ASSMP.

6.5 Reburial – Off-Site (PASS only)

This method of management involves the disposal of PASS below the water table at an appropriately licensed landfill. PASS can be placed beneath the water table at an appropriately licensed landfill if stringent requirements set out by the EPA are met. This option is only allowed for uncontaminated natural *in situ* PASS and is not available for AASS. NSW EPA (2014) sets out the requirements for disposal of PASS to a licensed landfill for reburial, and the receiving landfill will also need to meet their specific licence conditions. This option requires careful management of the PASS to minimise oxidation of the PASS during excavation, handling and transport, and impact on water quality where the PASS is placed. Given the stringent requirements for this option (e.g. regarding pH and pH change) a secondary strategy would also be required to manage any materials found not to be suitable for management using this method.

Given that there is currently very limited potential for Sydney region landfills to accept untreated, uncontaminated PASS for burial below the water table, this option has not been specifically adopted

herein. If it is (later) found that that this option is feasible, this ASSMP could be updated to cover the management requirements related to its implementation.

6.6 Separation of ASS Fines

This method of management involves the separation of the fine soil particles (generally comprising the ASS) from the coarse particles with a view to reducing the volume of ASS which needs to be treated/ managed. This option requires careful management and treatability studies and is only feasible for specific sites.

Given the nature of site and soil conditions, this option is not considered to be suitable.

6.7 Proposed Acid Sulphate Soil Management Strategy

Two options for management of ASS are detailed in the following sections, namely either on or off-site treatment of ASS, as these options are considered to be the most suitable to the proposed development. Regardless of which option is adopted, careful on-site management of soils and water will be required.

7. On-Site Treatment of ASS

Option 1 for management of the ASS is on-site treatment. The management requirements for this strategy are detailed in this section and the following sections (excluding Section 9). On site neutralisation, management, monitoring and validation of ASS should be undertaken as required using the methodology given below.

Where there is any uncertainty regarding the presence/absence of ASS, the subject materials should be treated in accordance with this methodology. If ASS assessment on materials being assumed to contain ASS shows that they do not contain ASS, further management/treatment for ASS will not be required.

7.1 Prior to Excavation of ASS

On-site treatment will require preparation of a Treatment Area(s), Stockpiling Area(s) and Leachate Collection Area(s).

Allowances should be made during construction planning to resume sufficient land to allow for these items. Leachate collection location, lining and construction should be similarly pre-planned.

Figure 1 shows a cross section of a typical treatment pad.

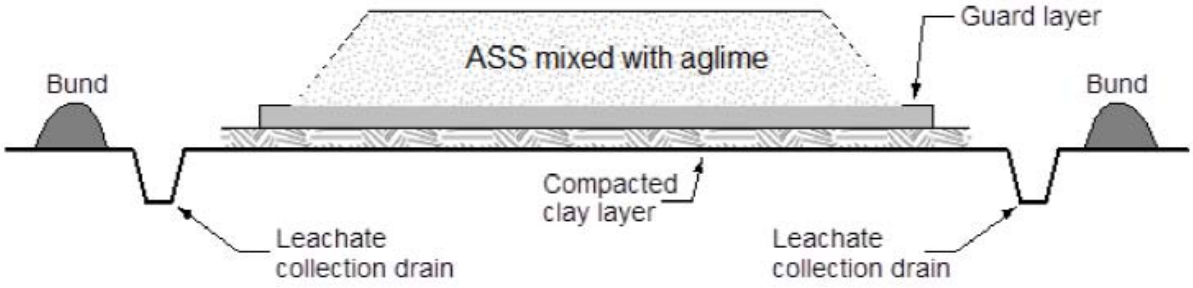


Figure 1: Schematic cross-section of a treatment pad, including clay layer, guard layer, leachate collection drain and bunding[1]

These areas should be prepared as follows:

- Prepare a treatment pad and (if required) stockpile pad of appropriate area for the volume of soil to be treated/ stored. The pad should be prepared on relatively level or gently sloping ground to minimise the risk of any potential instability issues, with a natural (or shaped) fall to the local drainage sump. The treatment area should be located as far as practical from any potential ecological receptors (such as drainage lines which enter the stormwater system);
- Lining of the surface of the pad with selected compacted clay (at least two layers to a combined compacted thickness of 0.5 m) or a geosynthetic liner as approved by the environmental consultant;
- Apply a guard layer of fine agricultural lime ('ag lime') over the compacted clay or geosynthetic liner, to neutralise downward seepage. This guard layer of lime should be applied at a rate of approximately 10 kg fine ag lime per m^2 per vertical metre of stockpile, i.e. if a treatment stockpile of 3 m is proposed, the guard layer would need to comprise approximately 30 kg of ag lime per m^2 of surface area. The guard layer should be re-applied following removal of treated soils prior to addition of untreated ASS; and
- Liming pads should be bunded and a circumference drain excavated to collect and contain leachate. The drain and inner bund slopes should be covered with a layer of fine lime applied to neutralise any possible leachate migrating from the stockpiled material. The drain should direct soil into an appropriately sized sump or retention pond. Collect waters should be monitored and if necessary treated before reuse or release. Alternatively water from the drain can be pumped into on-site tanks for storage, testing and treatment.

If small quantities of ASS are to be excavated, then the use of a skip bin may be appropriate instead of treatment pad. Any leachate drainage from the skip bin should be avoided, or otherwise will need to be contained and treated as necessary.

[1] Figure reproduced from Dear, S-E
Dear S E, Ahern, C R, O'Brien, L E, S K McElenea, A E Moore, N G & Watling, K M, *Queensland Acid Sulfate Soil Technica Manual: Soil Management Guidelines*, Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government, 2014

7.2 Neutralising Materials for Soils

Agricultural lime commonly known as ag lime, is the preferred neutralisation material for the management of ASS, as this material is usually the cheapest and most readily available product for acid neutralisation. Furthermore, ag lime is slightly alkaline (pH of 8.5 to 9), non-corrosive, of low solubility and does not present handling problems. Ag lime comprises calcium carbonate ($CaCO_3$), typically made from limestone that has been finely ground and sieved to a fine powder.

It is generally preferable if an ag lime with a purity of 95% or better is used (i.e. NV >95, where NV is the neutralising value, a term used to rate the neutralising power of different forms of materials relative to pure, fine calcium carbonate which is designated NV = 100). The ag lime should be fine and dry, as texture and moisture can also decrease the effective neutralising value. Ag lime with a NV of 95% to 98% is usually used. There could be economic justification for using a less pure grade of ag lime, however, this would require a higher application rate to be adjusted by a factor of 100/NV (see Section 7.3 for application rates). Potential cost savings from using less pure material may be offset by the corresponding increase in the transport and disposal costs.

Coarse grained calcite is not recommended, as one of the products of the neutralisation reaction is gypsum ($CaSO_4.2H_2O$) which has a relatively low solubility and tends to coat the reacting calcite grain, forming a partial barrier against further reaction.

Gypsum may also give off hydrogen sulphide if in reaction with acidic conditions and can itself result in the generation of sulphuric acid.

Dolmitic ag lime, or magnesium blend ag lime, should not be used as these materials impose environmental risks from overdosing with the potential to damage estuarine ecosystems.

An alternative neutralising material can be used subject to prior approval by a suitably qualified scientist or engineer.

7.3 Lime Application Rate and Pre-Treatment Testing

Calculated liming rates from investigations reported in DP (2015) are shown in Table 3. These are considered to be indicative liming rates (or as a “starting point”), and actual liming rates for successful neutralisation of ASS are likely to be variable for the following reasons:

- Acid production will vary both horizontally and vertically through the ASS profile due to the variability of natural systems; and
- Delineation of ASS across the entire site has not been undertaken.

It is therefore recommended that some pre-treatment testing, where possible, be undertaken to determine liming rates prior to treatment of ASS. Results of pre-treatment testing may reveal that some excavated soils will not require treatment prior to disposal/re-use.

Table 3: Indicative liming rates based on analytical results presented in DP (2015)

Sample Location (Test Bore / depth (m))	Liming Rate (kg $CaCO_3$/tonne)
204/1.2-1.4	125
213/1.1-1.5	14

Some excavations (such as from piling returns) are likely to contain a mix of ASS and non-ASS. Soils may be temporality stored in stockpile pads (see Section 7.1) or in skip bins (if in smaller quantities) so that the soil can be tested as 'batches' prior to treatment. Testing of samples for SPOCAS and/ or Chromium Suite should be undertake at a rate of between one sample per 100 m^3 and one sample per 500 m^3 of soil (typically a minimum of three samples) depending on the size of the batch and homogeneity of the material. Possible overtreatment of soils may be avoided with pre-treatment testing. It is noted that the fastest turnaround of results for SPOCAS testing is typically three days from receipt of the sample at the laboratory (with the timing generally commencing from the morning after the samples are received by the laboratory), and this timing may not always be available from the laboratory.

Material will only be considered to have been successfully treated when all soil has been validated in accordance verification testing with Section 7.5.

If an alternate neutralising product is used, a specific dosing rate will need to be calculated. The required dosing rate should be calculated from the following formula:

Neutralising Material Required (kg) per tonne of soil =

$$\left(\frac{\%\,S \times 623.7}{19.98}\right) \times \frac{100}{ENV\,(\%)} \times FOS$$

Where: *%S = net acidity (% S units). This value is obtained from the SPOCAS/ chromium suite analytical results and should be the "worst case" result of the acid or sulphur trails of all samples;*
623.7 = % S to mol H^+/t;
19.98 = mol H^+/t to kg $CaCO_3$/t;
FOS (factor of safety) = a minimum value of 1.5 needs to be adopted, although values of up to 2 can be suitable;
ENV = Effective Neutralising Value (e.g. Approx. 95% for fine ag lime).

Further details for the calculation of liming rates are provided in Ahern C R et al (2004). Whilst the above formula is provided, the environmental consultant will provide the liming rate based on the soil analysis.

7.4 Treatment Process

The process for the treatment of ASS is as follows:

- Prepare a treatment/ stockpiling pad in accordance with Section 7.1;
- Excavate and segregate any non-ASS overburden (filling) from the area containing ASS if material types can be separated during works. [Given the soil profile (see Section 5), all

excavated natural soils, close to or below the groundwater table, should be considered as PASS until otherwise determined by pre-treatment testing (Section 7.3)];

- Transport ASS material requiring treatment to the treatment area (in sealed trucks if required);
- Manage ASS during stockpiling and treatment to minimise dust and leachate generation (e.g. by covering, or lightly conditioning with water). If wet weather prevails, stop works and cover the stockpiled material with a plastic sheet to reduce the formation of leachate;
- Spread the ASS onto the guard layer in layers of up to 0.3 m thick, leaving a 1 m flat area between the toe of the spread soil and the containment bund or drain. When spreading the first soil layer, care should be taken not to churn up the lime guard layer;
- Let the ASS dry to facilitate lime mixing (if too wet, then adequate mixing of lime cannot be achieved);
- Apply ag lime to the stockpiled soil (see Section 8.3 for liming rate) and harrow/ mix thoroughly prior to spreading the next layer;
- Continue the spreading/ liming/ mixing cycle. This can be done one layer at a time, or with multiple ASS layers placed on top of each other;
- Assess the success of the treatment using verification testing (in accordance with Section 7.5). Samples will need to be collected from all layers (which is likely to require use of plant for sampling). The verification testing has two components: field screening and laboratory analysis. It is likely that laboratory analysis will only be undertaken after the field screening results have passed;
- If verification sampling indicates that additional neutralisation is required, add additional lime (at an appropriate liming rate) and mix as described above;
- When verification testing indicates that lime neutralisation is complete, then the stockpiled soil may be removed from the treatment pad;
- Re-use the treated ASS on-site or dispose off-site in accordance with waste classification (refer to Section 7.7); and
- Management of leachate water and groundwater (in accordance with Section 9).

7.5 Verification Testing

Verification testing should be conducted as follows:

- During and following neutralisation, the soils will require pH screening to confirm that the appropriate quantities of lime have been added and the soils have been suitably mixed/ blended prior to disposal. The pH testing (field and oxidised pH screening tests) should be undertaken on the treated material at a frequency of between one sample per 25 m^3 and one sample per 100 m^3 of treated soil or a minimum of six samples per treatment batch (depending on the volume and homogeneity of the batch);
- Once the pH screening results all meet the criteria (given in Section 8.6), laboratory verification testing will be required at a rate of between one sample per 100 m^3 and one sample per 500 m^3 (or typically a minimum of three per batch) of treated material. The laboratory testing can comprise SPOCAS, or, as an alternate method if no jarosite was present in the ASS prior to

treatment, the Chromium Suite analytical method can be used. It is noted that the typical fastest turnaround of results for laboratory testing is three days from receipt of the sample at the laboratory (with the timing generally commencing from the morning after the samples are received by the laboratory), and this timing may not always be available from the laboratory. This should be taken into account to ensure adequate on site storage is available for treated and untreated ASS; and

- Compare the validation results with the acceptance criteria (given in Section 7.6). If all results meet the acceptance criteria, the ASS will be considered to have been successfully treated.

7.6 Acceptance Criteria for Treated ASS

The acceptance criteria are based on the results of "field" and peroxide pH testing and laboratory testing. ASS will be considered to have been successfully treated when all of the following are met:

- Field pH (i.e. field pH in water) is ≥ 5.5 (and ≤ 8.5 for any materials to be re-used on site);
- Peroxide pH (i.e. pH after forced oxidation) is ≥ 6.5;
- pH_{KCL} is ≥ 6.5;
- TAA = 0;
- TPA = 0 (preferably, although TPA<ANC may be considered suitable subject to specific assessment); and
- Net acidity is ≤ 0.

The net acidity is calculated from SPOCAS/ chromium suite analytical results as follows:

$$\text{Net Acidity } (\%_{Sulphur}) = (S_{pos} \text{ or } S_{Cr}) + \text{s-TAA} + (S_{RAS} \text{ or } S_{NAS}) - \text{ANC} / \text{FF}$$

Note: S_{pos} or S_{Cr} is potential acidity (from SPOCAS suite or chromium suite)
s-TAA is actual acidity
S_{RAS} or S_{NAS} or is retained acidity (from SPOCAS suite or chromium suite)
ANC is acid neutralising capacity
FF is Fineness Factor of soils

Further treatment of the soil will be required if any of the above conditions are not met.

7.7 Disposal of Treated ASS

Waste classification of treated ASS material to be disposed of off-site is to be conducted in accordance with NSW EPA (2014) and the *Protection of the Environment Operations (POEO) Act* 1997.

With regard to ASS, Part 4 (Acid Sulphate Soils) of NSW EPA (2014) states that ASS must be treated (neutralised) prior to acceptance by a landfill operator (unless it is to be disposed of as "PASS" to an appropriately licensed landfill). After treatment, the soil should be chemically assessed in accordance with Step 5 in Part 1 NSW EPA (2014). This will determine whether any other contaminants are present in the material. When the classification has been established, the soil should be disposed of to a landfill that can lawfully accept that class of waste. The treated ASS would (at a minimum) be

classifiable as General Solid Waste, however, chemical testing needs to be conducted to confirm the classification prior to disposal and a higher classification could apply. Waste classification and disposal requirements are discussed in the RAP. Prior arrangements should be made with the landfill to ensure that it is licensed to accept the waste.

8. Off-Site Treatment

Option 2 for management of the ASS is off-site treatment. The management requirements for this strategy are detailed in this section.

Where there is any uncertainty regarding the presence/absence of ASS, the subject materials should be treated in accordance with this methodology. If ASS assessment on materials being assumed to contain ASS shows that they do not contain ASS, further management/ treatment for ASS will not be required.

8.1 Prior to Excavation

Prior to disturbance of potential ASS, the following will be undertaken:

- Identification of a suitable, appropriately licenced treatment facility. It is advised that the waste generator is responsible for ensuring that waste is disposed to a facility/ site which is legally able to accept it, as required by the POEO Act 1997;
- Provision of test results to the facility;
- Determining and addressing any specific requirements of the treatment facility, and amending this ASSMP as required to check that all requirements are met; and
- Confirming that the treatment facility will accept ASS from the site on the dates required.

8.2 Management and Transport

The general procedure for the management and transport of ASS is as follows:

- Excavate and segregate or dispose of any non-ASS overburden (such as filling) from the area containing ASS if material types can be separated during works. [All excavated natural soils, close to or below the groundwater table, should be considered as PASS unless testing is undertaken and results show otherwise];
- Any ASS material requiring transport to the treatment facility should be loaded directly into sealed trucks (sufficient to contain any water draining from the soils) and covered. Given that the soil is likely to be wet, and as such heavier than dry soils, it is critical that an accurate estimate of the weight of the material is made so that trucks are not overloaded;
- Transport of the ASS to the waste facility by a direct route to minimise transport time; and
- Management of leachate water and groundwater (in accordance with Section 9) will also be required.

8.3 Treatment

The treatment facility must manage, treat and dispose of the ASS in accordance with their licence conditions.

9. Water and Groundwater Management

Water is the main mechanism by which acid and metals from oxidised ASS are mobilised and transported. Careful management of water is therefore paramount to effective management of potential adverse impacts from ASS.

The below sections provide strategies for management, assessment and disposal of water leaching from ASS, surface water and water from groundwater dewatering.

9.1 Leachate and Surface Water Collection

All water that has been in contact with ASS/ assumed ASS must be managed, assessed, treated and appropriately disposed of.

Water from the ASS treatment/ storage area should be collected in lined drains, retention ponds (see Section 7.1) or in tanks. Any other water which may have come into contact with ASS should be collected in an on-site retention ponds or tanks.

All water which has potentially come into contact with ASS requires management in accordance with the below sections.

9.2 Dewatering Management

Dewatering is expected to be required for the proposed development.

Dewatering a site with ASS is a high environmental risk activity. The reduction of the groundwater table may expose sulphidic soils to oxygen which may generate acidic leachate. The greater the spatial area exposed and the longer the groundwater is lowered from its usual state, the higher the risk of acidic leachate entering the environment.

9.2.1 Proposed Dewatering Methods

The extent of dewatering will depend on the groundwater levels encountered during site works. Measured groundwater levels are given in Section 5.3, however, groundwater levels fluctuate with weather conditions.

At this stage the dewatering method or extent, quantitative details of the dewatering system, including proposed duration of discharge and the hourly and total quantities of water to be discharged is not known. Discharge rates may be evaluated during on-site field trials.

9.2.2 Risks Associated With Dewatering

There are numerous risks associated with dewatering in areas underlain by ASS. These risks include:

- Acidification of *in situ* soils drained within the dewatering cone of depression and difficulties associated with neutralising these *in situ* soils;
- Acidification of groundwater within the dewatering cone of depression after the system has re-flooded;
- Iron, aluminium and heavy metal contamination of groundwater arising from mobilisation of these compounds under low pH conditions; and
- Acidification and contamination of surface water bodies which receive groundwater.

9.2.3 Dewatering Risk Management

The following dewatering risk management methods are recommended for the project:

- Staging soil excavation to minimise the amount of dewatering at any one time;
- Monitoring groundwater inflow rates into excavations and groundwater levels around the excavations to assess the likely impact on surrounding groundwater levels; and
- Monitoring groundwater quality within excavations and treating groundwater prior to discharge from the site (as discussed in the following sections).

Piezometers (groundwater monitoring bores) may be installed and utilised to monitor localised groundwater levels which can give warning as to when the water table has lowered and oxidation of the potential acid sulphate layer is likely. Advice should be sought from an environmental consultant (or similar professional) in regards to the appropriate installation of piezometers if this method is to be adopted for monitoring the water table level.

9.3 Water Storage and Treatment

Water potentially impacted by ASS must be stored in a lined on-site retention pond or tank. The available storage capacity must take into account potential rainfall to minimise the risk of overflows during heavy rain. The storage facilities and volumes being stored must be managed to ensure that no water overflows from the storage, including over close down-periods (including weekends).

9.4 Water Assessment

All water which has potentially come into contact with ASS requires assessment (and if necessary treatment) for the parameters listed in Table 4, as a minimum. This table also details the recommended monitoring frequencies and target thresholds.

Table 4: Suggested Water Monitoring Frequencies and Target Levels for Disposal to Stormwater

Test	Frequency	Target Level for Disposal to Stormwater
pH	Field measurement: • during storage as required to allow timely treatment; • immediately prior to disposal; and • daily checks during discharge period.	• pH 6.5 – 8.5 (or otherwise determined by discharge authority) or not exceeding local water quality data (yet to be established).
Total Suspended Solids (TSS)	Field measurement: • immediately prior to disposal; and • as required based on visual observations; and Visual assessment: • daily during discharge period.	• water observed to be clear; and • Turbidity <50 NTU (or otherwise determined by discharge authority)
Iron	Laboratory analysis: • immediately prior to disposal; and • weekly checks during discharge period; and • as required based on visual observations.	• ≤ 0.3 mg/L iron or not exceeding local water quality data (yet to be established). • No obvious sign of iron staining/ settlement
Metals (aluminium, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, zinc)	Laboratory analysis: • one round of testing before first disposal; • if first round of testing exceeds target levels then further testing prior to disposal is required.	• ANZECC & ARMCANZ (2000) trigger values for (at least) 95% level of protection to marine ecosystem or not exceeding local water quality data (yet to be established)

Note:
ANZECC & ARMCANZ (2000): Australian and New Zealand Conservation Council and Agriculture, and Resource Management Council of Australia and New Zealand *Australian Water Quality Guidelines 2000*

The analytical suite listed in Table 4 may need to be expanded in the case that signs of contamination are identified in the water.

9.5 Treatment

9.5.1 General

Treatment of water from construction sites is commonly required for pH and TSS. Aeration and removal of TSS also generally decreases metal concentrations in the water. Standard industry treatment methods and commercial treatment products are suitable for the site and are likely to provide the most efficient treatment, however an alternate treatment method for pH is provided below.

If a suitable treatment method for man-made contaminants in the water (e.g. oil and grease or metals) cannot be implemented, an alternate disposal method may be required (e.g. trucking off-site to a liquid waste disposal facility or disposal to sewer in accordance with a specific Trade Waste Agreement which would need to be obtained from Sydney Water).

9.5.2 Alternate pH Treatment Method

Due to its low solubility in water, ag lime is not suitable for the neutralisation of leachate, which requires a product with a very quick reaction and high solubility. The most suitable neutralising agent for leachate and stockpile drainage water is generally slaked lime or quicklime (calcium hydroxide). These have a typical NV of about 135%.

A slaked (hydrated lime) solution can be produced by stirring quicklime into water, in a container of sufficient volume (for example, a plastic 200 litre drum). The slurry should be allowed to settle, and the clear solution (which will be caustic, with a pH of approximately 12.5 to 13) can be pumped or sprayed into the standing water in small amounts, with some agitation and monitoring. This procedure should be continued until the pH is adjusted to acceptable levels. Great care should be taken not to overshoot the desired pH with calcium hydroxide.

It is recommended that the contractor has several large bags of quicklime readily available at all times, subject to site constraints, with necessary equipment to produce, transport and apply the hydroxide solution as required.

Quicklime is very reactive, and relatively corrosive due to its caustic nature. When quicklime is mixed with water, the resulting reaction generates heat. Therefore, the material should be added in increments to a large amount of water to control the reaction. Slaked or quicklime should not be allowed to come into contact with the skin or be inhaled during use.

9.6 Disposal Options

In general site water can be disposed on site, through infiltration into the soil or disposed off-site.

Water requiring off-site discharge should be disposed of in accordance with relevant guidelines and licences. Consent for discharge should be obtained from the relevant authorities, where appropriate. The approval body for discharge into the stormwater system is City of Canada Bay Council. Sydney Water is responsible for discharge into sewer, and discharge can only be conducted in accordance with a Trade Waste Agreement. Sydney Water generally only accepts waters which have been contaminated by human activities, and it is the responsibility of the local government authority (City of Canada Bay Council) to accept water impacted only by ASS into the local stormwater system, subject to the water quality/ disposal management meeting their requirements. Alternatively water can be disposed to a licenced liquid waste facility, although this is generally an expensive option.

It is assumed herein that water will preferentially be disposed to stormwater in accordance with City of Canada Bay Council approval requirements. If the water is to be disposed on-site through infiltration into site soils the methodology described below will still apply with the exception of the need to measure/ treat for TSS, which is not relevant for re-absorption. If the water is found not to be suitable

for either of these disposal methods, specific disposal requirements/ approvals will need to be sought from Sydney Water or the receiving facility.

10. Guard Layers in Excavations

If engineered materials which are sensitive to acid are to be installed in excavations near where ASS has been exposed a “guard layer” should be placed to protect these materials. Following completion of the excavation, the newly exposed ASS should be covered with a guard layer (which can also serve as a working platform) to counteract the generation of acidic leachate due to the soils being exposed to air. This layer could be constructed of crushed recycled concrete mixed with limestone to form a 300 mm thick layer. [Note that the RAP discusses the requirements for importing materials such as crushed concrete].

11. Responsibilities

The responsible party for the main issues relating to ASS management are presented in Table 5. This section does not cover responsibilities related to general construction site activities.

Table 5: Responsibilities

Issue	Responsibility	Verified by/ Subject to the Approval of:-
Implementation of this ASSMP	Contractor	Principal
Monitoring	Contractor/ Environmental Consultant	Environmental Consultant
Liaison with authority/treatment facility	Contractor	Principal
Record keeping	Contractor	Principal/ Environmental Consultant
Alleviation of non-compliance issue	Contractor	Principal/ Environmental Consultant
Changes to ASSMP	Environmental Consultant	Principal

12. Reporting

According to Stone et al (1998) formal reporting of ASS management is not required, however, it is important to keep records of the management and validation process to show compliance with the guidelines and this ASSMP.

A record of management, treatment, monitoring, validation and disposal of ASS should therefore be maintained by the contractor and should include the following details:

- Date(s) of works involving ASS;
- Location/area and depth of excavated ASS material;
- Off-site treatment location and copy of licence (if applicable);
- Neutralisation process undertaken (if applicable);
- Liming material and rate utilised (if applicable);
- Results of field and analytical testing and comparison to acceptance criteria;
- Re-use/ disposal location (on or off-site);
- Tonnages of material treated/disposed and landfill dockets;
- Results of water monitoring; and
- Water discharge records.

These records should be made available to the Principal as requested and upon completion of works.

13. Conclusion

This ASSMP details the requirements to manage ASS during the proposed development works. If ASS is not detected in soils to be disturbed by the proposed development (from pre-treatment testing), no further ASS management will be required.

It is considered that implementation of this ASSMP will enable appropriate management of the potential risks associated with ASS to structures and surrounding water bodies, including the local groundwater and Powells Creek.

At the time of preparing this report, the RAP was being prepared and should be referenced for (additional) requirements for the management of excavated soils.

14. Limitations

Douglas Partners (DP) has prepared this report for this project at 7 Concord Avenue, Concord West, NSW in accordance with DP's proposal SYD151632 dated 9 December 2015 and acceptance received on 10 December 2015 from Jenny Rudolph of Elton Consulting (planning consultants) on behalf of F.T.D. Holdings (Concord West) Pty Ltd & Florindana Pty Ltd. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of F.T.D. Holdings (Concord West) Pty Ltd & Florindana Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its

own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The recommendations provided in the report are based on the sub-surface conditions previously encountered on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences.

DP's advice is based upon the conditions encountered during the previous investigations. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations, which have been limited by restrictions on intrusive investigations at the time of investigation. The advice may also be limited by budget constraints imposed by others or by site accessibility.

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

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

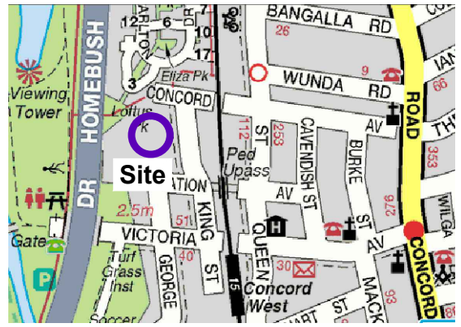
The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk.

Douglas Partners Pty Ltd

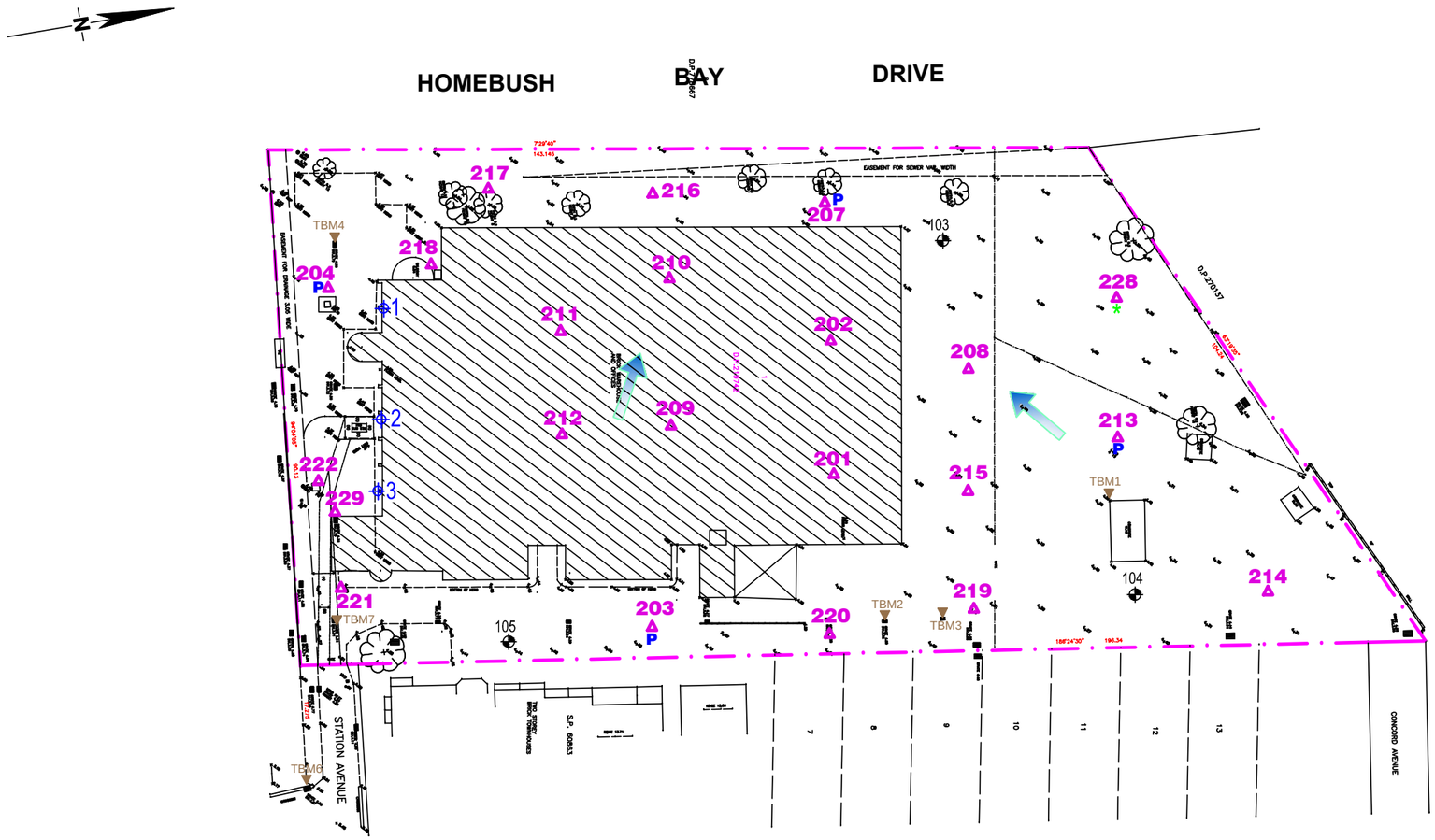
Appendix A

Drawing 1

& Development Plans



Locality Plan



LEGEND

- PREVIOUS TEST BORE LOCATION (1990)
- TEST BORE LOCATION
- TEST BORE LOCATION
- * HAND AUGER ONLY AT TEST BORE 228
- INFERRED GROUNDWATER FLOW DIRECTION
- TEMPORARY BENCH MARK (TBM)
- P PIEZOMETER INSTALLED AT TEST BORE LOCATION

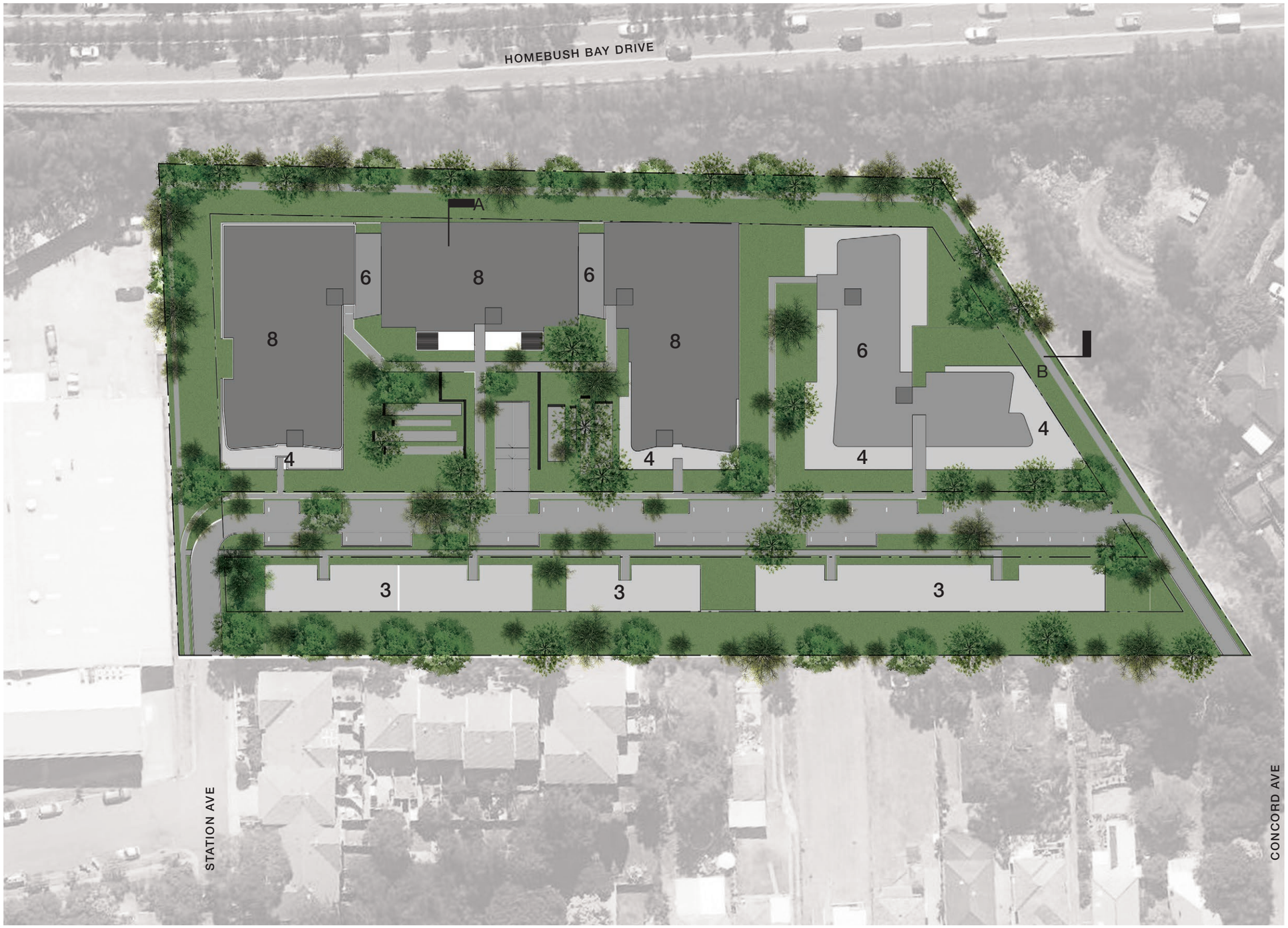
0 10 20 30 40 50 75 100m

1:1000 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: F.T.D. Holdings (Concord West) Pty Ltd & Floridana Pty Ltd		TITLE: **Location of Test Bores and Site Features**	PROJECT No: 84964.02
OFFICE: Sydney	DRAWN BY: PSCH	**Acid Sulphate Soil Management Plan**	DRAWING No: 1
SCALE: 1:1000 @ A3	DATE: 15.1.2016	**7 Concord Avenue, CONCORD WEST**	REVISION: 0

P:\84964.02 - Concord West, RAP & ASSMP\7.0 Drawings\7.2 Out\84964.02-1ASSMP.dwg, 8/02/2016 2:52:15 PM



Numbers Indicate Building Storeys

ANTONIADES ARCHITECTS
Suite 1, L2, 24 Bay Street, Double Bay NSW 2028
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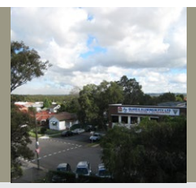
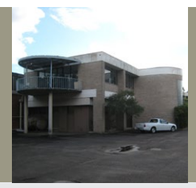
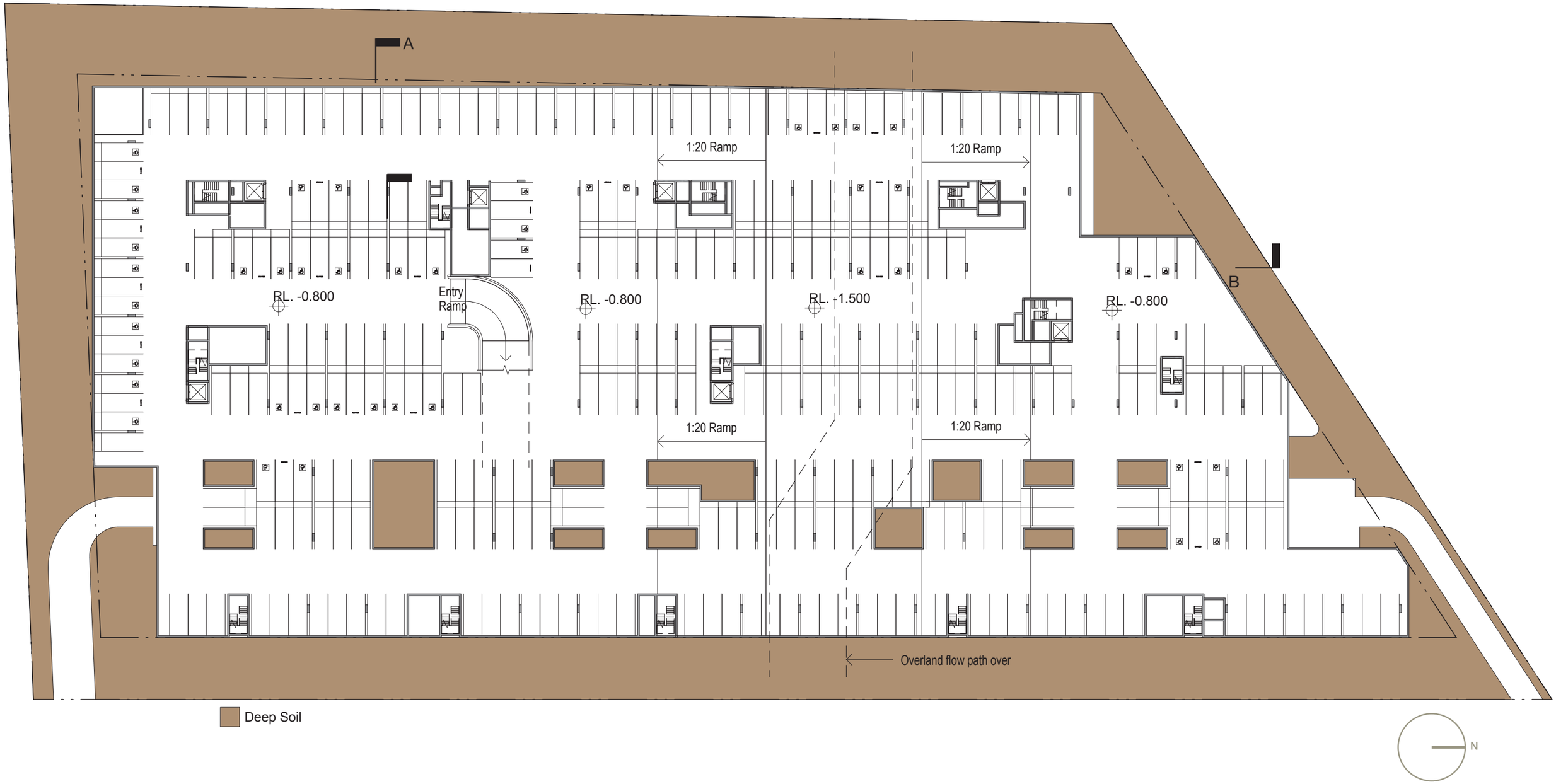




7 CONCORD AVE, CONCORD WEST
PLANNING PROPOSAL
November 2015

SITE PLAN



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BASEMENT PLAN

BICYCLE PATH

A

RL. 2.500

RL. 2.500

BUILDING 1

RL. 2.300

RL. 2.500

OVERLAND
FLOW PATH
UNDER

RL. 2.500

BUILDING 2

B

CENTRAL
COURTYARD

RL. 2.300

RL. 2.300

VISITOR PARKING

VISITOR PARKING

RL. 2.200

VISITOR PARKING

OVERLAND
FLOW PATH
UNDER

BUILDING 3

1 Bed
1 Bed +
2 Bed
2 Bed +
3 Bed
Studio

N

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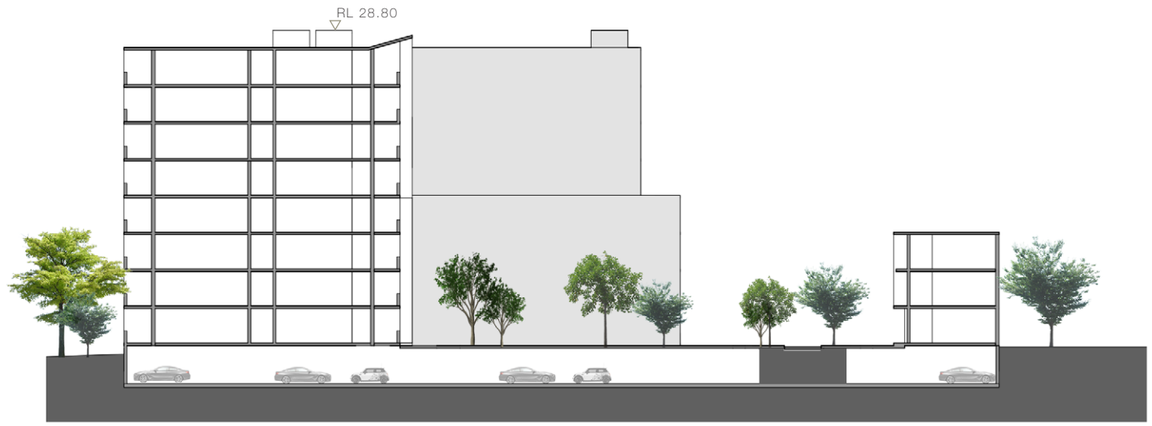
PLANNING PROPOSAL

November 2015

GROUND FLOOR PLAN



SECTION A

SECTION B

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7 CONCORD AVE, CONCORD WEST
PLANNING PROPOSAL

November 2015

SECTIONS

Appendix B

Previous Test Bore Logs

& Notes About This Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Soil Descriptions

Douglas Partners

Description and Classification Methods

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

Soil Types

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

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

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

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

The proportions of secondary constituents of soils are described as:

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

Definitions of grading terms used are:

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

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Descriptions

Soil Origin

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

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

Transported soils may be further subdivided into:

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

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

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

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Degree of Fracturing

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

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

Rock Descriptions

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

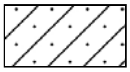
Soils


Topsoil

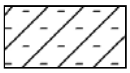

Peat


Clay

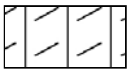

Silty clay

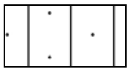

Sandy clay

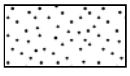

Gravelly clay

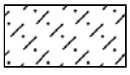

Shaly clay

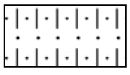

Silt


Clayey silt


Sandy silt

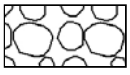

Sand

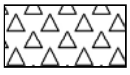

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

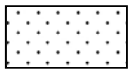

Talus

Sedimentary Rocks

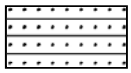

Boulder conglomerate

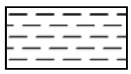

Conglomerate


Conglomeratic sandstone

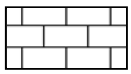

Sandstone


Siltstone


Laminite

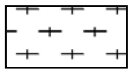

Mudstone, claystone, shale

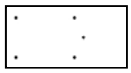

Coal


Limestone

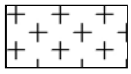
Metamorphic Rocks

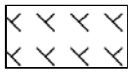

Slate, phyllite, schist

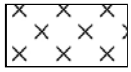

Gneiss

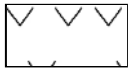

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Fred Hoskings Pty Ltd
PROJECT: Investigation For Future Development
LOCATION: Station Avenue, Concord West

SURFACE LEVEL: 4.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 45146
DATE: 18 Sep 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.3	FILLING - well compacted, brown and grey gravelly sand filling with some clay, humid							A			
		FILLING - variably compacted, red, yellow brown, grey gravelly clay filling with some ironstone gravel and timber pieces at 1.0-1.3m depth, damp							A			
	1.3	PEATY CLAY - soft, black peaty clay, moist							S			12,6,3 N = 9
	1.9	SILTY CLAY - stiff to very stiff, light grey mottled orange silty clay, moist							A			
									S			2,4,7 N = 11
									S			5,8,10 N = 18
		- saturated from 4.3m				▼			S			3,8,7 N = 15
	4.9	SHALE - extremely low strength, grey mottled orange shale						Note: Unless otherwise stated, rock is fractured along rough ironstained planar bedding planes or joints dipping 0°- 10°	S			16/130mm refusal
	5.95	SHALE - extremely low to very low strength, extremely to highly weathered, grey brown shale						5.95-7.6m: extremely to highly weathered, obscuring discontinuities	C	100	0	
	7.6	SHALE - low to medium strength, moderately to slightly weathered, highly fractured to fractured, grey brown shale						7.72m: B0°- 5°, 10mm clay 7.78m: J85° smooth 8.04m: J30° smooth 8.4m: J30°	C	100	41	PL(A) = 0.3MPa PL(A) = 0.3MPa
	9.0	Bore discontinued at 9.0m						8.85-8.95m: fragmented				

RIG: Multi-Access Rig **DRILLER:** Traccess **LOGGED:** Boyd/Islam **CASING:** HQ to 6.0m

TYPE OF BORING: Solid flight auger (100mm) to 5.95m; NMLC-Coring to 9.0m

WATER OBSERVATIONS: Free groundwater observed at 4.3m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: GRB
Date: 16/10/07

Douglas Partners
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BOREHOLE LOG

CLIENT: Fred Hoskings Pty Ltd
PROJECT: Investigation For Future Development
LOCATION: Station Avenue, Concord West

SURFACE LEVEL: 4.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 45146
DATE: 18 Sep 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
4.3	0.4	FILLING - well compacted, brown and grey recycled concrete, gravel and sand filling, humid							A			
	0.8	FILLING - poorly compacted, red brown mottled grey gravelly clay filling with some concrete fragments, humid							A*			
	1	SILTY CLAY - stiff to very stiff, light grey mottled orange and red slightly sandy silty clay, humid							S			2,4,6 N = 10
	2								S			6,10,12 N = 22
	3											
1	3.2	SHALE - extremely low to very low strength, grey mottled orange shale						Note: Unless otherwise stated, rock is fractured along rough, ironstained planar bedding planes or joints dipping 0°- 10°	S			12,20,5/20mm *refusal*
0	4.3	SHALE - medium strength, fresh stained, fractured, grey brown shale with some sandstone laminae						4.3-5.19m: B0° ironstained & clay veneer 5.1m: J25° 5.35m: J25° 5.6m: J40° 5.77m: J20° 5.8m: J20° 5.9m: J45° 6.1m: J20° 6.16-6.56m: J70°- 90°	C	100	77	PL(A) = 0.8MPa PL(A) = 0.7MPa
-3	6.6	SHALE - high strength, fresh, slightly fractured, dark grey shale						6.56m: J30° smooth 6.68-6.85m: J80° 7.26m: J75°				PL(A) = 1.4MPa
-4	7.5	Bore discontinued at 7.5m										

RIG: Multi-Access Rig **DRILLER:** Traccess **LOGGED:** Boyd/Islam **CASING:** HQ to 4.3m

TYPE OF BORING: Solid flight auger (100mm) to 4.3m; NMLC-Coring to 7.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Duplicate sample Z-180907 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: GRB
Date: 16/10/07

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BOREHOLE LOG

CLIENT: Fred Hoskings Pty Ltd
PROJECT: Investigation For Future Development
LOCATION: Station Avenue, Concord West

SURFACE LEVEL: 4.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 45146
DATE: 18 Sep 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.03	ASPHALTIC CONCRETE							A			
	0.3	FILLING - well compacted, dark grey slightly clayey, sandy gravel filling (roadbase). Gravel of slag with some ash, humid							A			
	1.0	FILLING - variably compacted, brown gravelly clay filling, with a trace of brick fragments, moist										
	1.5	SILTY CLAY - stiff, light grey slightly sandy silty clay with ironstone gravel, wet							S			2,5,7 N = 12
	2.0	GRAVELLY CLAY - soft, brown black gravelly clay, saturated (possibly peat layer)							A			
		SILTY CLAY - very stiff, light grey slightly sandy silty clay, moist										
									S			9,18,16 N = 34
								Note: Unless otherwise stated, rock is fractured along rough ironstained planar bedding planes or joints dipping 0°- 10°	S			7,9,9 N = 18
	3.9	SHALE - extremely low strength, grey mottled orange shale										
	4.15	SHALE- medium strength, moderately to slightly weathered, highly fractured to fractured, grey brown shale with some sandstone laminae						4.15-4.6m: B0° ironstained 4.67m: J25° healed 4.81m: J35° 5.34m: J40° 5.64m: J60° 6.04m: J35° 6.12-6.30m: J75°- 85° rough, irregular 6.33-6.50m: J25°- 35° with micro faults 6.76m: J45° 6.81m: J50° 6.92m: J85° 7.15m: J45° 7.43m: B0° 10mm clay	C	100	66	PL(A) = 0.5MPa PL(A) = 0.8MPa PL(A) = 1.4MPa
	6.5	SHALE - high strength, fresh, slightly fractured, grey shale with some sandstone laminae							C	100	100	
									C	100	98	PL(A) = 1.3MPa
	7.58	Bore discontinued at 7.58m										

RIG: Multi-Access Rig **DRILLER:** Traccess **LOGGED:** Boyd/Islam **CASING:** HQ to 4.4m

TYPE OF BORING: Solid flight auger (100mm) to 4.2m; NMLC-Coring to 7.58m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: GRB
Date: 16/10/07

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.52 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 45146A
DATE: 09 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	CONCRETE							
		FILLING - brown clay filling with some sand, silt and trace gravel		A	0.2		PID=2ppm		
					0.5				
	0.8	PEATY CLAY - soft, black peaty clay with trace gravel, moist							
	1.0	SILTY CLAY - soft, brown silty clay, with trace ironstone gravel, moist		A	1.0		PID<1ppm		
					1.5				
		- *saturated from 2.0m to 2.5m*						▼	
	2.5	SILTY CLAY - stiff to very stiff, mottled brown and grey silty clay, moist		A	2.5		PID=2ppm		
					2.8				
	3.0	Bore discontinued at 3.0m - target depth reached							

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.15m then 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: RV
Date: 15/10/07

Douglas Partners
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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.48 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 45146A
DATE: 09 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		CONCRETE							
	0.14	FILLING - brown sandy clay filling, with trace silt and gravel			0.2				
				A			PID<1ppm		
					0.5				
				A			PID=2ppm		
	1.0	Bore discontinued at 1.0m - refusal on concrete			1.0				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.14m then 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D.W
Date: 25/10/07

Douglas Partners
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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.42 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 45146A
DATE: 09 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.07	ASPHALTIC CONCRETE							Gatic cover; Concrete
	0.15	FILLING - brown and grey clayey gravel filling with some sand (roadbase)							
		FILLING - light brown silty clay filling, with trace gravel and brick pieces		A	0.2		PID<1ppm		Bentonite
					0.5				
	0.8	PEATY CLAY - soft, black peaty clay with trace rootlets, moist		A	0.8		PID=2ppm		
	1.0	SILTY CLAY - soft, grey silty clay with trace gravel, moist to wet		A	1.0		PID=3ppm	22-10-07	
	1.3	SILTY CLAY - stiff to very stiff, mottled red and grey silty clay with trace ironstone gravel, moist			1.3				
					1.5				Backfilled with gravel
				A*			PID<1ppm		
					2.0				
					2.5				Machine slotted PVC screen
				A			PID<1ppm		
					3.0				
									End cap
	4.3	Bore discontinued at 4.3m - refusal on weathered shale							

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.07m then 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.1m whilst augering. Groundwater measured at 1.16m bgl on 22/10/07

REMARKS: *BD1-091007 blind replicate 1.5-1.0m. ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.39 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 45146A
DATE: 09 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE							Gatic cover
		FILLING - brown gravelly sand filling with trace silty clay and concrete pieces (roadbase)		A	0.1		PID<1ppm		Concrete
	0.3	FILLING - mottled brown and grey clay filling, with trace gravel			0.3				
					0.5				Bentonite
				A			PID=3ppm	▼ 22-10-07	
	1.0	PEATY CLAY - soft, black peaty clay with trace of organic matter, moist		A	1.0		PID<1ppm		Backfilled with gravel
	1.2	SILTY CLAY - soft, grey silty clay, moist		A	1.2		PID=2ppm		
	1.4	SILTY CLAY - soft, grey silty clay with some shell fragments, wet to saturated		A	1.4 1.5		PID=2ppm		
									Machine slotted PVC screen
	1.9	SILTY CLAY - stiff to very stiff, brown and grey silty clay, with trace sand and gravel, moist		A	1.9		PID<1ppm		
					2.2				
	2.5	Bore discontinued at 2.5m - refusal on weathered shale							End cap

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.4m whilst augering. Groundwater measured at 0.76m bgl on 22/10/07

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D.W
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.28 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 207
PROJECT No: 45146A
DATE: 09 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - brown silty clay filling, with some gravel and trace sand and rootlets (grass surface)		A	0.0		PID<1ppm		Gatic cover; Concrete
				A	0.5		PID=1ppm		Bentonite
	1.0	FILLING - brown clay filling		A	1.0		PID<1ppm		Backfilled with gravel
	1.6	PEATY CLAY - soft, black peaty clay, moist			1.5				
	1.7	SILTY CLAY - stiff to very stiff, mottled red brown and grey silty clay, moist		A*	1.7		PID=1ppm	22-10-07	
					2.0				Machine slotted PVC screen
					3.0		- *insufficient soil from* auger to sample from depths of 3.0m & 4.0m		
	4.3	Bore discontinued at 4.3m - target depth reached							End cap

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering. Groundwater measured at 2.16m bgl on 22/10/07

REMARKS: *BD3-091007 blind replicate of 207/1.7-2.0m. ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials: DW
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.47 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 208
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - grey sandy gravel filling, with some concrete pieces, trace plastic and roots		A	0.0		PID=1ppm		
	0.2				0.1				
		FILLING - yellow brown sandy clay filling, with trace gravel		A	0.2		PID<1ppm		
					0.5				
				A			PID<1ppm		
					1.0				
	1.1	SILTY CLAY - soft, dark grey and brown silty clay, moist to wet			1.1			▼	
				A			PID=3ppm		
	1.6	Bore discontinued at 1.6m - target depth reached			1.6				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.1m whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.53 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 209
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	CONCRETE							
	0.2	FILLING - yellow sand filling			0.2				
		FILLING - brown grey clay filling, with trace sand and gravel		A			PID=1ppm		
		- slight hydrocarbon odour from 0.5m to 1.0m			0.5				
				A			PID=3ppm		
	1				1.0				1
	1.2	PEATY CLAY - soft, black peaty clay, moist			1.2				
		- slight odour of organic matter		A			PID=3ppm		
					1.5				
	1.7	SILTY CLAY - stiff to very stiff, mottled red and grey silty clay, moist			1.7				
				A			PID=2ppm		
	2 2.0	Bore discontinued at 2.0m			2.0				2
		- target depth reached							
	3								3
	4								4

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.15m then 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		⧗	Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.57 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 210
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		CONCRETE							
	0.16	FILLING - grey sandy clay filling, with trace gravel			0.2				
				A			PID=2ppm		
					0.7				
				A			PID<1ppm		
	1.2	Bore discontinued at 1.2m - refusal on ironstone probably in filling			1.2				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.16m then 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		⫧	Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.49 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 211
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.16	CONCRETE							
		FILLING - yellow sand filling		A	0.2		PID<1ppm		
	0.4				0.4				
		FILLING - brown grey clay filing, with trace sand and gravel			0.5				
				A			PID=2pm		
	1.3				1.0				
		PEATY CLAY - soft, black peaty clay, moist - slight odour of organic matter		A	1.3		PID=3ppm		
	1.7				1.5				
		SILTY CLAY - stiff to very stiff, red and grey silty clay		A	1.7		PID=2ppm		
	2.0	Bore discontinued at 2.0m - target depth reached			2.0				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.16m then 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D.W
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.57 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 212
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	CONCRETE							
		FILLING - yellow sand filling			0.2				
	0.35	FILLING - brown and grey clay filling, with some sand and gravel		A			PID=2ppm		
	0.5	FILLING - concrete rubble filling?			0.5		- no auger returns at 0.5m-0.7m		
	0.7	Bore discontinued at 0.7m - refusal on concrete rubble filling?							

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.15m then 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.22 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 213
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0				0.0				Gatic cover
		FILLING - grey sand filling, with some concrete fragments and trace gravel and wire		A			PID<1ppm		Concrete
	0.2	FILLING - grey and brown clay filling, with trace gravel			0.2				
				A			PID<1ppm		Bentonite
					0.5				Backfilled with gravel
	0.7	PEATY CLAY - soft, black peaty clay, moist to wet			0.7				
				A			PID=2ppm		
1					1.0				1
	1.1	SILTY CLAY - stiff to very stiff, red brown and grey silty clay, damp			1.1			22-10-07	
				A*			PID=2ppm		
					1.5				
				A			PID<1ppm		Machine slotted PVC screen
2					2.0				2
		- trace gravel from 2.6m to 2.7m							End cap
	2.7	SHALE - *extremely low to very low strength, grey brown* shale							
	2.9	Bore discontinued at 2.9m - refusal on weathered shale							
3									3
4									4

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering. Groundwater measured at 1.08m bgl on 22/10/07

REMARKS: *BD2-101007 blind replicate of 213/1.1-1.5m. ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: A.W
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.4 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 214
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - grey sand filling with some clay and concrete fragments, trace gravel and rootlets		A	0.0		PID=1ppm		
	0.2	FILLING - brown clay filling with trace gravel, sand and rootlets		A	0.2		PID<1ppm		
					0.5				
	0.8	PEATY CLAY - soft, black peaty clay - very slight organic matter odour		A	0.8		PID=2ppm		
	1.2	SILTY CLAY - stiff, grey silty clay, humid		A	1.0 1.2		PID=3ppm		
	1.5	Bore discontinued at 1.5m - target depth reached			1.5				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: DW
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.51 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 215
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - grey sand filling with some gravel, concrete fragments and trace clay			0.1				
		FILLING - grey sand filling, with some gravel and clay		A			PID=1ppm		
	0.3	FILLING - brown and grey clay filling, with trace sand			0.3				
					0.5				
				A			PID<1ppm		
					1.0				
	1.1	PEATY CLAY - soft, black peaty clay, moist			1.1				
	1.2			A	1.2		PID=1ppm		
		SILTY CLAY - stiff, grey and red silty clay, moist							
				A			PID<1ppm		
	1.7	Bore discontinued at 1.7m - target depth reached			1.7				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials: D.C
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.38 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 216
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - mottled orange brown and grey clay filling with trace of sand, fibre cement fragment, timber and rootlets		A	0.0		PID<1ppm A216/0.3m fibre cement sample from 0.3m		
	0.5	FILLING - grey clay filling, with trace of gravel		A	0.3		PID=3ppm		
	1.0	SILTY CLAY - soft, grey silty clay with trace gravel, sand and rootlets, moist (possibly filling)		A	0.5		PID=2ppm		
		- wet to saturated from 1.5m to 2.4m - organic matter odour from 1.5m to 2.0m		A	1.0		PID=3ppm	▼	
	2.4	SILTY CLAY - stiff, mottled red and grey silty clay, with trace of gravel		A	1.5		PID=1ppm		
	3.0	Bore discontinued at 3.0m - target depth reached		A	2.0		PID=2ppm		
					2.5				
					3.0				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.42 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 217
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - brown and grey clay filling, with some gravel and trace of sand		A	0.0		PID<1ppm		
				A	0.5		PID=2ppm		
	1.0	SILTY CLAY - moist, brown silty clay, with trace of gravel and sand		A	1.0		PID=3ppm		
		- wet at 1.8m			1.5			▼	
	2.0	SILTY CLAY - stiff, mottled red and grey silty clay, moist		A*	2.0		PID=4ppm		
	2.3	Bore discontinued at 2.3m - target depth reached			2.3				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.8m whilst augering

REMARKS: *BD3-101007 blind replicate of 217/2.0-2.3m. ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D. V
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.44 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 218
PROJECT No: 45146A
DATE: 10 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE							
		FILLING - mottled grey, brown and red clay filling with some sand, trace gravel and roots		A	0.1		PID=3ppm		
	0.25				0.2				
		FILLING - yellow brown sand filling, with some gravel and trace of clay			0.4				
				A			PID=3ppm		
	0.7				0.7				
		FILLING - brown clay filling, with trace gravel		A*			PID<1ppm		
1	1.0				1.0				1
		PEATY CLAY - soft, black peaty clay, moist		A			PID=2ppm		
	1.2				1.2				
		SILTY CLAY - soft, dark grey silty clay, moist			1.3				
				A			PID=2ppm		
					1.5				
	1.7								
		SILTY CLAY - stiff, mottled grey and brown silty clay, damp							
2					2.0				2
				A			PID=2ppm		
	2.2				2.2				
		Bore discontinued at 2.2m - target depth reached							
3									3
4									4

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD4-101007 blind replicate of 218/0.7-1.0m. ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: DW
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.42 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 219
PROJECT No: 45146A
DATE: 11 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	CONCRETE							
		FILLING - brown clay filling, with some gravel and trace sand		A	0.2		PID<1ppm		
	0.4	FILLING - mottled brown and grey clay filling, with trace of gravel			0.4				
				A	0.5		PID=2ppm		
	0.9	PEATY CLAY - soft, black peaty clay, moist - slight organic matter odour		A	0.9		PID=4ppm		
	1.1	SILTY CLAY - soft, grey silty clay, moist			1.1				
	1.2	SILTY CLAY - stiff, mottled grey and brown silty clay, with trace of gravel, moist			1.2				
				A			PID=2ppm	▼	
		- wet at 1.5m to 1.7m							
	1.7	Bore discontinued at 1.7m - target depth reached			1.7				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (120mm diameter) to 0.15 then 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.5m whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D. W
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.3 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 220
PROJECT No: 45146A
DATE: 11 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.17	CONCRETE							
4	0.3	FILLING - dark grey sand filling, with some clay and trace gravel		A	0.2		PID<1ppm		
		FILLING - mottled brown and grey clay filling, with trace gravel		A	0.3		PID<1ppm		
	0.6	PEATY CLAY - soft, black clay, moist - organic matter odour		A	0.5		PID=2ppm		
	0.8	SILTY CLAY - soft, brown and grey silty clay, moist			0.6				
	1	- wet at 1.0m to 1.3m		A	0.8		PID=1ppm	▼	1
3	1.3	SILTY CLAY - stiff, mottled red brown and grey clay, with trace ironstone gravel			1.3				
				A*	1.5		PID=1ppm		
	1.9	Bore discontinued at 1.9m - target depth reached			1.9				2
2	2								
	3								3
1									
	4								4
0									

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Concrete coring (150mm diameter) to 0.17 then100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.0m whilst augering

REMARKS: *BD1-111007 blind replicate of 220/1.5-1.9m. ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D. V
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.45 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 221
PROJECT No: 45146A
DATE: 11 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - brown silty sand filling with trace clay, gravel and rootlets (garden surface)			0.1				
		FILLING - brown gravelly sand filling with trace of silt, clay and timber		A			PID=2ppm		
					0.5				
		- strong hydrocarbon odour from 0.8m to 1.7m							
	1	- stained grey from 1.0m to 1.7m			1.0			▼	1
				A			PID=8ppm		
					1.2				
				A			PID=9ppm		
	1.7	Bore discontinued at 1.7m - refusal on unknown object			1.7				
	2								2
	3								3
	4								4

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.0m whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.43 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 222
PROJECT No: 45146A
DATE: 11 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE							
	0.15	FILLING - brown clayey sand, with trace of gravel							
		FILLING - brown, orange and grey clay filling, with some gravel and trace sand		A	0.2		PID=3ppm		
					0.5				
	0.8	FILLING - yellow sand filling, with trace clay		A	0.8		PID=2ppm		
	1.0	SILTY CLAY - soft, grey silty clay, moist		A*	1.0		PID=2ppm	▼	
		- wet at 1.2m to 1.3m							
	1.3	SILTY CLAY - stiff, mottled grey and brown clay, humid		A	1.3		PID=4ppm		
	1.5	Bore discontinued at 1.5m - target depth reached			1.5				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: 100mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.2m whilst augering

REMARKS: *BD2-111007 blind replicate of 222/1.0-1.3m. ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: N.V
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.47 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 228
PROJECT No: 45146A
DATE: 15 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - brown silty clay filling, with some sand and trace gravel, cobble sized rock pieces, metal pieces, tile fragments and bone		A	0.0		PID<1ppm		
	0.12	FILLING - mottled grey and yellow clay filling, with some rock fragments			0.1				
		Bore discontinued at 0.12m - refusal in filling							

RIG: Hand tools **DRILLER:** DW **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING: Hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ^Benchmark obtained from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 25/10/07

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BOREHOLE LOG

CLIENT: Fred Hosking Pty Ltd
PROJECT: Phase 1 and 2 Contamination Assessment
LOCATION: 7 Concord Avenue & 202-210 George Street Concord West

SURFACE LEVEL: 4.4 AHD^
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 229
PROJECT No: 45146A
DATE: 30 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE							
	0.15	FILLING - brown gravelly sand filling, with trace of clay (roadbase)							
		FILLING - mottled grey, black and brown clay filling, with trace of rootlets		A	0.2		PID<1ppm		
					0.5				
	0.6	FILLING - grey clayey sand filling		A	0.6		PID=2ppm	▼	
					1.0				
	1.1	FILLING - grey silty clay filling		A	1.1		PID<1ppm		
					1.5				
	1.7	FILLING - mottled grey and red-brown silty clay filling		A	1.7		PID=2ppm		
					2.0				
	2.6	SILTY CLAY - grey mottled brown silty clay, humid		A	2.6		PID=1ppm		
	2.9	Bore discontinued at 2.9m - refusal in shale			2.9				

RIG: Bobcat **DRILLER:** S Gregor **LOGGED:** DW **CASING:** Uncased

TYPE OF BORING:

WATER OBSERVATIONS: Free groundwater observed at 0.7m whilst augering

REMARKS: ^Benchmark obtained from survey plan provided by client
Important Note: Soil strengths were determined subjectively in the field and are not to be used for geotechnical purposes

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D.W
Date: 7/11/07

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