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Geotechnics / Environment / Groundwater

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Project 71015.37
23 July 2018
71015.37.R.002.Rev1
SCP:jlb

Attention: Wail Thomas

Email: wthomas@scentregroup.com

Dear Sir

Acid Sulphate Soil Management Plan
Warringah Mall Stage 2
145 Old Pittwater Road, Brookvale

1. Introduction

This report is an acid sulphate soil management plan (ASSMP) for the proposed Stage 2 redevelopment building works at the Warringah Mall Shopping Centre, Brookvale. The assessment was carried out in accordance with the Douglas Partners Pty Ltd (DP) proposal dated 13 October 2016 and was commissioned on 17 October 2016 by Scentre Design and Construction Pty Ltd.

Acid sulphate soils (ASS) comprise naturally occurring soils that produce sulphuric acid when they react with oxygen (which can also mobilise metals in soils). ASS includes potential acid sulphate soils (PASS), which have not fully reacted with oxygen and actual acid sulphate soils (AASS) that have been previously oxidised. 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, ASS tests undertaken, potential impacts, responsibility and operational requirements such as groundwater and surface water protection. Data from DP's previous investigations undertaken in 2013 have been incorporated in preparing the ASSMP.

This ASSMP applies for excavation into:

- Natural alluvial soils; or
- Filling derived from alluvial soils (i.e. excluding crushed sandstone or other engineered filling products e.g. roadbase, pavement materials, stabilised soils); and,
- Any excavation below the permanent groundwater table.

2. Site Identification and Proposed Development

Warringah Mall, at 145 Old Pittwater Road, is a large shopping mall complex at Brookvale, NSW, with significant frontages to Old Pittwater Road, Cross Street and Condamine Street (becoming Pittwater Road) to the south, north and east of the mall, respectively. Drawing 1, Appendix A shows a locality plan for Warringah Mall. The 'site' for the purpose of this report comprises the area of the Stage 2 redevelopment works, as shown in Drawing 1.

The proposed Stage 2 works include demolition of some structures, followed by the extension of existing buildings and construction of a new multi-storey shopping centre within the Stage 2 area, including the extension of the existing multi-storey car park up to Level 1M. The works will include:

- Some minor re-grading of existing site levels for new buildings and slab levels;
- Installation of new foundations for new or extended structures; and,
- Some local deeper excavation at the southern edge of the Stage 2 area, for an access road.

3. Previous Assessments

DP has previously conducted intrusive investigations at the site. Among other reports, the findings of the investigations have been reported in:

- DP, Report on Phase 2 Contamination Assessment, Proposed Stage 2 Warringah Mall Redevelopment, (Project 71015.18), December 2013; and,
- DP, Report on Preliminary Geotechnical and Hydrogeological Investigation, Proposed Stage 2 Warringah Mall Redevelopment, (Report 71015.37.001.Rev1), July 2018.

As noted in those reports, reference to the Sydney 1:100 000 Geology Series Sheet indicates that the site is largely underlain by alluvial and estuarine sediments and Hawkesbury Sandstone. Reference to the Sydney 1:100 000 Soils Landscape Series Sheet indicates that the site is largely within an area of 'disturbed' terrain, with some residual soils towards the southern part of the site. The investigations indicate conditions that are broadly consistent with the above mapping.

As noted by the previous investigations, reference to the Acid Sulphate Soil Risk mapping (digital data supplied by the NSW Department of Environment and Climate Change, based on published 1:25 000 Acid Sulphate Soil Risk Mapping, 1994-1998) indicates that the site is partly underlain by areas at "no known risk", while other areas, including much of the northern half of the Stage 2 area, are underlain by soil with "low probability of occurrence" of acid sulphate soil (ASS). This soil mapping is generally not expected to contain ASS materials, although localised occurrence may occur. An extract of the mapping is shown in Figure 1, with areas of "low probability of occurrence" shown in orange.

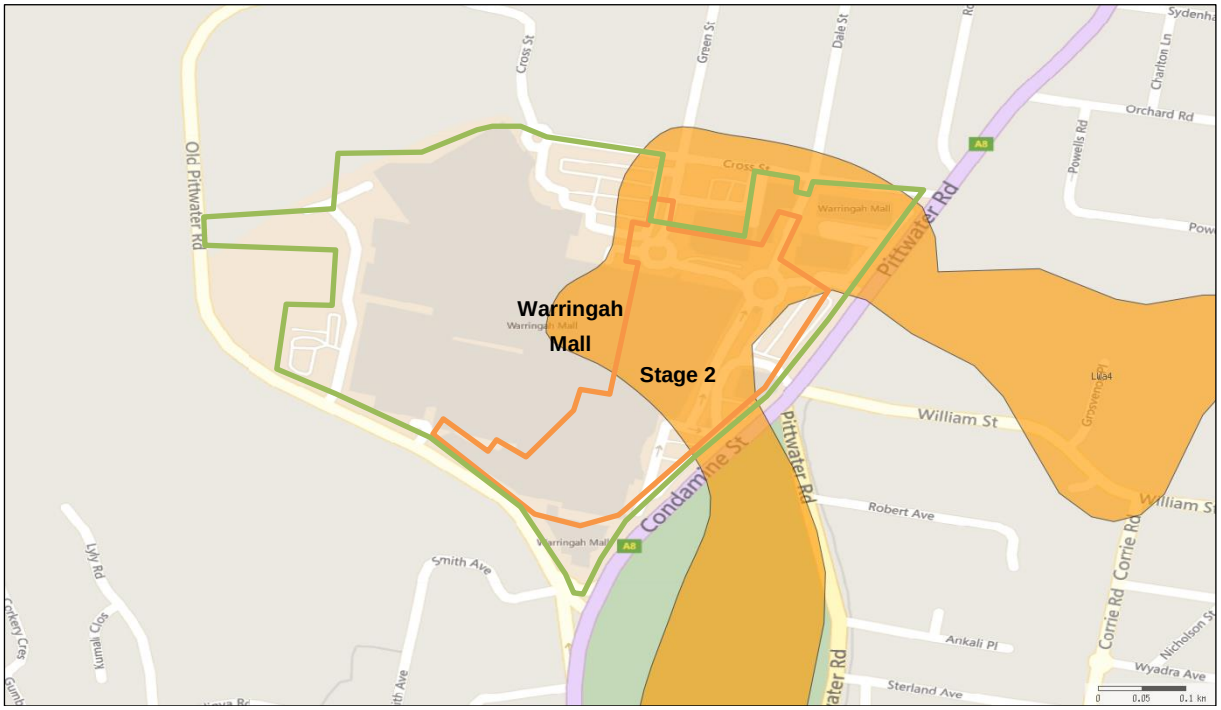


Figure 1: Extract of acid sulphate soil risk mapping at Warringah Mall

Test locations across the greater site from past investigations are shown in the attached Drawing 2.

The results of investigations to date indicate that ground conditions are variable within the Stage 2 area, including filling and residual soils overlying shallow sandstone in some areas and filling and deep alluvial and estuarine soils underlain by sandstone in other areas. The deep alluvial and estuarine soils tend to be associated with a paleochannel that runs from north-west to south-east across the site. Depths to sandstone of up to 30 m have been identified within the paleochannel.

At three locations in the Stage 2 area (marked in red in the attached Drawing 2), samples obtained during testing were subjected to field screening for acid sulphate soils indicators, and selected samples were issued for sPOCAS laboratory testing. The results are included in our report 71015.18 dated December 2013, as noted above, and a summary of the results of the screening and laboratory testing is attached in Table A1.

Based on the ASS field screening results and laboratory test results in the Stage 2 area, it has been assessed that:

- PASS is present below the water table within the site;
- Some natural soils above the water table could be PASS, although not to the same degree as that identified below the water table; and,
- Near surface filling such as ripped/crushed sandstone is not considered to be PASS, although it may have acidic properties. It is noted, however, that Warringah Mall is within an area of highly disturbed terrain and that pockets of filling may have been sourced locally from areas of acid

sulphate soils. Therefore filling, other than near-surface filling materials such as crushed sandstone and roadbase, are considered to be possible PASS, particularly filling close to the groundwater table.

Past groundwater assessment and modelling has indicated that groundwater flow is generally toward the old alignment of Brookvale Creek (shown in the attached Drawing 1) and the nearby culvert alignment. Groundwater is inferred to flow:

- to the west or south-west at the northern part of the site; and,
- to the north or north-east at the southern end of the site.

4. Guidelines

This ASSMP is devised on the basis of the following guidelines endorsed by NSW Government Planning and Infrastructure and industry standards:

- Stone T, Ahern CR and Blunden B, "Acid Sulfate Soils Manual 1998", Acid Sulfate Soils Management Advistory Committee (ASSMAC), Wollongbar, NSW, August 1998.
- Dear SE, Moore NG, Dobos SK, Watling KM and Ahern CR, "Soil Management Guidelines", in "Queensland Acid Sulfate Soil Technical Manual", Department of Natural Resources and Mines, Indooroopilly, Queensland, 2002.
- Ahern CR, McElnea AE and Sullivan LA, "Acid Sulfate Soils Laboratory Methods Guidelines" in "Queensland Acid Sulfate Soils Manual 2004", Department of Natural Resources, Mines and Energy Indooroopilly, June 2004.
- Dear SE, Ahern CR and Moore NG, "Acid Sulfate Soil Management Plans for Queensland", in "Acid Sulfate Soils: Environmental Issues, Assessment and Management, Technical Papers", Brisbane, June 2000.

5. Proposed Development and Potential for Disturbance of ASS

A summary of the proposed works that have the potential to disturb or impact upon ASS is provided in Table 1, on the following page.

Table 1: Works with Potential to Impact on ASS

Nature of Works	Potential Impact
Limited excavation of soils for: - re-grading of the Stage 2 area for new slabs and access roads - installation of new below-ground services	Excavations are likely to be limited and above the permanent groundwater level, and are not generally expected to disturb ASS. They may, however, potentially locally encounter ASS in natural soils (if filling is not deep), or in filling materials (if natural soils have been re-used in filling).
Piles for the building structure	Spoil returns (if any) from piling may contain a mixture of ASS and non-ASS soils.
Shallow foundations for the building structures	Local excavations for shallow foundations may potentially encounter ASS where alluvial or estuarine soils overlie shallow rock, or in filling as mentioned above.
Local, deep excavation at the southern limit of Stage 2, largely in an area of existing higher ground.	Excavations are likely to be largely within residual soil and rock, above the permanent groundwater table, and are not generally expected to disturb ASS. Possible local, limited interception of ASS towards the base of the excavation where the excavation area extends to areas underlain by alluvial soils, or in filling as mentioned above.

6. Proposed Investigation

Given that the past, preliminary acid sulphate soil investigation was targeted at the separate culvert works at the site, it is suggested that sampling be undertaken from seven additional test bores in the Stage 2 area to provide coverage of the site in accordance with ASSMAC (1998) once the specific work methods and excavation depths are known. This additional sampling would meet the minimum number of sampling locations (10 boreholes for a site of approximately 5 ha in area).

The additional test locations would allow the extent and nature of the ASS at the site to be better known. This ASSMP may need to be updated based on the findings of the additional investigation.

It may also be prudent to conduct additional targeted sampling in any areas of planned significant disturbance (by volume), to better define the soil types and depths to which this ASSMP will apply.

7. ASS Management Options

ASSMAC (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 for the works, care must be taken to minimise impacts on the local environment.

7.1 Non-Excavation or Minimal Earthworks

Non-excavation or minimisation of invasive earthworks is the principal recommended management 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 is too much risk of contaminating groundwater or run-off.

Given the nature of the proposed development, the non-excavation of soil is likely to be a limited management option and non-excavation of soil is unlikely to be a suitable standalone option for the site. The potential for minimising disturbance/excavation of ASS could be reviewed and implemented where possible.

7.2 Treatment: On-Site

This method of management involves the treatment of disturbed ASS by neutralising the acid producing potential. A 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 is generally straightforward and this option is feasible for most sites. The treated ASS would then need to be disposed to a suitably licensed landfill.

If an on-site treatment option is adopted, based on the likely limited disturbance of ASS on the site, it is likely that the soils can be treated in small volumes such as in lined skip bins.

Based on limited laboratory analysis to date, indicative liming rates of 1.5 to 19 kg CaCO3/tonne have been indicated for the Stage 2 area, although it is noted that liming rates of up to 43 kg CaCO3/tonne have been indicated by test results in the greater Warringah Mall site. Liming rates should be determined from the proposed investigation (Section 6) and by on site testing during excavation/construction.

7.3 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 licenced to undertake this activity by the EPA. It is foreseen that the treated ASS would then need to be disposed of to a suitably licenced landfill.

7.4 Reburial: On-Site (PASS Only)

This method of management involves the rapid replacement of PASS below the water table at a site before it undergoes any significant oxidation. This option is not generally suitable for actual acid sulphate soil (AASS). This needs to be carefully managed to minimise oxidation of the PASS during disturbance and impact on water quality where PASS is placed. Given the likely surplus of soils, and limited options for reburial, this option is unlikely to be practical on this site.

7.5 Reburial: Off-Site (PASS Only)

This method of management involves the disposal of PASS below the water table at an appropriately licenced landfill. PASS can be placed beneath the water table at an appropriately licenced 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. EPA Waste Classification Guidelines, November 2014 (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.

7.6 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 the proposed development this option is not likely to be adopted and has not been discussed further.

8. 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 the management, assessment and disposal of water leaching from ASS, surface water and water from groundwater dewatering.

8.1 Leachate and Surface Water Collection

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

Water from the ASS treatment/storage area (if treated on site) should be collected in lined drains/detention basins or in a tank. Any other water which may have come into contact with ASS should be collected in an on-site detention basin/tank.

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

8.2 Dewatering Management

Dewatering a site with ASS is a high environmental risk activity. The reduction of the groundwater table may expose sulphidic soil 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. Dewatering is not anticipated to be adopted for the Stage 2 works, and has not been discussed further.

8.3 Water Storage

All water which has potentially come into contact with ASS requires assessment (and if necessary treatment) for a number of the parameters including pH, total suspended solids (TSS), total and soluble iron, heavy metals and volatile organic compounds (VOCs) as a minimum, with potential additional testing based on signs of concern. Reference should also be made to our Report 71015.18, and the list may need to be expanded if other contaminants are identified in the groundwater. Monitoring frequencies and target thresholds can be provided following the proposed investigation (see Section 7).

8.4 Treatment

In general, site water will need to be subject to testing and probable treatment prior to disposal on or offsite.

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 may be adopted for the site to treat collected water prior to disposal. The treatment method(s) will depend on the water properties.

8.5 Disposal Options

On-site water disposal (e.g. by infiltration into the soil) may affect down-gradient receptors such as the freshwater Brookvale Creek. For such disposal, water would generally need to meet Australian and New Zealand Conservation Council (ANZECC), and Agriculture, and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian Water Quality Guidelines 2000* values for the protection of, as a minimum, 95% of freshwater aquatic species.

Water requiring off-site discharge should be disposed of in accordance with relevant guidelines and licenses. Consent for discharge should be obtained from the relevant authorities, where appropriate. The approval body for discharge into the stormwater system (at the time of preparing this report) is the Northern Beaches 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 (Northern Beaches 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 licensed liquid waste facility, although this is generally an expensive option.

Site water must be effectively treated and assessed to meet the discharge or disposal criteria, prior to discharge or disposal.

9. 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.

10. Reporting

10.1 Contractor Reporting Requirements

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

- Date;
- Volume of excavated material;
- Results of field and analytical testing and comparison to acceptance criteria;

- Neutralisation process undertaken;
- Liming material and rate utilised;
- Results of monitoring;
- Disposal location; and
- Tonnages of material treated/disposed and landfill dockets.

These records should be maintained and available at the completion of the works.

11. Conclusion

This ASSMP details the requirements to manage ASS during the proposed development works. Given that only limited sampling has been undertaken prior to preparation of this ASSMP, further investigation has been proposed to provide site coverage in accordance with ASSMAC (1998) and to better define the extent and nature of the identified PASS at the site. This ASSMP may need to be updated based on the results of the proposed investigation.

12. Limitations

Douglas Partners (DP) has prepared this report (or services) for this project at Brookvale in accordance with DP's proposal dated 13 October 2016 and acceptance received from Mr Wail Thomas dated 17 October 2016. This report is provided for the exclusive use of Scentre Design and Construction 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 results provided in the report are indicative of the sub-surface conditions 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. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during the previous investigation. 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, and by subsequent works. 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. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the (geotechnical / environmental / groundwater) components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

Sally Peacock
Geotechnical Engineer/Associate

Paul Gorman
Principal

Attachments: About this Report
Drawings 1 and 2
Table A1

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

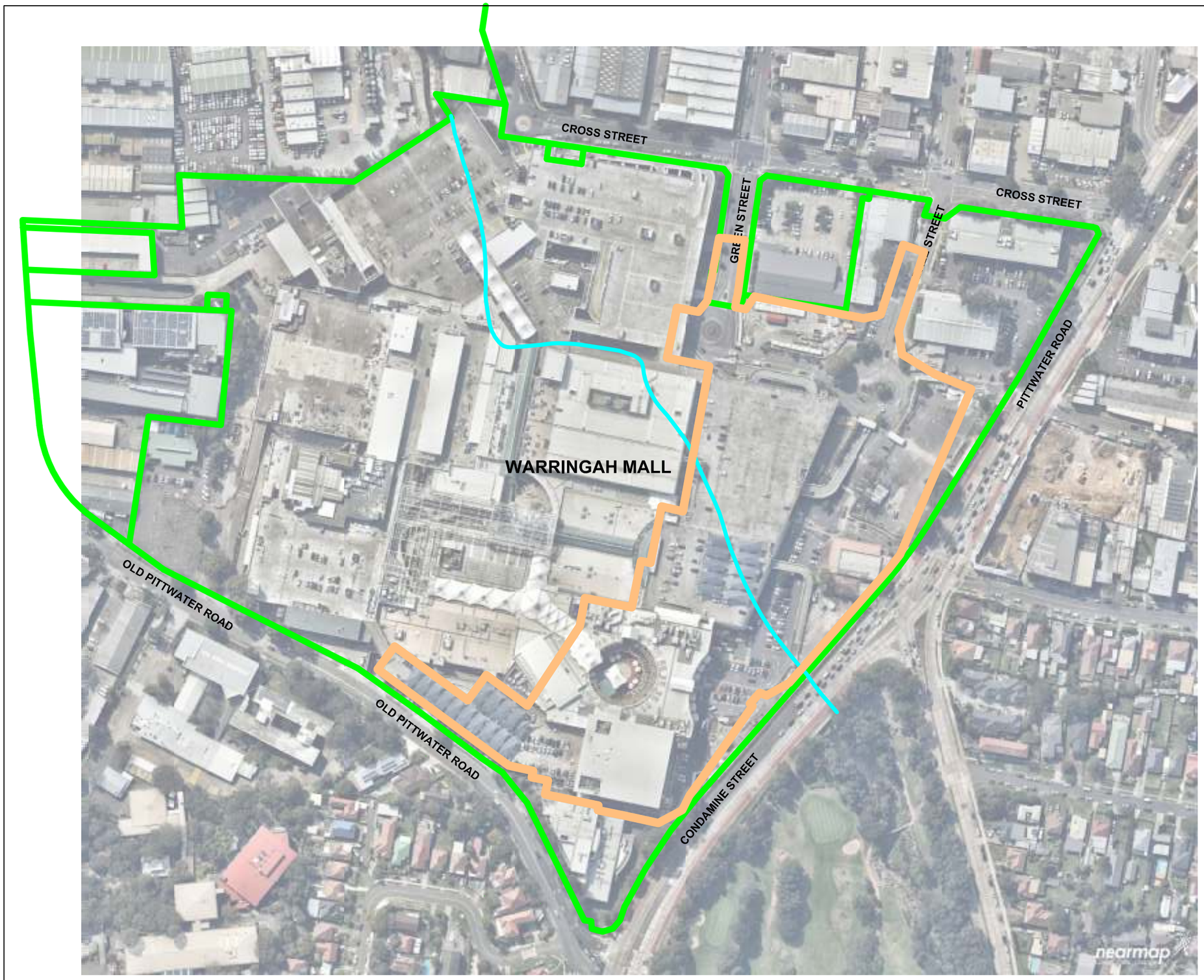
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later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



LEGEND

- Approximate Extent of Stage 2 Works
- Approximate Property Boundaries
- Approximate Pre-Development Brookvale Creek Alignment

Note: Base aerial Photograph from www.nearmap.com (dated 9/9/16, accessed 3/1/16)

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CLIENT: Scentre Design and Construction Pty Ltd		TITLE: **General Site Features**	PROJECT No: 71015.37
OFFICE: Sydney	DRAWN BY: SCP	**Proposed Stage 2**	DRAWING No: 1
SCALE: 1:2500	DATE: 03.11.2016	**Warringah Mall, Brookvale**	REVISION: A

N
MGA

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Scentre Design and Construction Pty Ltd		TITLE: **Test Location Plan**	PROJECT No: 71015.37
OFFICE: Sydney	DRAWN BY: SCP	**Proposed Stage 2**	DRAWING No: 2
SCALE: 1:2000	DATE: 03.11.2016	**Warringah Mall, Brookvale**	REVISION: A

MGA

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Table A1: Summary of Results for Acid Sulphate Soils Testing in Stage 2 Area

Sample Location	Depth (m)	Soil Description (see logs for full description)	Screening Tests			sPOCAS Laboratory Results										
			pH_F	pH_{FOX}	Strength of Reaction (1,2,3,4; F)*	pH_{KCl}	pH_{Ox}	TAA (moles H^+/t)	TSA (moles H^+/t)	TPA (moles H^+/t)	a-S_{NAS} (moles H^+/t)	a-ANC_E (moles H^+/t)	a-Net Acidity (moles H^+/t)	S_{KCl} (%w/w S)	S_{POS} (%w/w S)	S_P (%w/w S)
740	0.4-0.5	Clay filling, trace silt, sand & gravel	7.1	4.6	1	-	-	-	-	-	-	-	-	-	-	-
	0.9-1.0	Sand filling, some gravel, trace brick, terracotta, glass	6.5	4.3	1	-	-	-	-	-	-	-	-	-	-	-
	1.4-1.5	Sand and clay filling (possibly reworked natural)	6.4	4.0	1	-	-	-	-	-	-	-	-	-	-	-
	1.9-2.0	Clayey sand, moist	10.7	10.7	2-3F	-	-	-	-	-	-	-	-	-	-	-
	2.4-2.5		11.2	10.3	2-3F	-	-	-	-	-	-	-	-	-	-	-
	2.9-3.0		10.0	7.0	2-3F	-	-	-	-	-	-	-	-	-	-	-
	3.4-3.5		9.4	5.4	1	-	-	-	-	-	-	-	-	-	-	-
	3.9-4.0		9.2	6.8	1	-	-	-	-	-	-	-	-	-	-	-
	4.4-4.5	Clayey sand, saturated	8.8	3.8	2-3F	-	-	-	-	-	-	-	-	-	-	-
	4.9-5.0	Clayey sand, saturated, very slight hydrocarbon odour	8.4	2.9	1	3.9	4.3	25	<5	17	<5	<0.05	**25**	0.02	<0.005	0.02
	5.4-5.5		7.9	3.1	2-3F	-	-	-	-	-	-	-	-	-	-	-
	5.9-6.0		7.8	3.0	2-3F	-	-	-	-	-	-	-	-	-	-	-
752	0.4-0.5	Sandy gravel filling (roadbase)	7.2	2.4	2-3F	-	-	-	-	-	-	-	-	-	-	-
	0.6-0.7	Clayey sand filling, trace rock fragments (ripped sandstone)	7.4	3.0	2-3F	-	-	-	-	-	-	-	-	-	-	-
	0.9-1.0	Clayey sand, moist	7.2	3.0	2-3F	-	-	-	-	-	-	-	-	-	-	-
	1.4-1.5	Sandy clay, moist	7.0	3.2	2-3F	4.1	4.5	5	32	37	6	<5	**19**	0.02	0.01	0.03
	1.9-2.0	Clayey sand , moist	6.6	6.9	1	-	-	-	-	-	-	-	-	-	-	-
	2.4-2.5		8.3	7.4	1	-	-	-	-	-	-	-	-	-	-	-
	2.9-3.0	Sandstone	8.1	6.2	1	-	-	-	-	-	-	-	-	-	-	-
763	0.4-0.5	Sandy gravel filling (roadbase)	6.7	4.2	1	-	-	-	-	-	-	-	-	-	-	-
	0.9-1.0		6.5	3.4	1-2	-	-	-	-	-	-	-	-	-	-	-
	1.4-1.5	Sand filling, trace clay and sandstone fragments	5.1	3.5	3-4	-	-	-	-	-	-	-	-	-	-	-
	1.9-2.0		5.4	3.6	3-4	-	-	-	-	-	-	-	-	-	-	-
	2.1-2.3	Sand filling, trace rock fragments	5.3	3.6	3-4	-	-	-	-	-	-	-	-	-	-	-
	2.4-2.5	Sand, trace silt (possible filling)	5.1	3.5	3	-	-	-	-	-	-	-	-	-	-	-
	2.9-3.0		5.2	3.6	1	-	-	-	-	-	-	-	-	-	-	-
	3.4-3.5	Sand, trace silt & clay, moist to wet	5.1	3.0	1	5.8	3.5	10	12	22	NT	<5	**27**	<0.005	0.03	0.03
	3.9-4.0		5.1	3.5	1	-	-	-	-	-	-	-	-	-	-	-
	4.4-4.5	Sand, some silt & clay, wet to saturated	10.0	9.0	3-4F	5.6	2.5	<5	590	600	NT	<5	**250**	0.01	0.4	0.41
	4.9-5.0	Sandy clay (probably with some peat), saturated	8.8	7.1	1	-	-	-	-	-	-	-	-	-	-	-
	5.4-5.5		8.6	5.5	1	-	-	-	-	-	-	-	-	-	-	-
	5.9-6.0		8.2	4.5	1	-	-	-	-	-	-	-	-	-	-	-

Notes:

pH_F	Field pH (pH of soil and deionised water solution)
pH_{FOX}	Field pH (pH of soil and hydrogen peroxide solution)
pH_{Ox}	pH of soil and hydrogen peroxide solution
pH_{KCl}	pH of solution of soil and KCl
*(1,2,3,4; F)	1 - denotes no or slight effervescence
	2 - denotes moderate effervescence
	3 - denotes vigorous effervescence
	4 - denotes very vigorous effervescence with gas evolution and heat
	F - denotes "frothy" reaction, indicative of organics

TAA	Total Actual Acidity
TSA	Total Sulphidic Acidity (TPA - TAA)
TPA	Total Potential Acidity
a-S_{NAS}	Retained Acidity
a-ANC_E	Acid Neutralising Capacity
S_{KCl}	KCl extractable sulfur
S_{POS}	Peroxide oxidisable sulfur
S_P	Peroxide oxidation sulfur
NT	Not tested
-	Not analysed / not applicable
BOLD	Exceedance of *Action Criteria* (a-Net Acidity of 18 moles H^+/tonne) for the disturbance of more than 1000 tonnes of material for all soil textures (ASSMAC)