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Project 85009.01
85009.01.R.002.Rev2
30 March 2017
LJH:jlb

Attention: Mr Matthew Lennartz

Email: matthewl@meriton.com.au

Dear Sirs

Summary of Geotechnical Conditions
Pagewood Part II – Due Diligence
128, 130-150 Bunnerong Road, Pagewood

1. Introduction

This report presents the results of a geotechnical desktop study of part of 128, 130-150 Bunnerong Road, Pagewood, referred to herein as Pagewood Part II (or "the site"), as shown on the attached Drawing 1. The site comprises the whole of Lot 1 in DP1187426 (Lot 2) and the northern portion of Lot 2 in DP118746 (Lot 1) and covers an area of approximately 8.95 hectares (ha).

Preparation of this report was commissioned by Mr Matthew Lennartz of Meriton via email on 11 January 2017 and undertaken in general accordance with Douglas Partners Pty Ltd (DP) standard conditions of engagement. It is understood that the report will be used for due diligence purposes and to support a rezoning application for mixed uses including residential (refer to proposed Masterplan layout shown on Drawing 1).

The objective of the geotechnical desktop study was to assess the likely geotechnical conditions at the site and to identify issues (based on reviewed information) that may be detrimental to the proposed development layout.

2. Site Description and Geology

The site is bound by Heffron Road to the north, Bunnerong Road to the east, Banks Avenue to the west and an internal road (Meriton Boulevard) to the south. At the time of preparing this report, the eastern portion of the site was occupied by commercial / industrial buildings and pavements and was being used for storage. The western portion was occupied by a large warehouse building and was being utilised for materials storage associated with the ongoing development of Pagewood Part I (refer attached Drawing 1).

Reference to the Sydney 1:100,000 Series Geological Sheet indicates that the site is underlain by Quaternary alluvial deposits, which typically comprise fine to medium grained "marine" sands with

podsols. Hawkesbury Sandstone, comprising medium to coarse grained quartz sandstone with minor shale and laminite lenses, underlies the site at depth.

The site is located over the Botany Sand Aquifer, a shallow unconfined to semi-confined groundwater system. The average saturated thickness of the Botany Sands Aquifer is 15 - 20 m. Hydraulic conductivity within the sand beds is highly variable and is typically around 20 m/day in clean sand.

3. Review of Previous Reports

Douglas Partners Pty Ltd (DP) has completed a number of environmental and contamination investigations across the site and the remainder of Lot 2 since 2011. The attached Drawing 3 (Project 71631.01) and Drawing 3 (Project 71631.02) show the previous CPT, bore and groundwater monitoring well locations.

The general sequence of subsurface materials encountered in the previous investigations is described below in increasing depth order:

FILLING:	Sand filling to typical depths of 1.0 m to 2.5 m, generally well compacted in the upper 1 m. In isolated locations the filling was as shallow as 0.3 m and as deep as 4.6 m.
SAND (alluvial)	Medium dense and medium dense to dense sand to depths of 5 – 7 m, becoming dense and very dense with occasional thin (<0.5m) clay and peat bands to depths of 21 – 38 m. The base of the alluvial sand unit was found to be up to 44 m in isolated locations.
CLAY & SAND: (residual)	Residual clayey sand and sandy clay of 0.4 – 2.0 m thick. In most locations no residual soil was encountered and in some isolated locations it was 4 – 8 m thick.
SANDSTONE:	Hawkesbury sandstone was encountered at depths of between 21 – 49 m depth.

Groundwater levels varied from a depth of 5.9 m to 7.8 m bgl or an RL of 14.2 m AHD to 16.6 m AHD. Based on these measured groundwater levels the inferred direction of groundwater flow is south to south west, i.e. towards Botany Bay and the groundwater extraction exclusion zone.

DP has also conducted numerous geotechnical investigations for multi-story tower developments across the Pagewood, Banksmeadow and Mascot areas, in which similar sub-surface soil and profiles have been encountered.

4. Conclusion and Recommendations

Based on our experience on the site and in nearby areas, the ground conditions at the site are considered likely to be similar to the surrounding areas (within Botany and Randwick Council) currently zoned as residential. Therefore from a geotechnical perspective, DP considers that site is suitable for rezoning to mixed uses including residential.

Excavations on-site are feasible, however, there is increasing difficulty in construction with increasing depth of excavation (and associated basement construction). Excavation will require relocation of

underground services, short and long-term retention support, excavation of material and possibly off-site disposal of excavated spoil if it is unsuitable or unable to be re-used elsewhere on-site.

Excavations up to 3 m depth are likely to be able to temporarily batter sidewalls during excavation works with permanent support provided by a cantilevered retaining wall (e.g. block wall or similar).

Excavations deeper than 3 m are likely to also require design consideration of the following items:

- Permanent Retaining Wall support – a continuous, secant pile wall constructed using a continuous flight auger (CFA) piling rig or a diaphragm wall is likely to be required to provide wall support during permanent retaining wall solution (Note: Continuous walls only appropriate above the groundwater level). Sheet piling may also be considered for shallower excavations but is likely to require additional ground anchor support and will not be suitable in any vibration sensitive areas or where surcharge loads require support. The size and depth of embedment of walls below the bulk excavation level will be required to be determined by the structural engineer.
- Ground Anchors – temporary ground anchors to support the retaining wall will be required until permanent support from the structure can be provided.
- Groundwater – excavation to below or near the groundwater level will need to carry out the following:
  - Obtain approval for temporary dewatering and construction from the relevant government department(s). Presently this approval includes the NSW Department of Primary Industries (Water).
  - Groundwater modeling of the effect of lowering the groundwater level on surrounding infrastructure.
  - Temporary dewatering of the groundwater level to allow construction.
  - Off-site disposal of groundwater (appropriate permission to dispose of this material to storm water or sewer will need to be obtained from the service provider).
  - Construction of a tanked (i.e. fully water-tight) basement
  - Allowance in the design for the ground slab to withstand the applied buoyancy forces. This generally includes ground anchors during construction to hold down the slab until the building has sufficient weight to counter the buoyancy forces.
  - Monitoring of groundwater levels in the area before and during construction.

Therefore, given the above, the preference would be to limit the depth of excavation on-site.

Additional geotechnical investigation and consultation will be required prior to preliminary and detailed design.

Reference should be made to DP Report 85009.01.R.001 regarding environmental/contamination comments on the proposed rezoning of the site.

5. Limitations

Douglas Partners (DP) has prepared this report (or services) for this project at Pagewood in accordance with DP's proposal dated 11 January 2017 and acceptance received from Mr Matthew

Lennartz dated 11 January 2017. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Meriton for this project only and for the purposes as described in the report. It should not be used for other projects 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 this 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. 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.

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

Yours faithfully
Douglas Partners Pty Ltd

Luke Jame-Hall
Geotechnical Engineer

Reviewed by

Michael J Thom
Principal

Gavin Boyd
Senior Associate

Attachments: About this Report
Drawing 1 Rev2
Drawing 3 (Project 71631.01)
Drawing 3 (Project 71631.02)

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.

PAGEWOOD PART I
(zoned for mixed use and under development)

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Meriton		TITLE: **Pagewood Part II - Due Diligence** **128, 130-150 Bunnerong Road, Pagewood**	PROJECT No:	85009.01
	OFFICE: Sydney	DRAWN BY: PG		DRAWING No:	1
	SCALE: As shown	DATE: Mar 2017		REVISION:	2

N

Banks Avenue

Westfield Drive

Heffron Road

Bunnerong Road

CPT1 MW8 BH8 BH15 BH7 BH16 BH23 CPT2 BH24 MW3A,B,C BH32 BH39 BH40 BH47 BH48 CPT4 BH41 BH54 BH1 BH38 BH46 BH49 BH55 BH6 BH9 BH14 BH17 MW4A,B,C BH25 BH30 MW5 BH2 BH26 BH29 BH34 BH37 BH42 BH45 BH50 BH56 BH5 BH10 BH13 BH18 BH21 BH53 BH3 BH4 BH11 BH12 BH19 BH20 BH27 BH28 MW6A,B,C BH36 CPT3 BH43 MW12 MW11 BH51 BH52

BH60 BH116 BH117 BH118 BH65 BH58 BH59 MW7A,B,C BH64 BH66 BH114 BH113 BH112 BH111 BH61 BH62 BH100 CPT9 BH85 MW15 MIXED USE ZONE BH96,96A BH97 BH98 MW16 INDUSTRIAL ZONE BH95 BH94 BH93 BH92 MW17 BH86 BH87 BH67 MW1A,B,C,D BH101 BH106 BH90 BH68 BH69 BH70 BH105 BH71 MW10 BH107 MW18A,B,C BH73 BH102 BH109 MW2A,B,C BH115 BH104 BH108 BH110 BH88 MW9 BH75 BH76 BH81 CPT8 MW13A,B,C BH80 BH83 BH77 BH79 MW14 CPT7 CPT6

0 10 20 30 40 60 80 100 150 200m

1:2000 @ A3

LEGEND

- Site Boundary
- Initial site boundary identified prior to fieldwork
- Borehole
- Groundwater Monitoring Wells (nested)
- Groundwater Monitoring Wells (shallow)
- Groundwater Monitoring Wells (long screen)
- Cone Penetration Tests (CPT)

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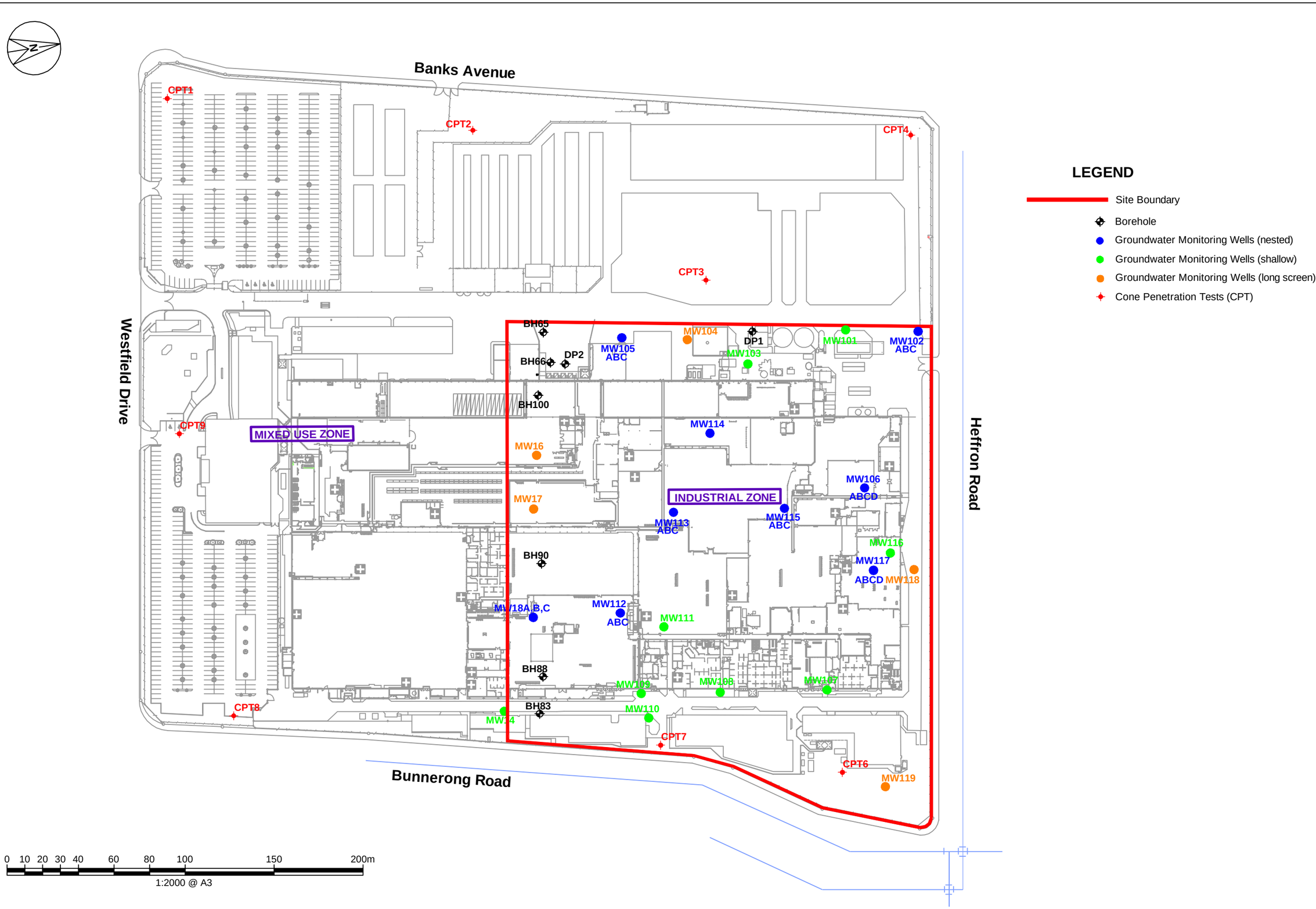
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: A		TITLE: **Phase 2 Sampling Locations**	PROJECT No: 71631.01
OFFICE: Sydney	DRAWN BY: PSCH	**Remediation Action Plan**	DRAWING No: 3
SCALE: As shown	DATE: MARCH 2012	**Part Lot 1 DP776089, Westfield Drive, Eastgardens**	REVISION: A



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: British American Tobacco Australia Ltd	TITLE: Test Bore Locations Phase 2 Contamination Assessment Part Lot 1 DP776089, Westfield Drive, Eastgardens	PROJECT No: 71631.02
	OFFICE: Sydney / DRAWN BY: PSCH		DRAWING No: 3
	SCALE: As shown / DATE: JULY 2012		REVISION: 0

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