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Project 86043.01

30 July 2018

R.005.Rev0 SCP:cm

Frasers Property Ivanhoe Pty Ltd Level 2, 1C Homebush Bay Drive Rhodes NSW 2138

Attention: Mr Chris Koukoutaris

Email: Chris.Koukoutaris@frasersproperty.com.au

Dear Chris Koukoutaris

Groundwater Monitoring Proposed Residential Development Ivanhoe Estate, Macquarie Park

This letter provides a summary of groundwater monitoring results at Ivanhoe Estate for the period 14 November 2017 to 22 June 2018, and brief comments.

Douglas Partners Pty Ltd (DP) installed six groundwater monitors (data-loggers) in monitoring wells at Bores 01, 05, 07, 10, 12 and 13 in November 2017, during geotechnical investigations at the site. The bore locations are shown in the attached Drawing GW1, and reference should be made to DP Report 86043.01.R.001.Rev1 for the detailed methods and results of the geotechnical investigation, and details of standpipe construction. The standpipes were purged of groundwater prior to the installation of groundwater monitors.

During the monitoring period, the dataloggers were inspected on a regular basis for intermediate uploads and maintenance. The dataloggers were generally removed from the boreholes on 22 June 2018, except at Bore 05, where the datalogger was removed in early March 2018 due to demolition works in the area. Surface damage to the standpipe was also observed at Bore 01 during the site visit of March 2018, with more severe damage noted in June 2018.

The attached figures show the water levels at well locations from 14 November 2017 to 22 June 2018, together with daily rainfall measurements from the Bureau of Meteorology. Rainfall measurements are those measured at Macquarie Park (Willandra Village) from 1 November 2017 to 30 June 2018.

The results of groundwater levels are summarised in the following table.



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Bore	Ground Surface Level (RL)	Range of Groundwater Depths (m)	Range of Groundwater Levels (RL)	Typical Groundwater Levels (RL)	Comment
01	67.5	17.3 - 18.2	49.3 - 50.2	49.3 - 50.0	Outlier readings in June 2018
05	59.2	12.5 - 12.9	46.3 - 46.7	46.3 - 46.7	
07	59.1	13.2 - 13.9	45.2 - 45.8	45.2 - 45.8	
10	45.2	4.4 - 4.9	40.3 - 40.8	40.3 - 40.8	
12	45.2	3.3 - 4.3	40.8 - 41.8	40.8 - 41.2	Responsive to rainfall events
13	46.8	4.8 - 5.3	41.2 - 42.0	41.2 - 42.0	

Table 1: Summary of Groundwater Monitoring Measurements

The following comments are made with regards to the groundwater readings obtained at the site:

- Groundwater levels at the site generally fell slightly during the course of the monitoring period, with typical fluctuations of 0.5 m to 1.0 m.
- Groundwater levels generally showed no significant response to rainfall events, with the exception of groundwater levels at Bore 12.
- At Bore 01, unusual readings were obtained in June 2018 following rainfall. It is considered likely that this is due to the surficial damage observed at the standpipe, with dislodgement of the standpipe cover possibly resulting in surface water inflow to the standpipe.
- At Bore 12, elevated groundwater readings followed some rainfall events, with water levels rising by up to 0.6 m, then rapidly dissipating to more typical groundwater levels. The standpipe construction at this location includes a bentonite seal down to sandstone. Presuming that the seal has performed adequately, the cause of the elevated water levels may be due to local ground conditions (eg groundwater infiltration through joints or bedding planes in the sandstone) and its proximity to the creek and/or the adjacent stormwater drains.
- Reference to the borehole logs in DP Report 86043.01.R.001.Rev1 indicates that the above groundwater levels correspond to levels within the sandstone bedrock.

The limitations of the associated geotechnical investigation report, DP Report 86043.01.R.001.Rev1 apply to this letter report.



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

Yours faithfully Douglas Partners Pty Ltd

S

Sally Peacock Geotechnical Engineer

Attachments:

About this Report Drawing GW1 Figures 1 to 6

eviewed by Bruce McPherson Principal



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.

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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.





CLIENT: Frasers Property Ivanhoe				
OFFICE: Sydney	DRAWN BY: PSCH			
SCALE: 1:2000 @ A3	DATE: 04.07.2018			

TITLE: Test Location Plan **Proposed Residential Development** Ivanhoe Estate, MACQUARIE PARK



NOTE:

- Base image from Nearmap.com (Dated 19.10.2017)
 Test locations are approximate only and are shown with reference to existing features.



- Cored bore location
- Shallow bore location
- Standpipe location

Site boundary



PROJECT No: 86043.01 DRAWING No: GW1

REVISION:

0





Figure 1: Groundwater Monitoring Results at Bore 01





Figure 2: Groundwater Monitoring Results at Bore 05





Figure 3: Groundwater Monitoring Results at Bore 07





Figure 4: Groundwater Monitoring Results at Bore 10





Figure 5: Groundwater Monitoring Results at Bore 12





Figure 6: Groundwater Monitoring Results at Bore 13