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# Groundwater Assessment

Douglas Partners

86529.00.R.009.Rev1

29 May 2019

PMO

**Lendlease Building Pty Ltd  
300 Barangaroo Avenue  
BARANGAROO NSW 2000**

Attention: Mr Luke James

Dear Sirs

**Comments on Groundwater for Stage 2 SEARs  
Sydney Football Stadium Redevelopment  
Moore Park, NSW****1. Introduction**

This letter provides information and comments on groundwater conditions at the above site. The work was commissioned by Lendlease Building Pty Ltd as part of the application for Stage 2 of the redevelopment project.

Douglas Partners has recently undertaken detailed geotechnical and contamination investigations on the site which are outlined in the following reports:

- Report on Detailed Site Investigation (Contamination) (Ref. 86529.00.R.006)
- Report on Geotechnical Investigation (Ref. 86529.00.R.007)

Information from these investigation reports has been used in the preparation of this letter.

**2. Site Description**

The redevelopment site is located in the northern portion of the Moore Park precinct immediately to the south of Moore Park Road. It is bounded by sports administration buildings, the SCGT Member's Carpark (MP1) and recreation facilities to the west, Sydney Cricket Ground to the south, and the Fox Studios complex to the east.

Natural ground levels in the area slope downwards to the south-west. Surface levels vary from about RL 52 m AHD in the north-eastern corner of the site to RL 40 m AHD along the western boundary. The landform has been altered and retaining walls have been constructed in and around the site.

The location of the site is shown on Drawing G1 in Attachment B.

### 3. Regional Geology and Hydrogeology

The *Sydney 1:100 000 Geological Series Sheet* indicates that the site is close to a boundary between Quaternary-aged marine sands and Hawkesbury Sandstone. The marine sands are transgressive dunes that comprise fine to medium-grained sand with podsols. Hawkesbury Sandstone typically comprises medium to coarse-grained quartz sandstone with minor shale and laminite lenses. An extract from the geological map is shown in Figure 1.

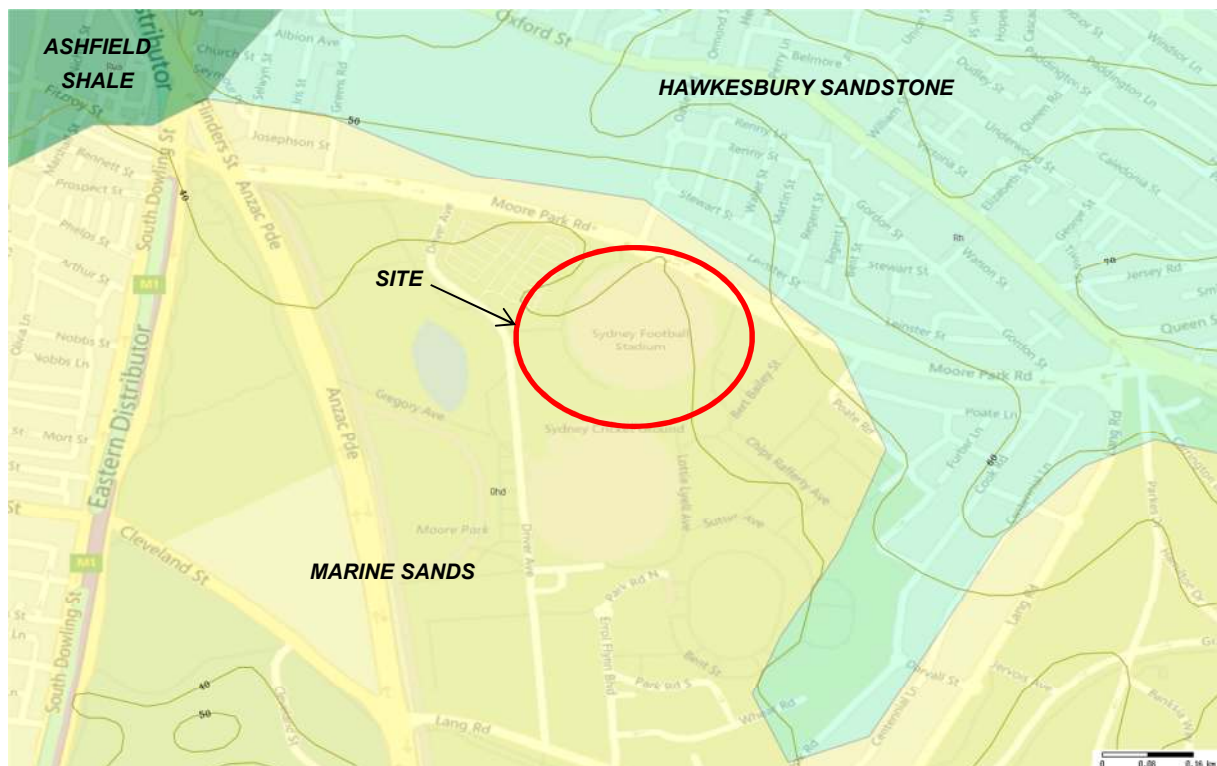


Figure 1: Extract from geological map with 10 m surface contours to AHD

The marine sands at Moore Park form the upstream end of the Botany Aquifer which is a considerable groundwater resource between Paddington and Botany Bay.

### 4. Geotechnical and Hydrogeological Model

The geotechnical model interpreted for the site can be described as follows:

- Filling of varying depth which was primarily sandy with sandstone gravel, cobbles and boulders (i.e. ripped sandstone). Some of this material may have been excavated from the north-eastern portion of the site and moved around to level the area during the original SFS development. Some inclusions of concrete, brick and tile were also observed within the filling;

- Natural sandy soils in the upper portion of the overburden. The sands varied from loose to very dense. The thickness of the sand layer generally increased towards the south-western portion of the redevelopment site;
- Natural clayey soils in the lower portion of the overburden apart from the north-eastern area where the sands were directly underlain by bedrock. The clays were typically sandy or silty, and firm to very stiff in strength. The thickness of the clay layer generally increased towards the south-western portion of the redevelopment site;
- Sandstone bedrock beneath the natural soils. The depth to rock beneath the existing stadium tends to increase towards the south-west, with what appears to be a deep infilled channel in the south-western corner of the site. Rock levels ranged from about RL 45 m AHD in the north-eastern corner to below RL 10 m AHD in the south-western corner. The rock is generally initially weathered, grading to low, medium and high strength with depth. Some bands/layers of weaker material are also present;
- The groundwater level varies across the site. It was measured at RL 40.9 m AHD in the north-eastern corner which is close to the bedrock surface. The measured groundwater level drops to RL 34.0 m AHD in the south-eastern corner and RL 33.0 m AHD in the south-western corner; both of these levels are within the natural sand profile.

This interpreted geotechnical model is shown on Drawing G102 (Interpreted Contours Showing Top of Rock) and on Drawings G103 to G106 (Sections A-A' to D-D') in Attachment B. Groundwater level contours based on recent observations are provided on Drawing GW1, also attached.

## 5. Proposed Development

The project involves the construction of a new stadium that will cover a slightly larger footprint than the existing stadium. The footprint will be extended westwards to accommodate the larger area, however the size of the new playing surface (i.e. grassed area) is similar to the existing facility. The design level of the field is RL 40.3 m AHD. The north-eastern area of the new stadium has its lowest slab level (L1) at RL 46.5 m AHD, dropping down to pitch level 50 m inside the Stage 1 SSDA Planning Envelope along the eastern side and 35 m along the northern side. This transition is shown on Drawings G102 and GW1 to allow comparison with rock and groundwater levels.

On the basis of this information, it is anticipated that the groundwater table will be at least 5 m beneath both the proposed field level and L1 at its shallowest point.

## 6. Comments in Relation to Stage 2 SEARs

The following comments are provided to address the Water and Natural Resources SEARs for the Stage 2 application. Due to the depth of groundwater on the site, and the fact that dewatering is not expected to be required, many of the SEARs are not relevant for the proposed development.

Our comments on the relevant SEARs are as follows:

- The background conditions for groundwater are shown on Drawing GW1. The levels are highest in the north-eastern portion of the site where sandstone bedrock is shallowest. The inferred groundwater flow direction is towards the south-west, and groundwater is likely to flow along the bedrock surface until the rock level drops and an aquifer within the overlying soils is formed. The groundwater contours are based on field observations within monitoring wells installed as part of the recent investigation.
- The playing surface of the former stadium is understood to have been irrigated using water pumped from a licenced bore located between the SFS and the SCG. This water is also used to irrigate the playing surface of the SCG. It is assumed that the new playing surface will be irrigated in a similar manner. There is unlikely to be any significant change to the groundwater extraction volumes as a result of the new development, and presumably the groundwater will be extracted in accordance with existing approvals.
- As the groundwater extraction volumes are expected to be similar to the former stadium, the new stadium is unlikely to have any new impacts on the groundwater system and other related water bodies (i.e. rivers, estuaries, waterways, wetlands, groundwater dependent ecosystems etc.).
- Dewatering during construction of the new facility and in the long term is unlikely to be required as the groundwater is 5 m or more beneath the new structures. A Dewatering Management Plan and extraction licence under the NSW Aquifer Interference Policy (2012) is therefore considered unnecessary. There should be no dewatering impacts on adjacent sites as dewatering is not proposed.

## 7. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for the proposed Sydney Football Stadium Redevelopment project at Moore Park, in accordance with DP's proposal dated 19 September 2018 and any subsequent changes in scope requested by Lendlease Building Pty Ltd. The report is provided for the use of Lendlease Building Pty Ltd for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic 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 limited by undetected variations in ground conditions between sampling locations.

This report must be read in conjunction with all of the attached notes 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 given 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 in Design Report.

Please contact the undersigned if further information is required.

Yours faithfully,  
**Douglas Partners Pty Ltd**



**Peter Oitmaa**  
Principal

Reviewed by



**Scott Easton**  
Principal

Attachments:      A: Notes About this Report  
                             B: Drawings

# 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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

## 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.

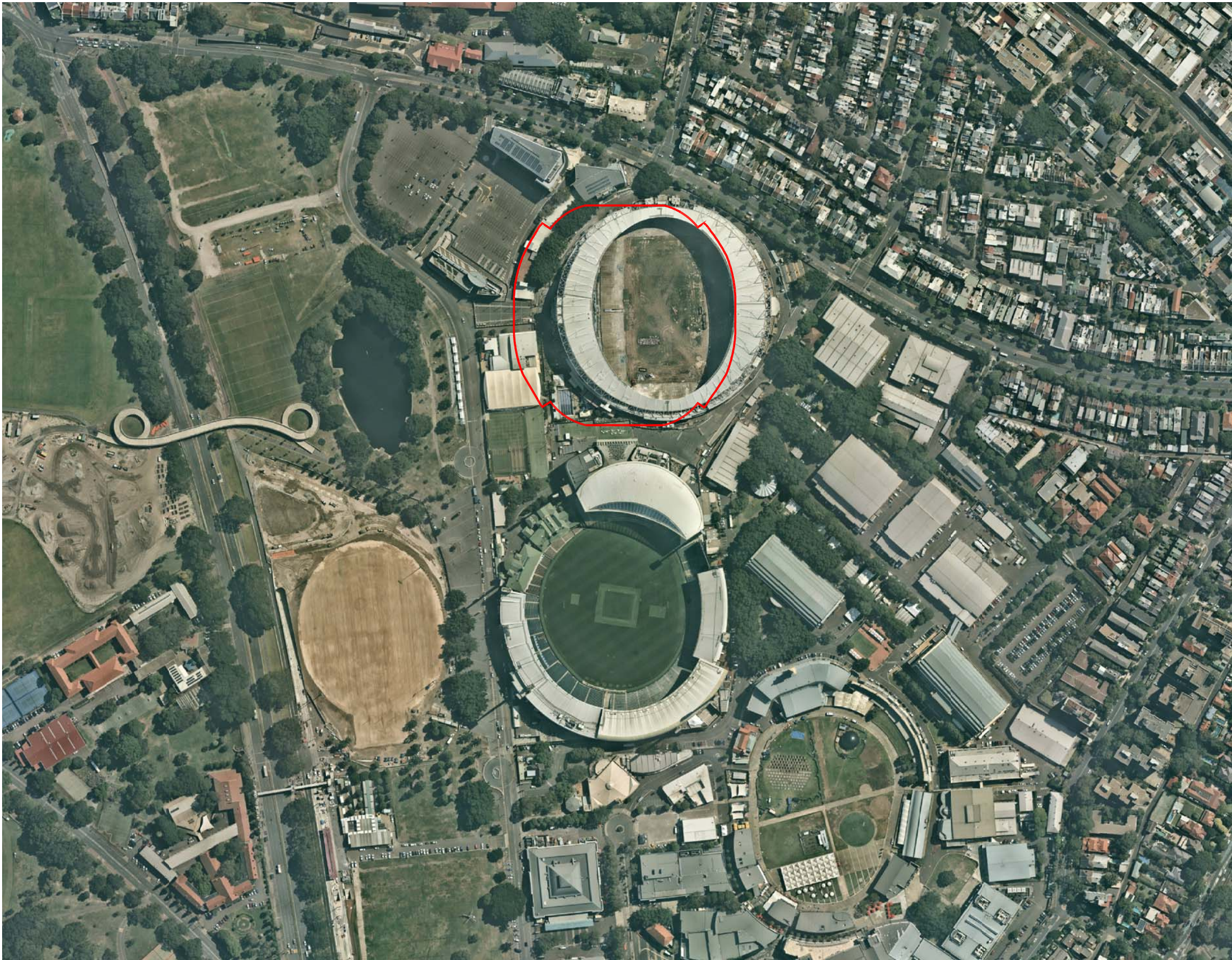
## **Information for Contractual Purposes**

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.

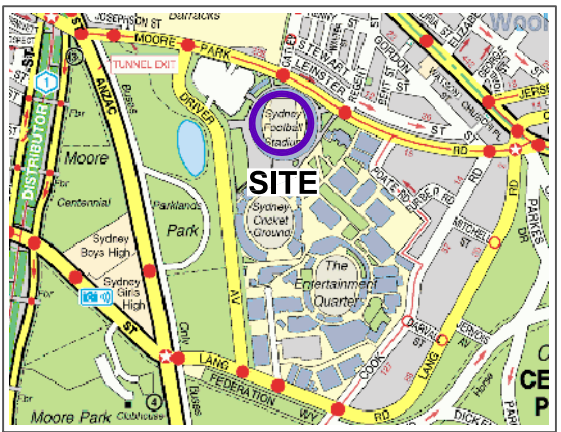
## **Site Inspection**

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.





0 20 40 60 80 100 150 200 300 400m  
1:4000 @ A3



Locality Plan

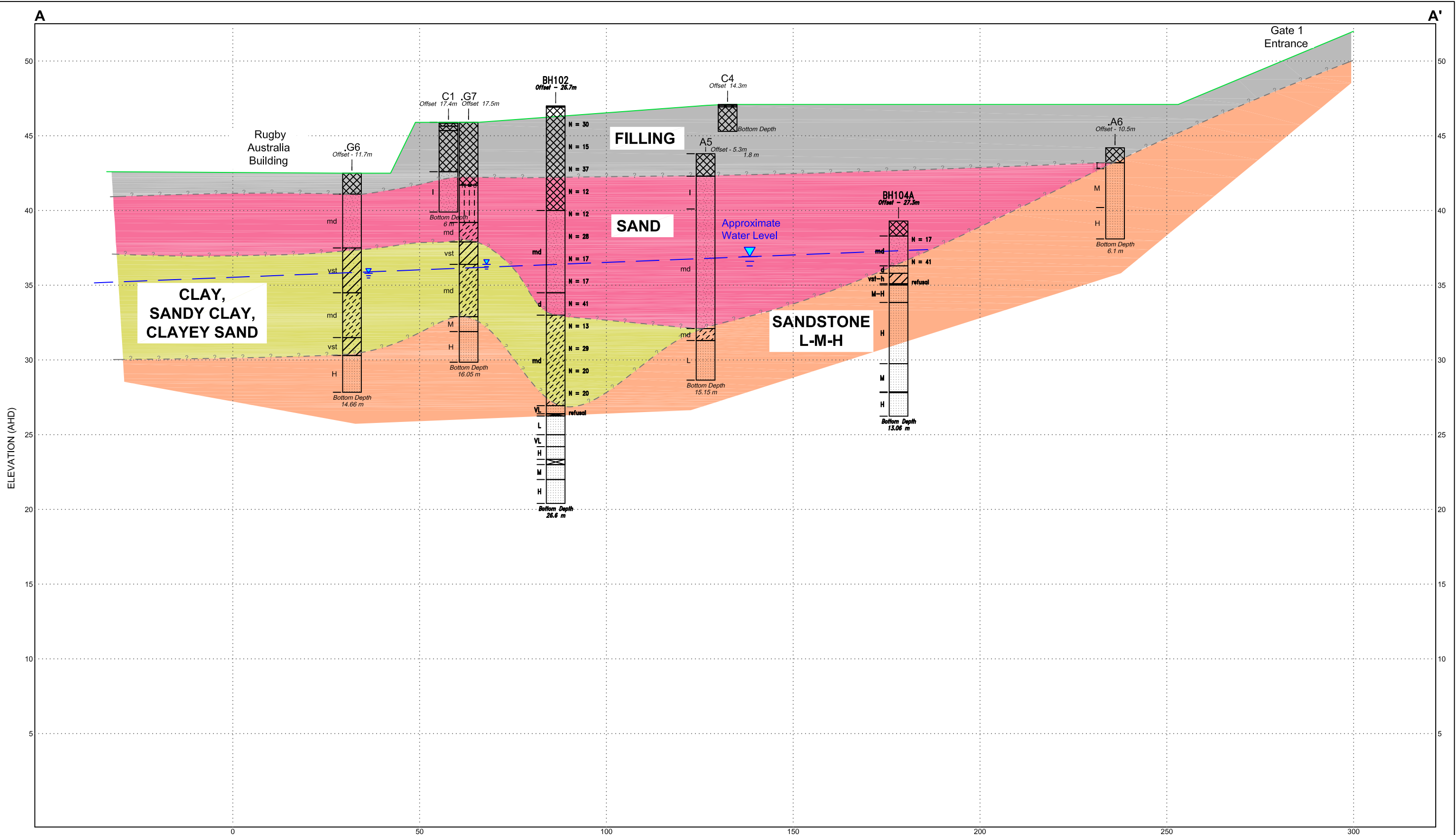
NOTE:  
1: Base image from Nearmap.com  
(Dated 4.3.2019)

 <b>Douglas Partners</b> <i>Geotechnics   Environment   Groundwater</i>	CLIENT: Lendlease Building Pty Ltd		TITLE: <b>Approximate Ground Floor Footprint Sydney Football Stadium Redevelopment MOORE PARK</b>		PROJECT No: 86529.00
	OFFICE: Sydney	DRAWN BY: PSCH			DRAWING No: G1
	SCALE: 1:4000 @ A3	DATE: 4.4.2019			REVISION: 0









**LEGEND**


**NOTE:**

- Subsurface conditions are accurate at borehole locations. Variations in subsurface conditions may occur between test locations.
- Interpreted strata boundaries are approximate and should be used as a guide only.
- Summary logs only. Should be read in conjunction with detailed logs.

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

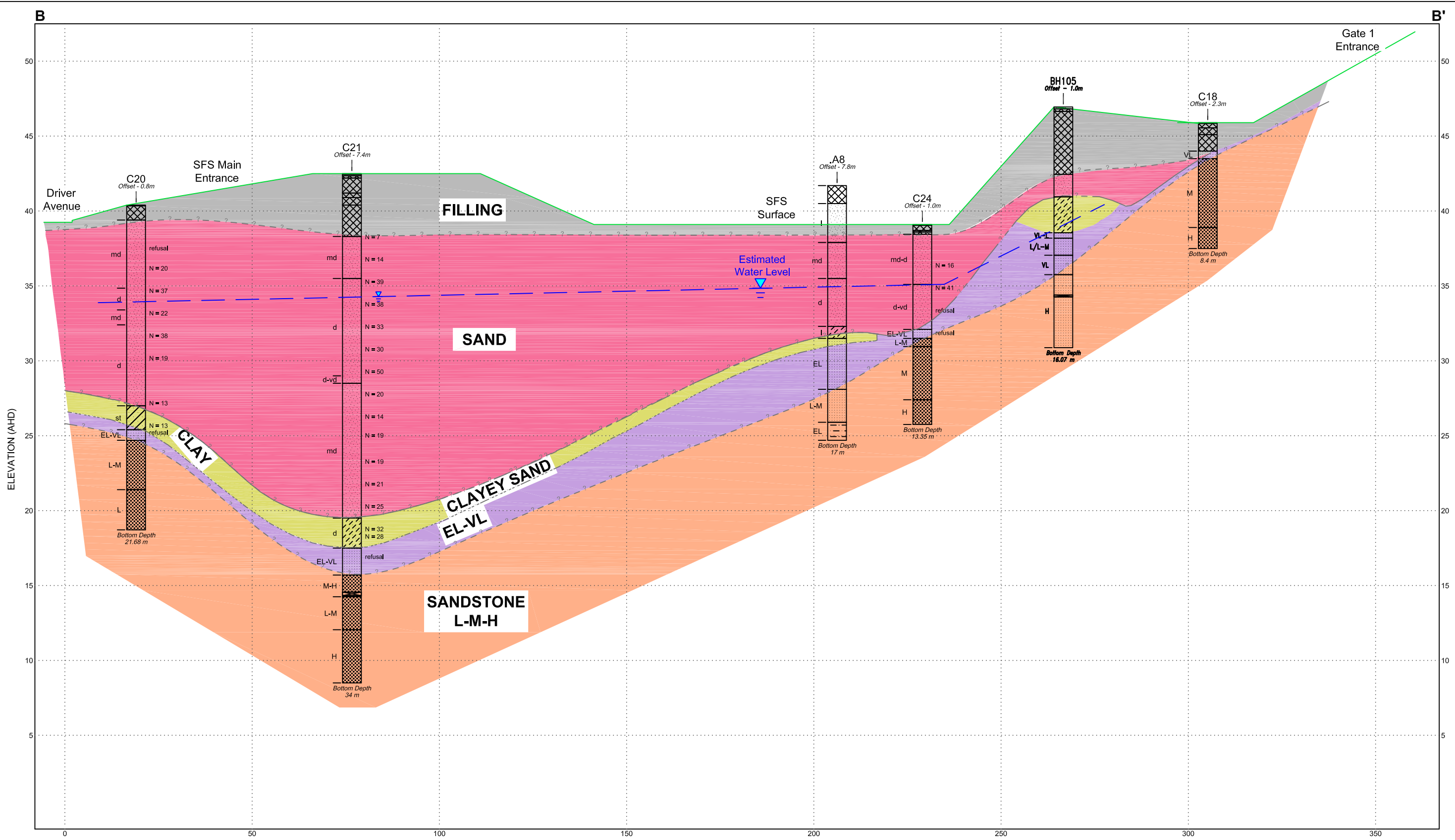
**SOIL CONSISTENCY**  
vs - very soft  
s - soft  
f - firm  
st - stiff  
vst - very stiff  
h - hard

**TESTS / OTHER**  
N - Standard penetration test value  
W - Water level  
- - - - - Inferred Geology

**Horizontal Scale (metres)**  
0 20

**Vertical Exaggeration = 4.0**

<b>Douglas Partners</b> Geotechnics   Environment   Groundwater	CLIENT: Lendlease Building Pty Ltd		TITLE: <b>Interpteted Geotechnical Cross Section A-A'</b> <b>Sydney Football Stadium Redevelopment</b> <b>MOORE PARK</b>	PROJECT No: 86529.00	
	OFFICE: Sydney	DRAWN BY: PSCH		DRAWING No: G103	
	SCALE: 1:1000 (H) 1:250 (V) @ A3	DATE: 4.4.2019		REVISION: 0	



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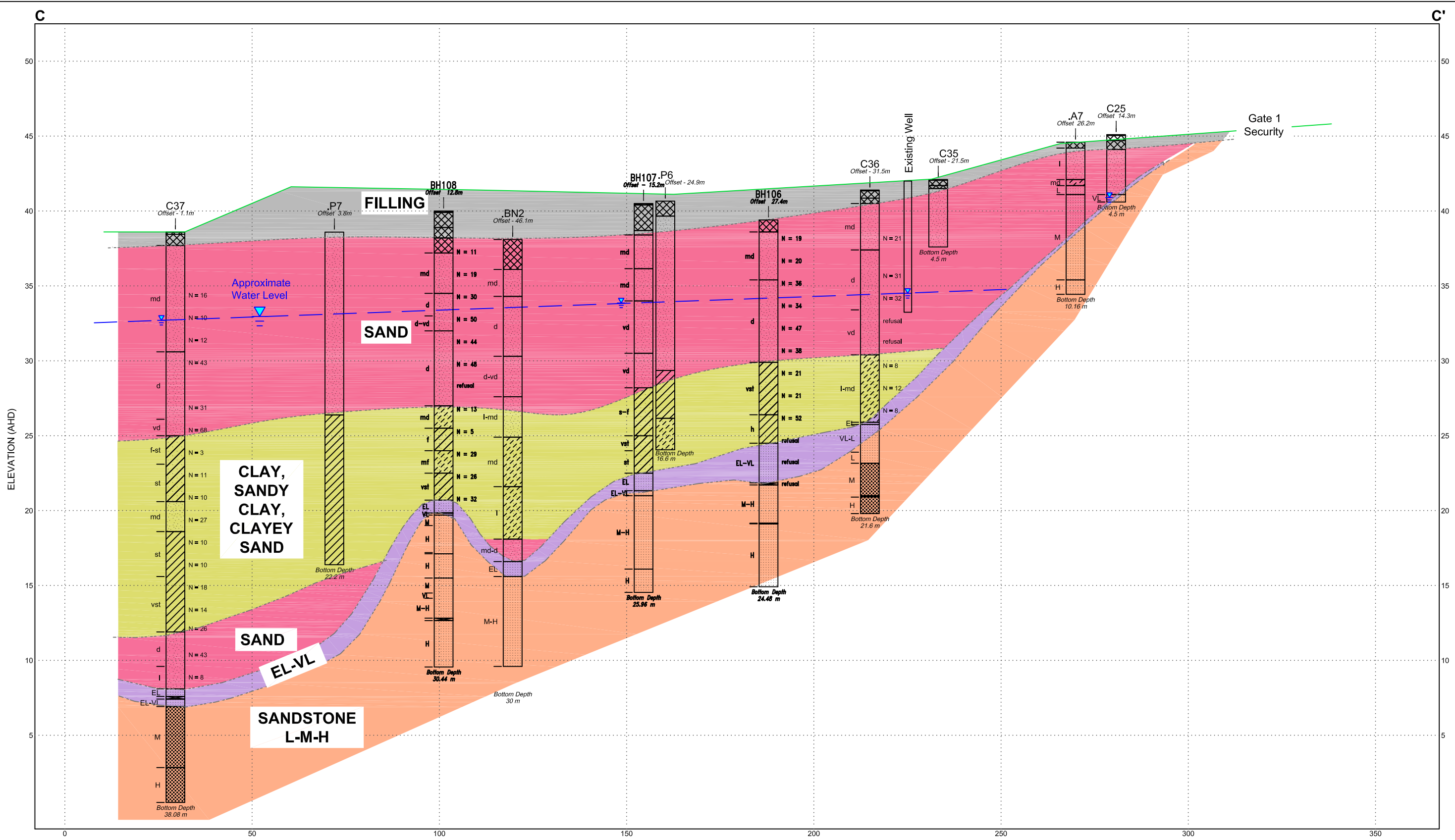
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WL - Water level  
- - - - - Inferred Geology

**SOIL CONSISTENCY**  
vl - very loose  
l - loose  
md - medium dense  
d - dense  
vd - very dense

0 20

Horizontal Scale (metres)

Vertical Exaggeration = 4.0



**LEGEND**

Core Loss	Clayey Silt	Sandstone	Silty Clay
Asphaltic Concrete	Concrete	Sandstone coarse grained	Silty Sand
Clay	Filling	Sandy Clay	
Clayey Sand	Sand	Siltstone	

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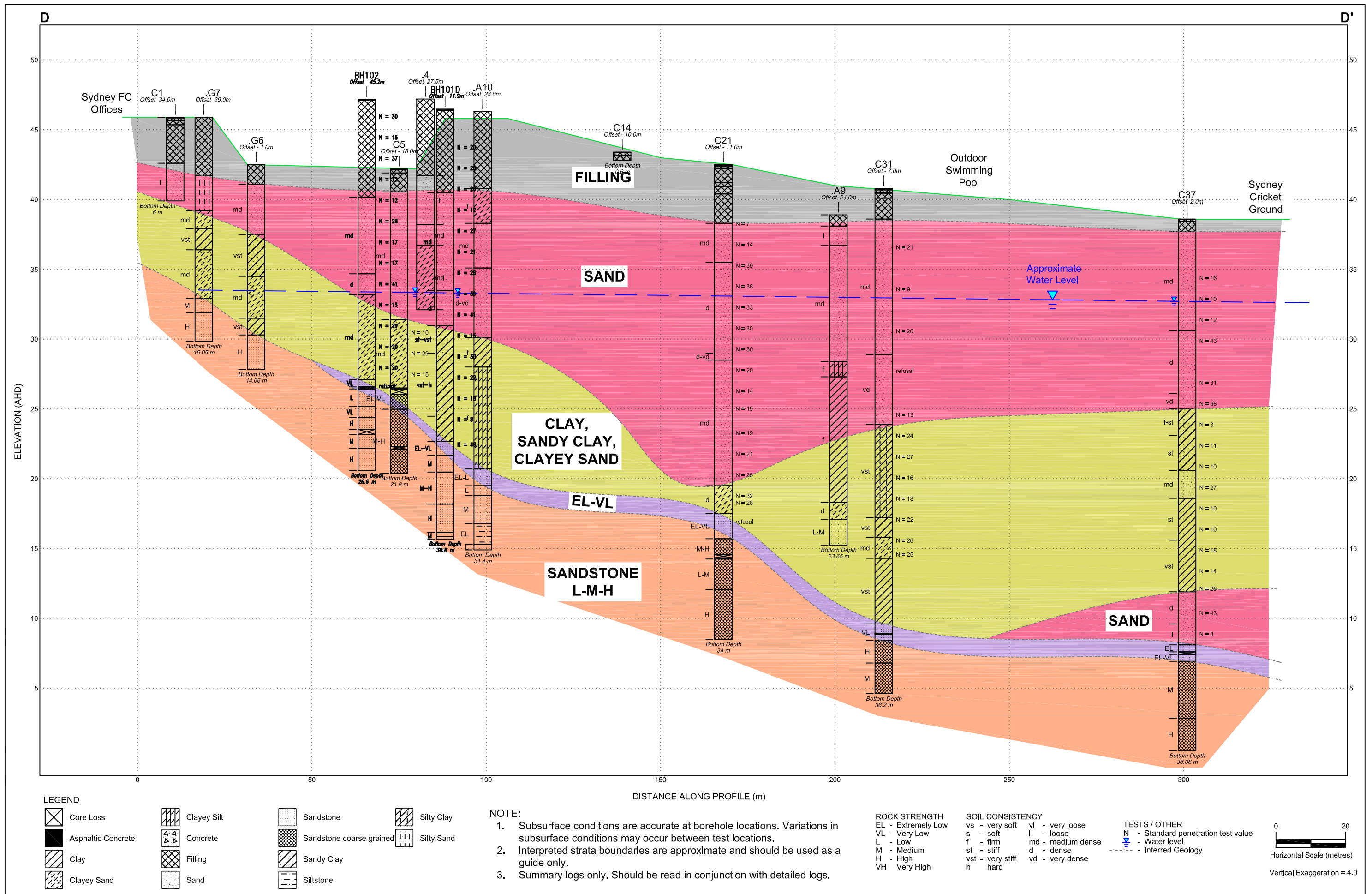
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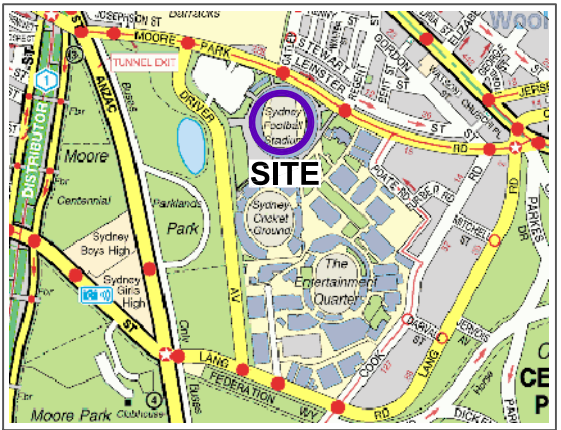
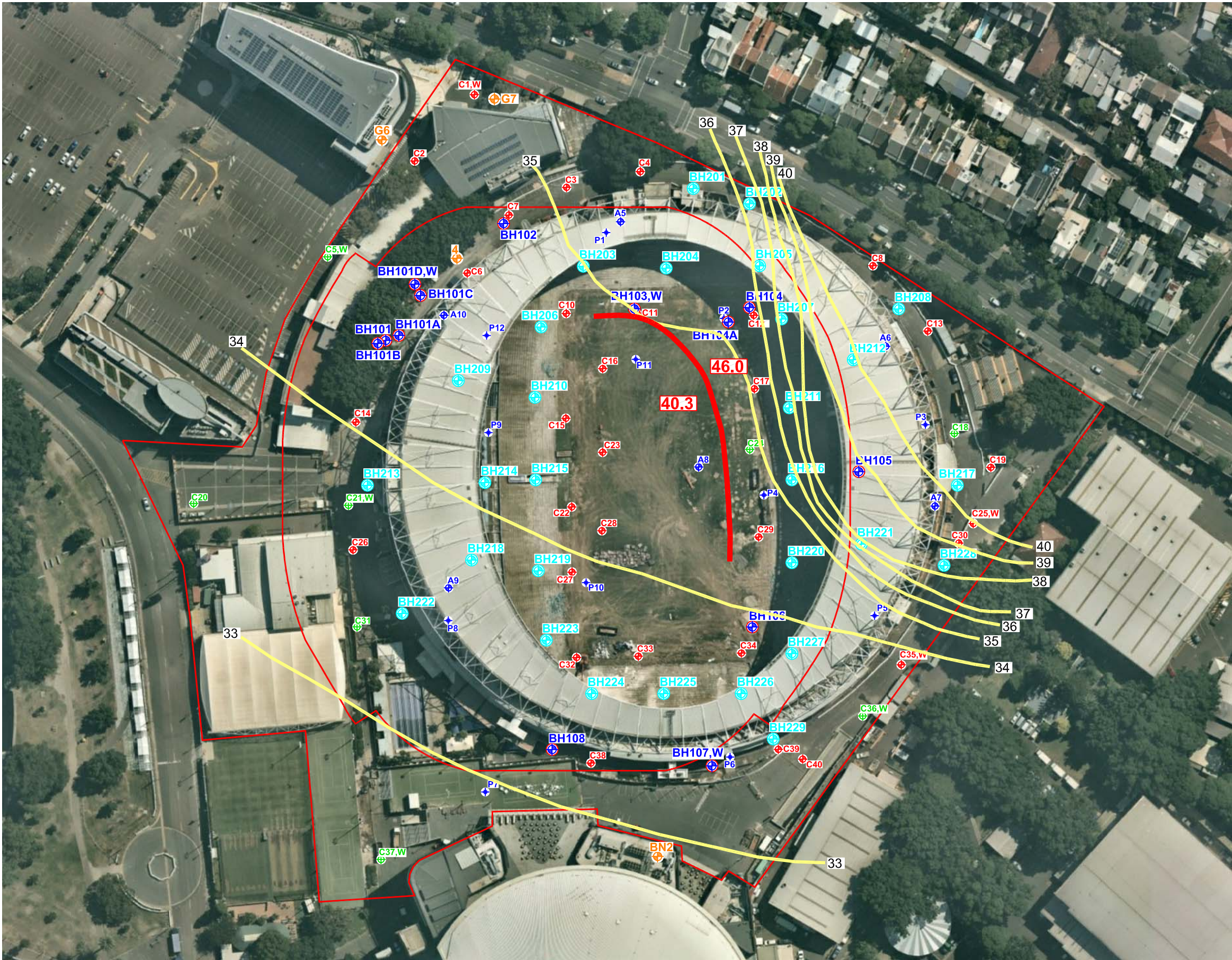
0 20  
Horizontal Scale (metres)

Vertical Exaggeration = 4.0









Locality Plan

NOTE:  
1: Base image from Nearmap.com  
(Dated 4.3.2019)  
2: Test locations are approximate only and are shown  
with reference to existing features.

LEGEND

- Geotechnical borehole (2018)
- Contamination borehole (2018)
- W Groundwater well
- Previous Borehole (Douglas Partners)
- Previous Borehole (Arup, 1985)
- Previous CPT (Arup, 1985)
- Geotechnical borehole (DP, 2019)
- Contamination borehole (DP, 2019)
- 34 Interpreted Groundwater RL (m, AHD)  
based on recent observations
- Lower level transition (approx.)  
RL (m, AHD)

