Douglas Partners
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Integrated Practical Solutions

Groundwater Management Plan for Lowering of Hospital Road

Randwick Campus Redevelopment
Hospital Road and Delivery Drive, Randwick

Prepared for
Lendlease Building Pty Ltd

Project 72505.13
March 2020

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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.

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Groundwater Management Plan for Lowering of Hospital Road
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1. Introduction

This Groundwater Management Plan (GMP) has been prepared by Douglas Partners Pty Ltd (DP) for the proposed lowering of Hospital Road, which is part of the Randwick Campus Redevelopment (RCR) at Hospital Road and Delivery Drive, Randwick.

The GMP was prepared in accordance with DP's proposal (email dated 22 January 2020) and acceptance received from Mr John Gillen of Lendlease Building Pty Ltd. The work was carried out as a variation under a professional services agreement with Lendlease Building Pty Ltd (Contract No. 258723-512, dated 3 May 2018).

The proposed road lowering is within the proposed Integrated Acute Service Building (IASB) development and adjacent to the Acute Service Building (ASB) development (currently under construction) for the RCR. It is understood that the lowering of Hospital Road and Delivery Drive will include excavation to about 4 m to 5 m deep to achieve the proposed road level at about RL 51.0 m, grading to RL 50.5 m at the southern end of Hospital Road. A deeper, localised excavation is also proposed to house new services in a trench below the road level.

This GMP is based on previous geotechnical and contamination reports undertaken by DP for the subject site and the adjacent ASB site (refer to Section 6 of this report).

Reference has been made to the NSW Aquifer Interference Policy (AIP) prepared by NSW Office of Water, dated September 2012.

This GMP summarises the geological and hydrogeological conditions encountered in the previous geotechnical investigations and provides comments on groundwater management and dewatering for construction purposes for the proposed road lowering only.

In this GMP, the process of 'dewatering' refers to collection and management of seepage water from excavations and from on-site detention tanks rather than groundwater extracted by pumping from wells or spear points, which is commonly undertaken to lower a water table.

The objective of the GMP is to ensure that any dewatering at the site is undertaken in a way that does not adversely impact on the aquifer beneath the site, and that any seepage water collected during the construction works is managed in accordance with current legislation and guidelines.

2. Proposed Development

It is understood that the road lowering project includes:

- Lowering of Hospital Road and Delivery Drive to final levels of approximately RL 51.0 m to RL 50.5 m (southern end). The excavation is close to existing multi-storey hospital buildings located on the eastern side of Hospital Road and the new ASB, which is currently under construction on the western side of Hospital Road.
- Excavation up to 5 m deep is expected along Hospital Road, reducing to zero at the southern end to meet the existing road level. In Delivery Drive, it is anticipated that the excavation will be up to about 4 m deep near Hospital Road, reducing to zero to match existing surface levels at the eastern end of Delivery Drive.
- A contiguous pile shoring wall is currently proposed around the excavation to the north of Delivery Drive, with the newly constructed contiguous pile shoring wall of the ASB, along the western side of Hospital Road, to be partially demolished and replaced with a new capping beam to suit;
- At a number of locations, 'gaps' of about 1 – 3 m in width are proposed in the shoring wall to avoid existing services and where foundation piles are proposed for new structures above. The existing services that extend through the proposed excavation will be diverted;
- Below the proposed final road levels, deeper bulk excavation is required to accommodate a 0.3 m thick pavement with detailed excavation for subsoil drainage trenches extending about 0.5 m deeper (i.e. excavations to between RL 50.2 m and RL 48.7 m);
- A bank of hydraulic services, stormwater and sewer pipes will be housed in one benched trench extending north-south below the new road level. The bulk excavation level for the lowest bench of the services trench generally ranges from about RL 48.8 m to RL 48.0 m, grading down to the south;
- A pre-cast concrete tunnel will be constructed within the main excavation and will not require excavation below the proposed road level.

The approximate location of the proposed road lowering is shown on Drawing 1 (dated 2.9.2019) in Appendix B. Drawings showing the proposed development are included in Appendix G.

3. Site Description

The proposed lowering of Hospital Road is along Hospital Road and Delivery Drive, which currently serves as a main access road in and around the Hospital Precinct. Within the surrounding footpaths and road pavements, numerous utilities exist below ground and within the proposed excavation for the road lowering. The ground surface generally slopes down towards the south along Hospital Road, and towards the east along Delivery Drive. The approximate site location and general site topography with 2 m contour lines are shown in Figure 1. It is noted that the contour lines shown in Figure 1 are sourced from published mapping and may not be representative of current surface levels (i.e. contours are indicative only).

The existing Hospital Precinct is located to the east of Hospital Road and accommodates a number of health facilities. The buildings along Hospital Road are generally less than 10-storeys high.

The Ainsworth Building (or Building SCH-CAMHS or Building 1C as shown on original design drawings) is located at the intersection of Hospital Road and Delivery Drive. The Ainsworth Building loading dock and basement level are at about RL 51.2 m and RL 51.0 m, respectively (based on Drawing No. 11D-NL00001 Issue B by BVN Architecture Pty Ltd). Medium and high strength sandstone is exposed within vertical road cuttings up to 2 m high near the northern end of the Ainsworth Building loading dock.

A multi-level car park with the lowest basement car park level at about RL 44.2 m is located off Hospital Road, near the intersection of Hospital Road and Francis Martin Drive. Medium strength sandstone with very low/low strength siltstone bands are exposed in the sidewalls of the lower basement levels adjacent Hospital Road.

The ASB development is currently under construction and is located to the west of Hospital Road, with a contiguous pile shoring wall extending along Hospital Road. This building has a basement Level -02 at RL 47.0 m.

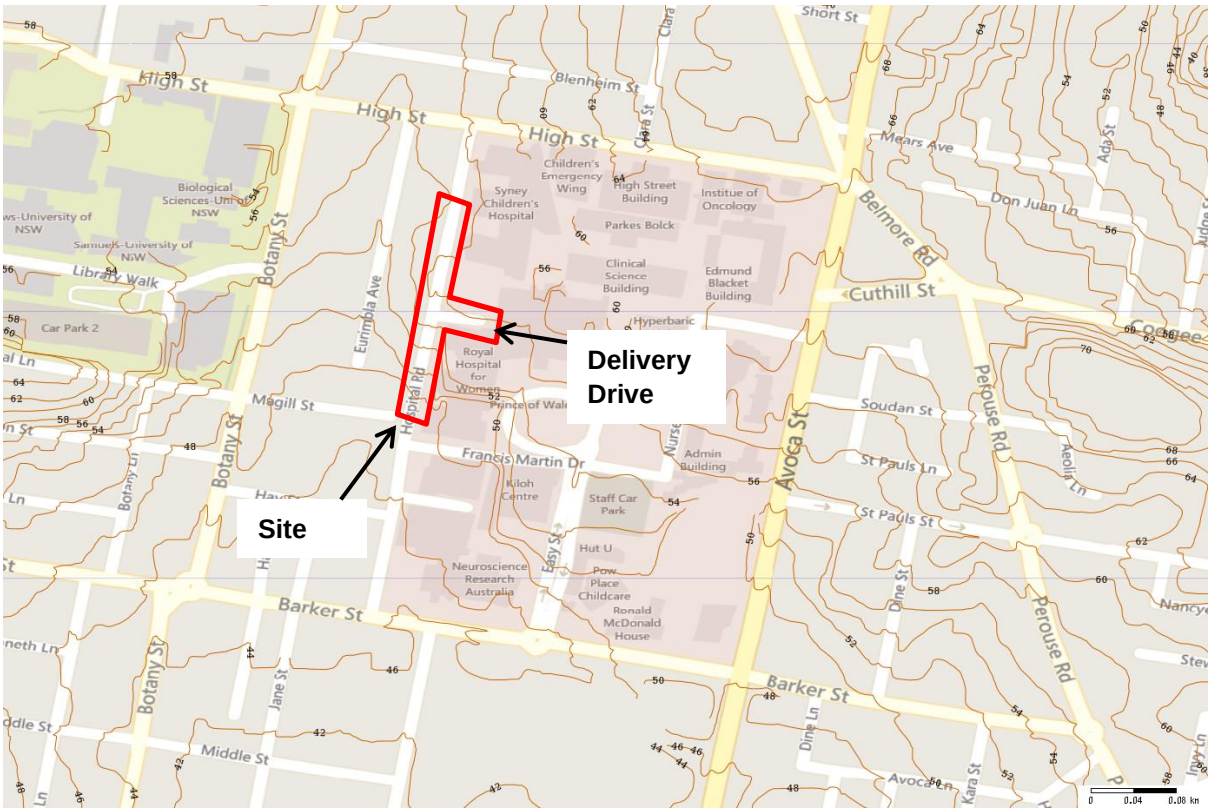


Figure 1: Site Location (Lowering of Hospital Road) and Topography with 2 m Contours

4. Regional Geology

Reference to the Sydney 1:100 000 Series Geological Sheet indicates that the site is underlain by fine to medium grained sand (shown in yellow in Figure 2). Hawkesbury Sandstone comprising medium to coarse grained quartz sandstone with minor shale and laminite bands (shown in green in Figure 2) is

present in areas to the north-east, south-east and south-west of the site. The previous investigations confirmed the presence of sand over Hawkesbury Sandstone with minor laminite bands.

Figure 2: Regional Geology (Source: Sydney 1:100 000 Series Geological Sheet)

The site is located well beyond the Western Sydney area, and therefore, there is no potential for saline soils to exist.

The Acid Sulphate Soils Map (Sheet ASS_007) sourced from the Randwick Local Environment Plan 2012 indicates that the site is located in an area which is not known to have acid sulphate soils.

5. Potential Effects on Neighbouring Properties

An assessment of the potential effects of water management on neighbouring properties and groundwater dependent ecosystems has been summarised in Table 1.

Table 1: Assessment of Potential Effects of Groundwater Management

Item	Comment
Proximity of Groundwater Dependent Ecosystems (GDEs)	No known groundwater dependent ecosystems in close proximity to the site.
Water supply losses by neighbouring groundwater users	No known groundwater users within close proximity (i.e. about 250 m) of the site. Other groundwater users distant from the site are not expected to be affected due to the groundwater drawdown predicted to be within historical, natural fluctuations in water levels.
Potential subsidence of neighbouring structures	Shoring walls installed into rock to reduce groundwater drawdown. Groundwater drawdown is expected to be less than natural fluctuation of the water levels. Therefore settlements due to drawdown are expected to be negligible.
Mounding of water up-gradient of structure	Up-gradient of the proposed Hospital Road lowering, stormwater runoff seepage is expected over the top of rock and through rock joints. A drained basement including a contiguous pile shoring wall is proposed for the Hospital Road lowering and the adjacent ASB (i.e. not designed as a 'cut-off' wall). DP assumes the subsurface drainage system is sufficient to prevent groundwater mounding, and therefore not an issue.

The volume of water to be pumped during construction dewatering is estimated to be less than 1,000 L/day from the pavement subsoil drainage trenches and an additional 2,000 L/day from the excavation for the services trench following heavy periods of rainfall. The estimated volumes of water ingress are based on groundwater data and proposed bulk excavation levels available at the time of preparing this report, consideration of adjacent lower-lying basement structures in proximity to the site, the rock contour levels and the permeability of the soil/rock.

The proposed road level and services trench are also above the measured water table located at the southern end of the ASB site, and consequently, there is no requirement to lower the water table. Therefore, the effects of drawdown are expected to not be an issue with dewatering for a drained basement.

Dewatering is likely to lower the groundwater seepage levels (i.e. those experienced due to stormwater runoff seepage over bedrock) close to the invert level of the subsoil drains or the soil/rock interface, whichever is shallower. Such drawdown levels are likely to be within the range of historical fluctuations in the groundwater seepage levels, and therefore, have no adverse impact on adjacent structures. It is noted that the groundwater seepage levels may be below the subsoil drains during relatively dry periods.

The flow direction of groundwater seepage is expected to follow the rock contours, which generally dip down towards the south and west.

6. Previous Investigations

6.1 Geotechnical

DP previously completed geotechnical investigations as follows:

- Project 72505.13.R.001.Rev0, dated 6 June 2018, which included the drilling of 16 boreholes across the subject site and adjacent ASB site (where access was readily available to drilling rigs), installation of 11 groundwater monitoring wells to monitor the groundwater levels, permeability tests in soil and rock, estimation of water inflows into the ASB basement and laboratory tests for geotechnical purposes. The results of previous rock-cored boreholes located in proximity to the site were also included in this geotechnical report.
- Project 72505.13.R.024.Rev0, dated 13 September 2019, which included two additional boreholes (BH501 and BH502) and the installation of one groundwater monitoring well within the ASB site near Magill Street;
- Project 72505.13.R.023.Rev0.IASB, dated 27 September 2019, which included two additional boreholes (BH401 and BH402) within the subject site and sonic integrity testing of the Ainsworth Building footings.

The locations of all boreholes and wells to date are shown on Drawing 1 (dated 2 September 2019) in Appendix B. The borehole logs and well logs for previous boreholes and/or groundwater wells that lie within the subject Hospital Road lowering and the adjacent ASB site are included in Appendix C.

The subsurface conditions generally include sandy filling and ripped sandstone filling of variable thickness, overlying loose and medium dense, non-plastic sand and Hawkesbury Sandstone bedrock. The bedrock surface is expected to dip down towards the south and west. The rock is initially extremely low to low strength and generally becomes more consistent medium and high strength sandstone with depth. Some extremely low to low strength siltstone and laminite bands were interbedded within the stronger sandstone.

Based on the site topography, published mapping and subsurface conditions encountered to date, acid sulphate soils and saline soils are unlikely to be geotechnical issues at this site.

Within the subject site, no groundwater was measured within BH401 whilst auger drilling or within the depth of BH402 (discontinued at depth of 0.5 m). Groundwater wells were installed in BH10, 11 and 12 for long-term groundwater monitoring. In BH10, 11 and 12, groundwater was measured within the upper rock layers, generally within 1 m below the top of rock level over the monitoring period to date. No groundwater was observed during auger drilling in BH1 and 2 during auger drilling. Further information on groundwater levels within the subject site and the adjacent ASB site is provided in Section 6.1.4 of this GMP.

6.1.1 Physical Soil Properties

Five particle size distribution (PSD) tests were carried out on natural soil samples collected within the road lowering site and the adjacent ASB site to assess the soil grading and to estimate the soil permeability using empirical methods. The results of the PSD tests indicate that the natural soil is fine

to medium grained sand, with either no (0%), with trace of (0 – 5%), or with some (5 – 12%) silt or clay content.

Based on the results of the five PSD tests on natural sand and using Hazen's equation to predict the soil permeability or hydraulic conductivity (k), the sand has an average 'k' value of 2.6 x 10^{-4} m/s.

6.1.2 Chemical Soil Properties

Ten soil samples were collected within the road lowering site and the adjacent ASB site and tested to assess the soil aggressivity (pH, chloride, sulphate and electrical conductivity) to buried concrete and steel elements.

Based on the results of the chemical analysis and with reference to Tables 6.4.2(C) and 6.5.2(C) of AS 2159 – 2009 "Piling design and installation", the six soil samples tested from BH1 to BH4, BH12 and BH14/3.5 – 3.95 m have a 'non-aggressive' exposure classification with respect to buried concrete and steel elements, assuming 'Soil Conditions B' (i.e. all soils above groundwater).

Three soil samples tested from BH8, BH9 and BH13 have a 'mild' exposure classification with respect to buried concrete and steel elements, assuming 'Soil Conditions B' (i.e. all soils above groundwater).

One soil sample tested from BH14/6.3 – 6.5 m, which is below the water table, has a 'moderate' exposure classification with respect to buried concrete and steel elements, assuming 'Soil Conditions A' (i.e. high permeability soils which are in groundwater).

6.1.3 Falling-Head Tests

Permeability tests within BH8, 9, 11, 12, 13, 14 and 16 targeted the soil permeability and tests within BH4, 10, and 17 targeted the rock permeability. The detailed results of the in situ falling head tests are provided in Appendix D and are summarised in Table 2.

Table 2: Results of Falling Head Tests

Well Location	Hydraulic Conductivity (m/s)			
	Sand		Sandstone	
	Test 1	Test 2	Test 1	Test 2
BH4	-	-	1.7 x 10^{-7}	1.7 x 10^{-7}
BH8	8.9 x 10^{-7}	Inaccessible	-	-
BH9	6.5 x 10^{-6}	8.9 x 10^{-6}	-	-
BH10	-	-	5.7 x 10^{-8}	6.0 x 10^{-8}
BH11	1.7 x 10^{-7}	2.1 x 10^{-7}	-	-
BH12	3.0 x 10^{-7}	3.2 x 10^{-7}	-	-
BH13	8.7 x 10^{-6}	1.1 x 10^{-5}	-	-
BH14	3.1 x 10^{-5}	4.9 x 10^{-5}	-	-
BH16	2.1 x 10^{-7}	4.1 x 10^{-7}	-	-
BH17	-	-	1.1 x 10^{-6}	1.2 x 10^{-6}

Based on the results of the of 13 falling-head tests in natural sand, the sand has an average 'k' value of 9.1 x 10^{-6} m/s.

These 'k' values represent a soil of relatively high permeability, and within the typical range of permeability for fine to medium grained sand with varying inclusions of silt and clay. It is noted that the hydraulic conductivity of sandy soil is highly dependent upon the grain size, the soil density, the amount of silt and clay content (i.e. fine particles less than 0.075 mm diameter) and the degree of saturation over the full depth of the sand profile.

The permeability of bedrock depends on the primary permeability of the rock, which considers the rock mass, and the secondary permeability of the rock, which is governed by the frequency and aperture (i.e. tightness, open or tight) of the rock joints or discontinuities. Based on the results of six in situ falling head tests within bedrock, the bedrock has an average 'k' value of 4.6 x 10^{-7} m/s. If open joints are intersected then the secondary permeability of the rock would be expected to be greater than the estimate provided. The permeability of the bedrock can be most accurately measured during the bulk excavation stage of construction.

6.1.4 Groundwater Monitoring

The results of the groundwater levels measured with a tape-measure during auger drilling, following purging of residual water from drilling or prior to undertaking falling head tests within groundwater monitoring wells are provided in Table 3. The top of rock depths/levels are also provided for comparison.

Table 3: Summary of Tape-Measured Groundwater Level Measurements (Vs. Top of Rock)

Bore	Groundwater During Drilling	Groundwater in Well (Post-Purging of Residual Water from Drilling and Tests)				Approximate Depth (& RL) to Top of Rock (m (& m AHD))
	Approximate Depth (& RL) (m (& m AHD))	Date	Approximate Depth (& RL) (m (& m AHD))	Date	Approximate Depth (& RL) (m (& m AHD))	
BH1	-	No Well	No Well	No Well	No Well	3.4 (45.1)
BH2	-	No Well	No Well	No Well	No Well	5.0 (50.2)
BH3	-	No Well	No Well	No Well	No Well	1.5 (53.1)
BH4	-	10.5.18	3.6 (48.3)	17.5.18	3.7 (48.2)	3.5 (48.4)
BH5	-	No Well	No Well	No Well	No Well	4.6 (44.8)
BH6	5.0 (42.6)	No Well	No Well	No Well	No Well	6.9 (40.7)
BH7	-	13.10.17	5.1 (49.5)	17.5.18	Not Accessed	3.9 (50.7)
BH8	-	10.5.18	Dry	17.5.18	Not Accessed	2.6 (47.9)
BH9	5.5 (43.7)	10.5.18	**5.1 (44.1)**	17.5.18	**5.2 (44.0)**	6.0 (43.2)
BH10	-	10.5.18	4.7 (47.5)	17.5.18	4.9 (47.3)	3.8 (48.4)
BH11	-	10.5.18	5.0 (47.5)	17.5.18	4.8 (47.7)	4.3 (48.2)
BH11		9.8.19	4.4 (48.1)			4.3 (48.2)
BH12	-	10.5.18	6.3 (49.4)	17.5.18	6.1 (49.6)	6.1 (49.6)
BH12		23.8.19	Dry to 6.0 (49.7)			6.1 (49.6)
BH13	-	10.5.18	Dry	17.5.18	3.5 (48.5)	3.2 (48.8)
BH14	4.5 (43.0)	10.5.18	**4.5 (43.0)**	17.5.18	**4.7 (42.8)**	6.6 (40.9)
BH16	-	10.5.18	4.2 (51.0)	17.5.18	4.1 (51.1)	4.1 (51.1)
BH17	-	10.5.18	5.1 (50.1)	17.5.18	5.0 (50.2)	4.4 (50.8)
BH401	-	No Well	No Well	No Well	No Well	0.6 (51.4)
BH402	-	No Well	No Well	No Well	No Well	-
BH501	2.7 (43.8)	2.10.19	2.1 (44.4)	-	-	3.2 (43.3)
BH502	-	No Well	No Well	No Well	No Well	0.6 (44.8)

Notes: **Bold** indicates that the measured groundwater level is above the top of rock

The results of the groundwater levels measured by electronic data-loggers during various monitoring periods within the subject site and the adjacent ASB site are provided in Appendix E. The results are plotted with rainfall data from a nearby station located at Randwick Street, Randwick (Station No. 66052, operated by the Bureau of Meteorology). Labels are shown at the respective time on the graphs where the data-loggers were manually handled for tests during the monitoring period (i.e. to identify false readings).

The groundwater levels within the monitoring wells within the Hospital Road site were mostly within 1 m below the rock surface or close to the soil/rock interface, with water levels generally fluctuating by up to 0.5 m. The water level in BH12 increased close to RL 50.0 m (i.e. to about 0.4 m within the overlying sand profile) following approximately 100 mm of rainfall over three consecutive days in September 2019. BH12 recorded a water level closest to the proposed Hospital Road lowering level.

Within the ASB site in BH9 and BH14, the water level was about 1 m and 2 m above the top of rock, or 3 m and 4 m below the proposed ASB basement Level -02 (RL 47.0), respectively. In the other wells, the water levels were close to or below the top of rock, and above Level -02.

The rainfall appears to effect the stormwater runoff seepage levels. For the purpose of this report, stormwater runoff seepage is similar to groundwater seepage but should not be misinterpreted to mean a water table.

6.1.5 Groundwater and Dewatering

Based on the groundwater data available at this stage, stormwater runoff seepage is expected at the soil and rock interface, and within bedrock along rock joints and extremely/highly weathered bedrock bands, all of which lie above the proposed excavation/basement for most of the site.

For the drained basement/contiguous shoring pile wall, any immediate lowering of stormwater runoff seepage through weep holes/spitter pipes in the shoring walls or between gaps in the shoring piles is expected to be within local historical fluctuations. The proposed road level and services trench are also above the water table located at the southern end of the ASB site, and consequently, there is no requirement to lower the water table. Therefore, the effects of drawdown are expected to not be an issue with dewatering for a drained basement.

Groundwater seepage due to excavation for the road lowering/basement should be managed through sump and pump techniques.

6.1.6 Stormwater Ingress

Based on the current information on groundwater monitoring, rainfall data, rock contours, and permeability testing within the subject site and the adjacent ASB site, together with the understanding of current lower-lying basement levels that border a lot of the proposed excavation, stormwater inflow or groundwater seepage into the excavation is estimated to be less than 1,000 L/day from the pavement subsoil drainage trenches and 2,000 L/day from the excavation for the services trench following heavy periods of rainfall.

The volume of stormwater inflow will ultimately depend on the soil permeability, rock fracturing, the amount of ground surface infiltration compared to surface run-off, and prevailing weather conditions. Greater volumes of stormwater inflow to the basement may be experienced if leaking stormwater

systems are present in the surrounding sandy soils or if prolonged or high intensity rainfall is experienced.

6.1.7 Geological Model

A summary of the subsurface conditions encountered across the site are shown in three interpreted geotechnical cross-sections A - A' to C - C' in Drawings 2 to 4 in Appendix B, with the proposed level for the road lowering shown indicatively. It should be noted that the interpreted geotechnical boundaries are shown for illustration purposes only and that the soil/rock profiles should be expected to vary in between and away from the borehole locations.

The road pavement is expected to be underlain by sandy filling and ripped sandstone filling of variable thickness, overlying predominantly medium dense sand extending to the top of Hawkesbury Sandstone bedrock.

The bedrock surface is expected to dip down towards the south and west. The rock is initially extremely low to low strength (except at BH12) and generally becomes more consistent medium and high strength sandstone with depth. The weaker, weathered rock profile is thicker at the southern end of the site, and is about 2m to 5 m thick. Some extremely low to low strength siltstone and laminite bands were interbedded within the stronger sandstone generally below RL 45 m.

Based on measurements of groundwater within previous and current boreholes and monitoring wells, groundwater seepage is expected at the soil and rock interface and within bedrock along rock joints and extremely/highly weathered bedrock bands, generally below the proposed road lowering level (except at BH401 where top of rock is about 0.5 m above the proposed road lowering level). The groundwater seepage levels generally dip down towards the south with the site topography, and should be expected to fluctuate with variations in climate.

6.2 Groundwater Contamination

DP completed a Detailed Site Investigation (DSI) for Contamination (Project 72505.14.R.001.Rev2, dated February 2019) to assess the soil and groundwater contamination at the RCR site and subsequently prepared a Remediation Action Plan (RAP) (Project 72505.14.R.002.Rev9.RAP) for the RCR site dated 19 September 2020. Whilst the reports were not specific to Hospital Road (albeit part of the RAP applies to the IASB Addition, which incorporates a part of Hospital Road) the groundwater conditions reported are likely to be similar to those encountered beneath Hospital Road. It is noted that previous Borehole BH11 (as referenced below) is located on Hospital Road. The groundwater conditions for the remaining locations are report for background and more regional conditions.

The groundwater assessment included the collection of nine groundwater samples from monitoring wells within Boreholes BH7, 11, 14, 16, 17, 202 and 204. The samples were tested for a common suite of groundwater contaminants and the laboratory test results are summarised in Table C2 within Appendix F, together with the adopted Site Assessment Criteria (SAC), which are shown at the top of Table C2 as Ground Investigation Levels (GILs). The GILs listed in Table C2 are based on the freshwater default guideline values (DGV) for a slightly to moderately disturbed system from Australian and New Zealand Governments (ANZG), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, 2018 (ANZG, 2018).

No phase separated hydrocarbons (PSH) were observed or detected by the interface meter during well development or sampling. Concentrations of all contaminants in the samples analysed were either below the detection limit or the SAC, with the exception of the following:

- Cadmium in sample BH14 (0.006 mg/L) which exceeded the GIL of 0.005 mg/L;
- Copper in samples BH14 (0.007 mg/L), GW7 and the duplicate (0.007 mg/L), BH202 (0.002 mg/L), BH204 (0.008 mg/L), BH11 (0.005 mg/L), BH14 (0.007 mg/L), and BH17 (0.003 mg/L) which exceeded the GIL of 0.0014 mg/L; and
- Zinc in sample GW7 (0.022 mg/L) and the duplicate (0.024 mg/L), BH202 (0.031 mg/L), BH204 (0.028 mg/L), BH11 (0.013 mg/L), BH14 (0.055 mg/L) and BD1 (0.026 mg/kg) which exceeded the GIL of 0.008 mg/L.

These results are however considered to be typical of groundwater conditions in urban settings.

Prior to the collection of groundwater samples for laboratory testing, the pH, dissolved oxygen and turbidity were measured within seven groundwater wells and the results are summarised in Table 4.

Table 4: Results of Tests for pH, Dissolved Oxygen and Turbidity

Borehole	pH	Dissolved Oxygen (%)	Turbidity (NTU)
BH7	5.1	7	110
BH11	6.4	36	130
BH14	6.7	87	20
BH16	7.3	59	19
BH17	5.5	13	15
BH202	6.6	29	28
BH204	5.1	27	35

The suitability of the groundwater for disposal to stormwater or sewer should be confirmed by the authority receiving the water.

DP's RAP indicates that based on the results reported in DP's DSI for Contamination, it is considered that further investigation and/or remediation of groundwater is not required. This statement is considered to apply for the lowering of Hospital Road also.

7. Monitoring and Reporting

Monitoring and associated reporting, as shown in Table 5, is mandatory during water management/dewatering and will be undertaken during excavation and construction works on-site, as specified in Section 16 of the DP (2019) *Remediation Action Plan, Randwick Campus Redevelopment – Stage 1, bound by Botany, Magill and Hospital Streets, Randwick* (RAP).

Assessment of monitoring data, criteria and contingencies (e.g. drawdown constraints, significantly higher flows, impact flow direction of cross-gradient plumes, groundwater quality) will need to be developed in consultation with Lendlease Building Pty Ltd and the dewatering contractor.

As a precaution, monitoring should be carried out using the existing groundwater monitoring well ("sentry" well) within borehole BH12, which is located on the upslope northern boundary of the proposed development within Hospital Road (refer to Drawing 1 in Appendix B). If the well from BH12 is destroyed as part of the development then construction of an additional groundwater monitoring well is required further north in Hospital Road. If any groundwater contaminants in the monitoring well are found to increase during dewatering, this will be used to alert the dewatering contractor and environmental consultant on the project so that the strategy may be revisited. This may provide an early warning to put a treatment option in place.

Given the volume of water to be pumped during construction dewatering may be less than 1,000 L/day from the pavement subsoil drainage trenches and an additional 2,000 L/day from the excavation for the services trench following heavy periods of rainfall, the dewatering contractor may decide to collect water in storage tanks and dispose periodically to a licenced facility if contamination is encountered.

Table 5: Monitoring and Reporting Requirements

Item	Monitoring	Monitoring Frequency	Reporting
Groundwater Drawdown	Utilise two existing groundwater monitoring wells within boreholes BH12 and BH501 to monitor any potential drawdown effects.	Measurement of groundwater levels within the wells at least once a week to monitor drawdown.	
Groundwater Quality Sampling and Testing	Samples are to be collected from the sentry well prior to commencement of dewatering, and during dewatering. Water testing is also required prior to disposal off-site and for re-injection on-site, should that dewatering option be taken. Contaminant and physical properties tested to be nominated by the Authority accepting water but to include as a minimum: • Heavy Metals and Iron; • Conductivity; • pH; • Dissolved Oxygen Levels; • Turbidity; • Suspended Solids; and • Oil and Grease.	One sample from BH12 prior to commencement of dewatering. One sample from BH12 every two weeks whilst dewatering is being undertaken. One sample from each water holding tank prior to disposal. Sampling frequency to be reviewed based on test results. No water volume in the collection tanks will be disposed without having been tested and the results confirmed to be acceptable. DP will issue memorandums following each sampling and testing event, stating whether the volume tested is considered to be acceptable for disposal to the stormwater system, or as otherwise agreed with the Authority accepting water or by the EPA.	
Groundwater inflow rates	Groundwater inflow to be measured in collection tanks of a pre-determined size or at a point of discharge using a calibrated flow meter.	Twice daily, or once collection point is filled (whichever is more frequent) for the first two weeks. Daily after steady groundwater inflow rates are established.	Weekly
Quantity of water disposed	Calibrated flowmeter connected to any pump-out system.	Automatically	Weekly

All monitoring will be undertaken by the appointed Environmental and Geotechnical consultant. The results of each round of sampling and testing will be documented in a memorandum to LL, including any recommendations. At the completion of excavation works a dewatering compliance report, which includes discussion on the results of the dewatering monitoring, will be compiled by DP.

8. Acceptance Criteria

The acceptance criteria for groundwater disposal off-site (i.e. stormwater) are summarised in Table 6 and, where applicable, are based on Freshwater default guideline values (DGV) for a slightly to moderately disturbed system from Australian and New Zealand Governments (ANZG), Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2018 (ANZG, 2018).

No water can be disposed to stormwater unless permission is formally granted by the Authority responsible, which is likely to be Randwick Council. The Authority responsible for the receiving water body may stipulate alternative threshold levels.

Table 6: Acceptance Criteria for Groundwater Disposal Off-Site to Stormwater

Chemical and Physical Properties	Criteria
Arsenic	24 µg/L
Cadmium	0.2 µg/L
Chromium (III+VI)	0.4 µg/L
Copper	1.4 µg/L
Lead	3.4 µg/L
Mercury	0.6 µg/L
Nickel	11 µg/L
Zinc	8 µg/L
Iron	300 µg/L
Conductivity	2200 µs/cm
pH	6.5 - 8.5
Dissolved Oxygen	85 - 110 % saturation
Turbidity	50 NTU
Suspended Solids	50 mg/L
Oil and Grease	10 mg/L

Based on the preliminary measurements for pH, dissolved oxygen and turbidity on groundwater within seven monitoring wells to date, the pH and dissolved oxygen may need to be increased by using pH neutralisers and aeration systems, respectively, with some flocculation of groundwater required to reduce turbidity prior to disposal.

If the water does not meet the proposed acceptance criteria then contingency measures are to be developed in consultation with the dewatering contractor.

Appropriate sampling procedures must be undertaken to limit cross contamination including that:

- Standard operating procedures for measuring and sampling equipment used are followed;

- Site specific work statement and safety plans are developed prior to commencement of works;
- Samples are stored under secure, temperature controlled conditions. An ice box (esky) continually topped with ice will be used for storage during the field work. All recovered samples will be returned to the refrigerator at the DP office at the completion of each day, and forwarded in an ice box to the laboratory on the following day;
- The laboratory undertaking the analysis is NATA accredited for the analysis undertaken; and
- Chain of custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory.

Other options for groundwater which does not meet criteria for stormwater disposal could include:

- Treatment for the contaminants identified prior to stormwater disposal,
  - Set up of a treatment process on site to achieve the criteria in Table 6;
  - Testing required after treatment as confirmation;
- Disposal to the sewer under a licence issued by Sydney Water,
  - Must meet the conditions / criteria listed in a license issued by Sydney Water;
- Collection and disposal by a liquid waste contractor,
  - The contractor should conduct testing to determine fees, but will accept the waste for disposal at their facility;
- Re-injection into the sandy soil within ASB or subject site (subject to Lendlease Building Pty Ltd considering the below impacts for the re-injection location(s), which should be determined by Lendlease Building and the appointed Environmental/Geotechnical Consultant),
  - Concentrations in the sentry well must continue to meet the criteria in Table 6;
  - Re-injection cannot impact on excavation stability, slabs-on-ground and any subsurface structures such as services and/or pits. Re-injection has the potential to raise groundwater levels and this would reduce the bearing capacity of shallow footings supported in sand;

    A shallower groundwater level may also induce hydrostatic pressure and/or vertical uplift pressure on subsurface structures and this may not have been considered as part of their design and construction;

    Furthermore, the sandy soil profile in this area includes fine particles such that the natural sand is not readily “free-draining”. Ponding of re-injected water may occur at the ground surface.

The preferred method will need to be agreed between DP and Lendlease Building Pty Ltd initially, then with the dewatering contractor.

9. Aquifer Interference Policy Considerations

The NSW Aquifer Interference Policy (AIP) indicates that the term “aquifer” is commonly understood to mean a groundwater system that is sufficiently permeable to allow water to move within it, and which can yield productive volumes of groundwater. A groundwater system is defined as any type of saturated geological formation that can yield low or high volumes of water.

The site and surrounding areas are underlain by relatively high permeability Quaternary sediments comprising medium to fine grained sands. The sands are considered to be a “highly productive groundwater source” as outlined in the AIP.

Table 1 in Section 3.2.2 of the AIP outlines minimal impact considerations. The AIP indicates that “if predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable”. The following minimal impact considerations are outlined for highly productive groundwater sources (coastal sands):

- Less than or equal to 10% cumulative variation in water table 40 m from any high priority groundwater dependant ecosystem, high priority culturally significant site, or less than a 2 m decline at any water supply work;
- A cumulative pressure head decline of not more than 2 m at any water supply work; and
- Any change in groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.

The minimal consideration impacts relate to impacts on groundwater dependant ecosystems and groundwater users. Based on the groundwater investigation results, the proposed excavation on the site is considered to comply with the AIP minimal consideration requirements for the following reasons:

- Pumping of water will occur from sumps inside the shoring walls to allow for construction of a drained basement;
- There are no registered groundwater users within close proximity to the site. Other groundwater users distant from the site are not expected to be affected due to the minimal groundwater drawdown predicted;
- DP is not aware of any groundwater dependant ecosystems in close proximity of the site;
- DP is not aware of any water sharing agreements in the area;
- The groundwater investigation indicates stormwater runoff is about 0.1 m - 0.5 m over the top of bedrock. The proposed lowering of Hospital Road does not require bulk excavation below the water table that exists deeper in the sand profile at the southern end of the site. Therefore, any drawdown of the water is significantly less than 2 m;
- The take of water can be measured during the construction period.

DP cannot advise on the capacity of the existing or proposed stormwater drains to receive the flow volumes collected from the construction works. This should be confirmed by Council or the civil engineer.

10. References

1. NSW Office of Water, NSW Aquifer Interference Policy, September 2012;
2. Australian and New Zealand Governments (ANZG), Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2018 (ANZG, 2018);
3. AS 2159 – 2009 “Piling design and installation;
4. Report on Supplementary Geotechnical Investigation within ASB and Hospital Road Lowering, Project 72505.13.R.001.Rev0, dated 6 June 2018;
5. Investigation Summary Report within ASB, Project 72505.13.R.024.Rev0, dated 13 September 2019;
6. Report on Supplementary Geotechnical Investigation within Hospital Road Lowering, Project 72505.13.R.023.Rev0.IASB, dated 27 September 2019;
7. Detailed Site Investigation (DSI) for Contamination (Project 72505.14.R.001.Rev2, dated February 2019);
8. Remediation Action Plan (RAP) (Project 72505.14.R.002.Rev9.RAP) dated 19 September 2020.

11. Limitations

Douglas Partners Pty Ltd has prepared this GMP for the Lowering of Hospital Road Site within the Randwick Campus Redevelopment project at the site bound by Hospital Road and High, Magill and Botany Streets, Randwick in accordance with DP’s proposal (email dated 22 January 2020) and acceptance received from Mr John Gillen of Lendlease Building Pty Ltd). The work was carried out as a variation under a professional services agreement with Lendlease Building Pty Ltd (Contract No. 258723-512, dated 3 May 2018). This GMP is provided for the exclusive use of Lendlease Building Pty Ltd 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 relying upon this GMP 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 GMP 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.

This GMP 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.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

Introduction

[illegible]

[illegible]

Copyright

[illegible]

Borehole and Test Pit Logs

[illegible]

[illegible]

Groundwater

[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]

[illegible]

Reports

[illegible]

[illegible]

- [illegible]
- [illegible]
- [illegible]

[illegible]

About this Report

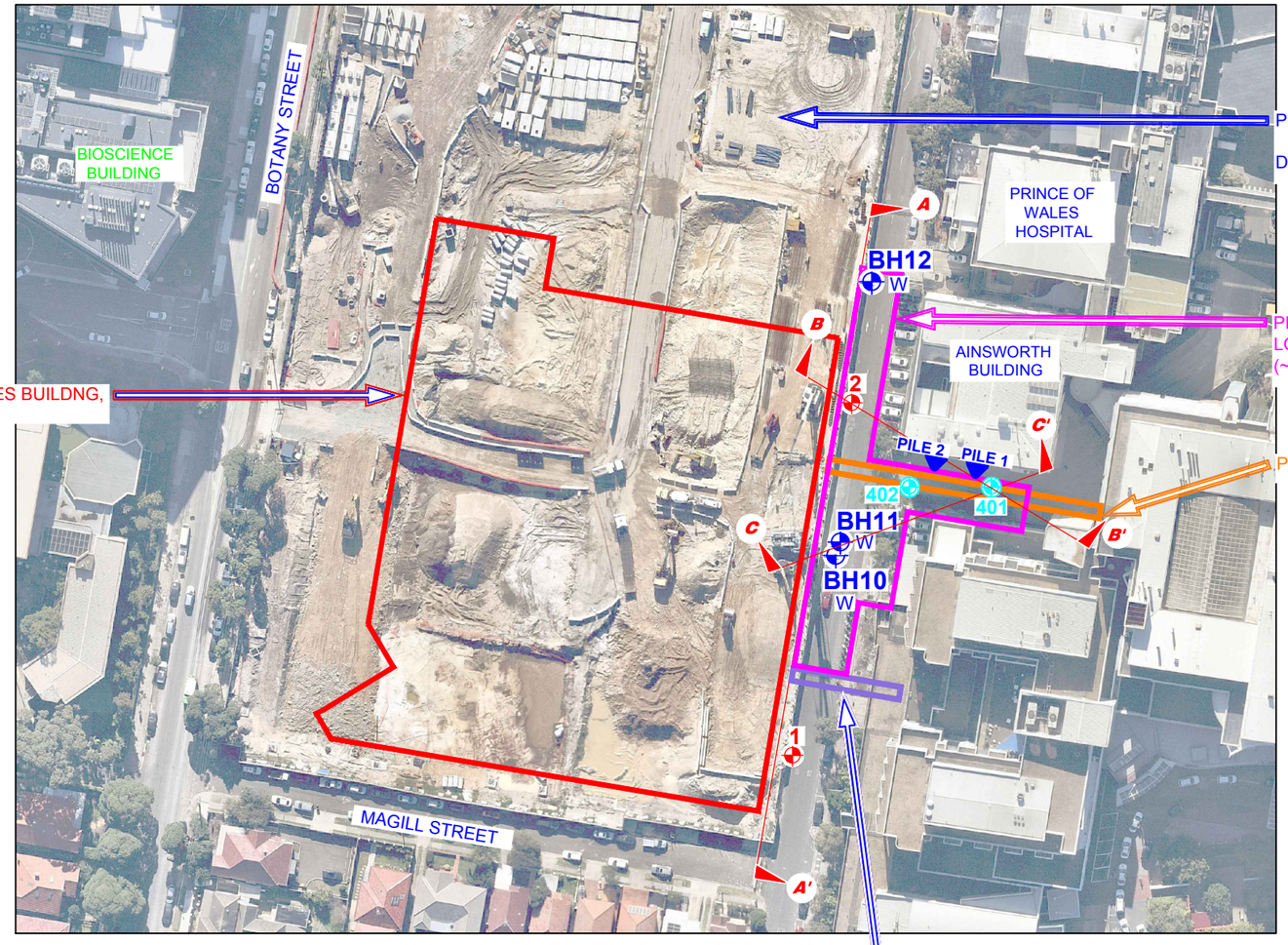
Site Anomalies

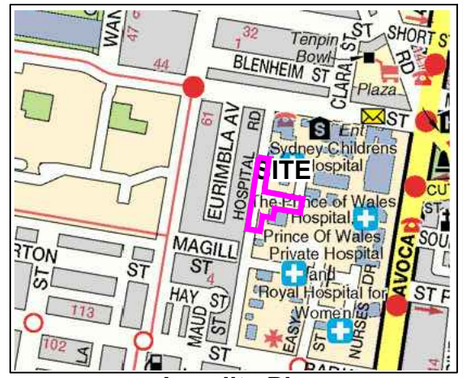
Information for Contractual Purposes

Site Inspection

Appendix B

Drawings





Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 1.7.2019)

0 5 10 20 30 40 50 75 100 125m

1:1250 @ A3

LEGEND

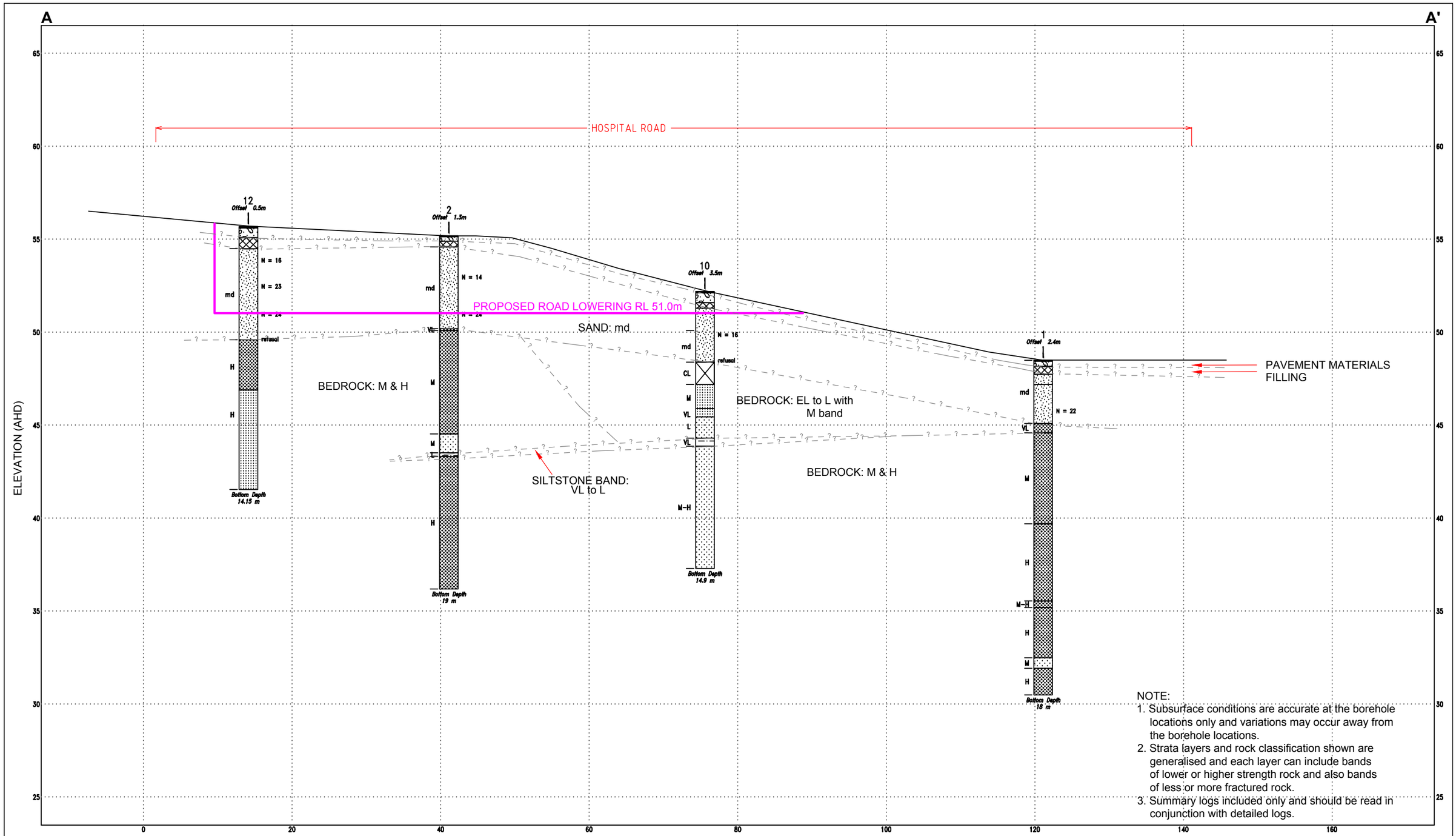
- Previous borehole (Proj. 72505.11, Feb 2018)
- Previous borehole (72505.13, R.001, June 2018)
- W Groundwater monitoring well
- Current borehole (72505.13 R.023 Sept. 2019)
- Sonic Integrity Test of pile footing
- A A' Interpreted geotechnical Cross Section

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Lendlease Building Pty Ltd		TITLE: **Locations of Previous and Current Boreholes** **Randwick Campus Redevelopment** **Hospital Road and Delivery Drive, RANDWICK**
OFFICE: Sydney	DRAWN BY: PSCH	
SCALE: 1:1250 @ A3	DATE: 2.9.2019	

N

PROJECT No:	72505.13
DRAWING No:	1
REVISION:	0



NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs included only and should be read in conjunction with detailed logs.

LEGEND

Core Loss
Asphaltic Concrete
Filling
Roadbase
Sand
Sandstone
Sandstone coarse grained
Sandstone fine grained
Siltstone

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

SOIL CONSISTENCY
md - medium dense

TESTS / OTHER
N - Standard penetration test value
- Water level

Horizontal Scale (metres)
Vertical Exaggeration = 2.5

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: LendLease Building Pty Ltd		TITLE: **Interpreted Geotechnical Cross Section A-A'**	PROJECT No: 72505.13
OFFICE: Sydney	DRAWN BY: PSCH	**Randwick Campus Redevelopment**	DRAWING No: 2
SCALE: 1:500 (H) 1:200 (V) @ A3	DATE: 13.09.2019	**Hospital Road and Delivery Drive, RANDWICK**	REVISION: 0

B

B'

ELEVATION (AHD)

65
60
55
50
45
40
35
30
25

HOSPITAL ROAD

DELIVERY DRIVE

2
Offset 2.7m

N = 14

md

SAND: md

PROPOSED ROAD LOWERING RL 51.0m

VL

L

M

H

ASB BASEMENT
RL 47.0m

BEDROCK: M & H with L bands

Bottom Depth
19 m

BH401
Offset 3.6m

VL

L

M

L

Bottom Depth
4.55 m

PAVEMENT MATERIALS

FILLING

BEDROCK: EL to L with
M band

0
20
40
60
80
100
120
140
160

DISTANCE ALONG PROFILE (m)

NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs included only and should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Concrete
- Filling
- Roadbase
- Sand
- Sandstone
- Sandstone coarse grained
- Sandstone fine grained
- Siltstone

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

SOIL CONSISTENCY
md - medium dense

TESTS / OTHER
N - Standard penetration test value
▽ - Water level

0 10
Horizontal Scale (metres)
Vertical Exaggeration = 2.5

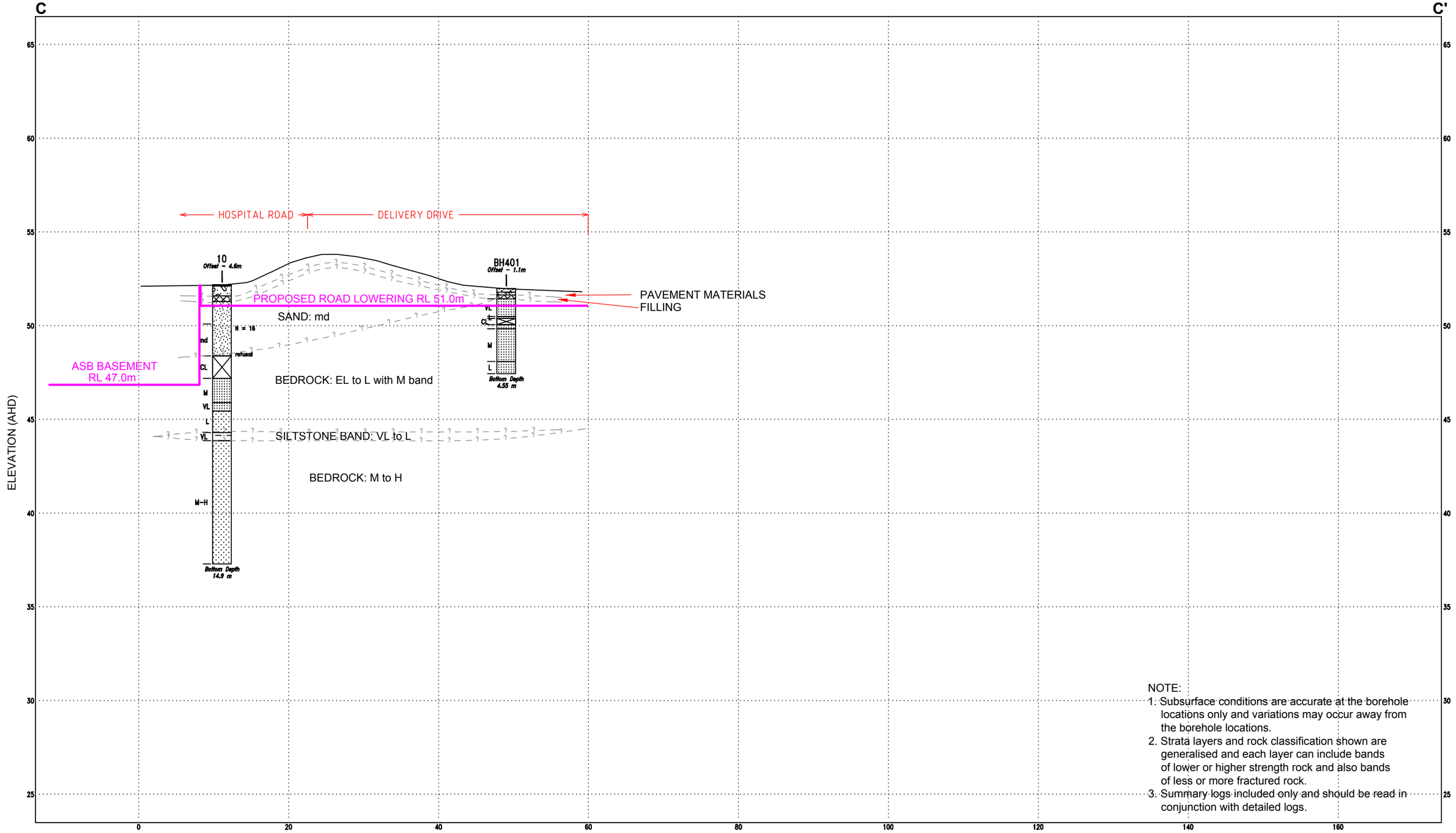
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: LendLease Building Pty Ltd		PROJECT No: 72505.13
OFFICE: Sydney	DRAWN BY:	DRAWING No: 3
SCALE: 1:500 (H) 1:200 (V) @ A3	DATE: 13.09.2019	REVISION: 0

TITLE: **Interpreted Geotechnical Cross Section B-B'**
Randwick Campus Redevelopment
Hospital Road and Delivery Drive, RANDWICK

C

C'



NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs included only and should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Concrete
- Filling
- Roadbase
- Sand
- Sandstone
- Sandstone fine grained
- Siltstone

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

SOIL CONSISTENCY
md - medium dense

TESTS / OTHER
N - Standard penetration test value
WL - Water level

0 10
Horizontal Scale (metres)

Vertical Exaggeration = 2.5

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: LendLease Building Pty Ltd		TITLE: **Interpreted Geotechnical Cross Section C-C'**	PROJECT No: 72505.13
OFFICE: Sydney	DRAWN BY: PSCH	**Randwick Campus Redevelopment**	DRAWING No: 4
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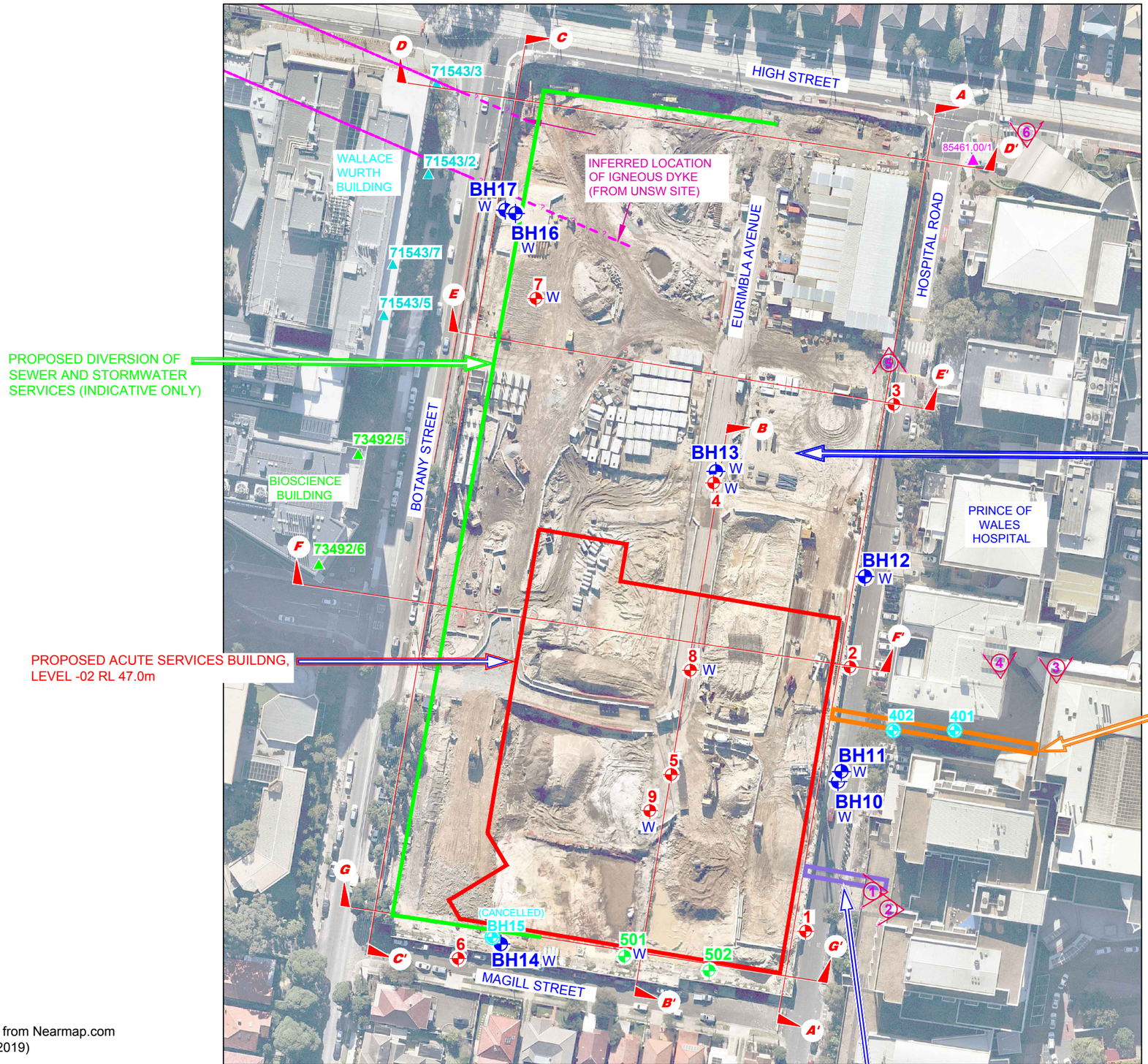

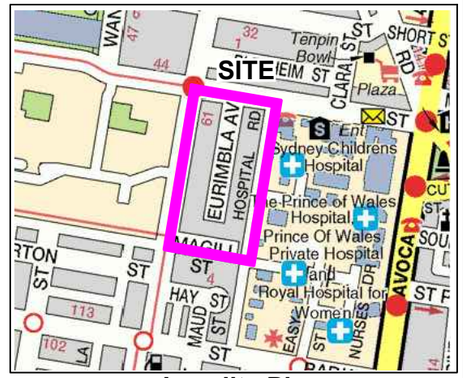

Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 1.7.2019)

0 5 10 20 30 40 50 75 100 125m
1:1250 @ A3

LEGEND

- Previous borehole (UNSW Wallace Wurth Building, Proj. 71543, 2010)
- Previous borehole (UNSW Bioscience Building Proj. 73492, 2013)
- Previous borehole (Prince of Wales Hospital Proj. 85461.00, 2016)
- Previous borehole (Proj. 72505.11, Feb 2018)
- Previous borehole (72505.13, R.001, June 2018)
- W Groundwater monitoring well
- Current borehole (72505.13 R.024 Sept. 2019)
- Current borehole (72505.13 R.023 Sept. 2019)
- A A′ Interpreted geotechnical Cross Section
- 1 Photo number with direction of view

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Lendlease Building Pty Ltd		TITLE: **Locations of Previous and Current Boreholes** **Randwick Campus Redevelopment** **Hospital Road and High, Magill and Botany Streets, RANDWICK**
OFFICE: Sydney	DRAWN BY: PSCH	
SCALE: 1:1250 @ A3	DATE: 2.9.2019	

PROJECT No:	72505.13
DRAWING No:	1
REVISION:	0

Appendix C

Results of Previous Investigations

BOREHOLE LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 48.5 AHD
EASTING: 337072.8
NORTHING: 6245429.4
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 72505.11
DATE: 18 - 19/9/2017
SHEET 1 OF 2

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 F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
48	0.05	ASPHALTIC CONCRETE - typically <10mm diameter										
	0.33	ROADBASE - dark grey, angular, igneous gravel, typically <30mm diameter							A			
	0.75	FILLING - grey-brown medium to coarse grained sand filling with some fine to medium grained sandstone gravel							A			
47	1.3	0.7m: rootlets							A			
		SAND - pale grey, medium grained sand with some dark brown silty bands, damp, occasional rootlets										
46	2	SAND - medium dense, orange-brown, medium grained sand with a trace of clay, damp							S			9,12,10 N = 22
	3							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 20°				
45	3.4	SANDSTONE - very low strength, light grey medium grained sandstone with some low strength bands										
	3.9	SANDSTONE - medium strength, slightly weathered then fresh, slightly fractured, light grey medium grained sandstone with some carbonaceous flecks						3.94m: J30°, ro, un, cln				PL(A) = 0.89
44	4							4.72m: J30°, he, un, fe stn				PL(A) = 0.4
	5	5.37-5.61m: very low strength band with dark grey siltstone laminations						5.31-5.43m: B (x3) 5°, ro, un, cbs, un 5.53m: Ds, 80mm 5.7m: Ds, 60mm	C	100	83	PL(A) = 0.09
43	6											
								6.65m: Ds, 10mm 6.77m: Ds, 20mm				PL(A) = 0.42
42	7											PL(A) = 0.71
	8							7.92m: B0°- 5°, ro, un, cly vn	C	100	99	PL(A) = 0.83
41	8.8	SANDSTONE - high strength, fresh, slightly fractured and unbroken, light grey medium and coarse grained sandstone. Typically indistinctly bedded										
	9							9.12m: J30°, ro, un, cln				PL(A) = 1.08
40												
39												

RIG: DT100 **DRILLER:** SS **LOGGED:** ARM/RMM **CASING:** HW to 2.5

TYPE OF BORING: Diatube to 0.05m; Non-destructive drilling to 1.6m; Solid flight auger (TC-bit) to 2.5m; Rotary to 3.9m; NMLC-Coring to 18.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Water loss at approximately 14.5m (~50%)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 48.5 AHD
EASTING: 337072.8
NORTHING: 6245429.4
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 72505.11
DATE: 18 - 19/9/2017
SHEET 2 OF 2

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 F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
38		SANDSTONE - high strength, fresh, slightly fractured and unbroken, light grey medium and coarse grained sandstone. Typically indistinctly bedded *(continued)*										PL(A) = 1.32
	11							10.72m: B10°, ro, pl, cly vn				
37									C	100	100	PL(A) = 1.32
	12											
36												PL(A) = 3.34
	13 12.95	SANDSTONE - medium to high strength, fresh, light grey, medium and coarse grained sandstone with some fine quartz gravel bands and carbonaceous laminations										PL(A) = 0.96
35	13.3	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium grained sandstone. Typically indistinctly bedded						13.65m: B5°, ro, un, cln				
	14											PL(A) = 1.86
34									C	100	95	
	15							15.16-15.31m: B (x3) 5°-10°, ro, un, cly vn				PL(A) = 2.33
33								15.53m: J30°, ro, un, cln				
	16 16.0	SANDSTONE - medium strength, fresh, light grey to grey fine to medium grained sandstone with some siltstone laminations										PL(A) = 0.66
32	16.57	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium and coarse grained sandstone. Indistinctly bedded to massive										
	17								C	100	98	
31								17.23-17.28m: B (x2) 0°-5°, ro, un, cly vn				PL(A) = 1.54
	18 18.0	Bore discontinued at 18.0m - target depth reached										
30												
	19											
29												

RIG: DT100 **DRILLER:** SS **LOGGED:** ARM/RMM **CASING:** HW to 2.5

TYPE OF BORING: Diatube to 0.05m; Non-destructive drilling to 1.6m; Solid flight auger (TC-bit) to 2.5m; Rotary to 3.9m; NMLC-Coring to 18.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Water loss at approximately 14.5m (~50%)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 1 PROJECT: RANDWICK SEPTEMBER 2017

3.9m – 8.0m

BORE: 1 PROJECT: RANDWICK SEPTEMBER 2017

8.0m – 13.0m

BORE: 1 PROJECT: RANDWICK SEPTEMBER 2017

13.0m – 18.0m

BOREHOLE LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 55.2 AHD
EASTING: 337086
NORTHING: 6245508.3
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 72505.11
DATE: 18 - 20/9/2017
SHEET 1 OF 2

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 F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
55	0.05	ASPHALTIC CONCRETE							A			
	0.3	ROADBASE - dark grey, sandy fine to medium grained igneous gravel roadbase (possibly recycled road surface)							A*			
	0.6	FILLING - grey-brown, fine to medium sand filling with trace fine gravel and glass fragments, damp							A			
54	1	SAND - medium dense, yellow-brown, medium grained sand, damp										
									A			
53	2	- with some dark brown silty sand bands to 2.0m							S			4,7,7 N = 14
52	3											
51	4							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 20°	S			6,11,13 N = 24
50	5	5.0 5.1 SANDSTONE - very low strength, light yellow-brown, medium grained sandstone						5.18m: B0°- 5°, ro, un, fe stn 5.27m: B5°, ro, pl, cln				PL(A) = 0.43
		SANDSTONE - medium strength, slightly weathered, slightly fractured then unbroken, light yellow-brown medium grained sandstone. Typically indistinctly bedded with some distinct ironstained beds										PL(A) = 0.62
49	6								C	100	92	PL(A) = 0.71
48	7							>>				PL(A) = 0.67
47	8								C	100	100	PL(A) = 0.94
46	9	9.47-9.7m: ironstained cross bedding at 70°- 45°						9.47m: B5°, he, fe stn				PL(A) = 0.91

RIG: DT100 **DRILLER:** SS **LOGGED:** ARM/RMM **CASING:** HW to 2.5

TYPE OF BORING: Diatube to 0.05m; Non-destructive drilling to 1.9m; Solid flight auger (TC-bit) to 2.0m; Rotary to 5.1m; NMLC-Coring to 19.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD1/20170918 taken at 0.3m to 0.4m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 55.2 AHD
EASTING: 337086
NORTHING: 6245508.3
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 72505.11
DATE: 18 - 20/9/2017
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE *(continued)*										
45	10.66	SANDSTONE - medium strength, fresh, slightly fractured, light grey medium and fine grained sandstone. Typically indistinctly bedded						10.63m: Ds, 30mm				PL(A) = 0.71
44	11							11.46m: B5°, ro, pl, cly vn	C	100	97	
	11.68	SILTSTONE - low strength, slightly weathered, dark grey siltstone with approximately 30% sandstone beds						11.69m: Ds, 10mm				PL(A) = 0.17
	11.88	SANDSTONE - high strength, fresh, unbroken, light grey to grey, medium and coarse grained sandstone. Typically indistinctly bedded and massive						11.87m: Ds, 10mm				PL(A) = 1.24
43	12											
42	13							13.48m: Ds, 30mm				PL(A) = 0.9
								13.68m: Ds, 20mm				
41	14											PL(A) = 1.22
									C	100	94	
40	15	15.34-15.8m: some distinct siltstone beds						15.09-15.28m: B (x4) 10°, pl, cly, 5mm				PL(A) = 1.29
								15.72m: B10°, pl, he				
39	16							15.76m: Ds, 20mm				PL(A) = 1.31
38	17											PL(A) = 1.52
								17.63m: Ds, 10mm	C	100	99	
37	18											PL(A) = 1.25
36	19 19.0	Bore discontinued at 19.0m - target depth reached										

RIG: DT100 **DRILLER:** SS **LOGGED:** ARM/RMM **CASING:** HW to 2.5

TYPE OF BORING: Diatube to 0.05m; Non-destructive drilling to 1.9m; Solid flight auger (TC-bit) to 2.0m; Rotary to 5.1m; NMLC-Coring to 19.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD1/20170918 taken at 0.3m to 0.4m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 2 PROJECT: RANDWICK SEPTEMBER 2017

5.1m – 9.0m

BORE: 2 PROJECT: RANDWICK SEPTEMBER 2017

9.0m – 14.0m

BORE: 2 PROJECT: RANDWICK SEPTEMBER 2017

14.0m – 19.0m

BOREHOLE LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and Delivery Drive, Randwick

SURFACE LEVEL: 52.0 AHD
EASTING: 337117
NORTHING: 6245489
DIP/AZIMUTH: 90°/--

BORE No: BH401
PROJECT No: 72505.13
DATE: 16/8/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
52	0.2	CONCRETE SLAB: 2x 14mm diameter steel bars							A/E			
	0.35	ROADBASE							A			
	0.55	FILLING: brown, fine to medium grained, sand filling with some fine igneous gravel, moist										
51	1	SANDSTONE: very low strength, light grey and yellow fine to medium grained sandstone										
	1.6	CORE LOSS						1.6m: CORE LOSS: 330mm	A			
	1.93											PL(A) = 0.25
50	2	SANDSTONE: low strength, moderately weathered, slightly fractured, orange brown, medium grained sandstone						2.23m: B 0°, pl, ro, fe				PL(A) = 0.4
	2.15	SANDSTONE: medium strength, slightly to moderately weathered, slightly fractured, light grey, yellow and red, fine to medium grained sandstone						2.7m: B 0°, pl, ro, cly vn				
49	3	2.83-3.0m: low strength band							C	89	96	PL(A) = 0.28
		3.6-3.73m: high strength band of iron indurated sandstone						3.73m: B 0°, pl, ro, fe				PL(A) = 1.3
	3.9											PL(A) = 0.45
48	4	SANDSTONE: low strength, slightly weathered, slightly fractured, grey, yellow and pink, fine to medium grained sandstone										PL(A) = 0.13
	4.55	Bore discontinued at 4.55m Target depth reached						4.4m: J 45°, pl, ro				
47	5											
46	6											
45	7											
44	8											
43	9											

RIG: BG Rig 8 **DRILLER:** BG Drilling **LOGGED:** KR **CASING:** HQ to 1.6m

TYPE OF BORING: Diacore to 0.2m; Hand auger to 0.55m; Solid flight auger (TC-bit) to 1.6m; NMLC coring to 4.55m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Surface level is interpolated from survey drawing (no reference number). Co-ordinates are approximate and were obtained using google earth.com.au

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 401 **PROJECT: Randwick** **August 2019**

1.60 – 4.55 m

BOREHOLE LOG

CLIENT: Lendlease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: □□□□□□R□□d □□d D□□□□r□Dr□□□□R□□d□□□□

SURFACE LEVEL: 53.6 AHD
EASTING: 337098.4
NORTHING: 6245489.2
DIP/AZIMUTH: 90°/--

BORE No: BH402
PROJECT No: 72505.13
DATE: 16/8/2019
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
53	0.19	CONCRETE SLAB: 18mm diameter steel bar			0.21				
		FILLING: brown, fine to medium grained gravelly sand filling with some fine igneous gravel, moist		A/E	0.25				
	0.47			A/E	0.35				
		Bore discontinued at 0.47m Hand auger refusal in filling			0.45				
52	1								1
51	2								2
50	3								3
49	4								4
48	5								5
47	6								6
46	7								7
45	8								8
44	9								9

RIG: Hand Tools **DRILLER:** BG Drilling **LOGGED:** KR **CASING:** Uncased

TYPE OF BORING: Diacore to 0.19m; hand auger to 0.47m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Surface level and co-ordinates measured using digital, global positioning system, accurate to <0.1m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 51.9 AHD
EASTING: 337044.9
NORTHING: 6245563
DIP/AZIMUTH: 90°/--

BORE No: 4 (72505.11)
PROJECT No: 72505.13
DATE: 19 - 21/9/2017
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
51.9	0.04	ASPHALTIC CONCRETE (typically <10mm diameter)		A	0.07				Gatic Cover
51.8	0.07	ASPHALTIC CONCRETE (typically <20mm diameter)		A	0.15				
51.7	0.2	ROADBASE - dark grey, angular, igneous gravel typically 40-80mm diameter, slight hydrocarbon odour		A	0.5				
51.1	0.8	FILLING - orange-brown, medium grained sand filling with some sandstone gravel and a trace of clay (ripped sandstone)		A	0.6				
50.9	1			A	0.9				
50.8				A	1.0				
50.5				A	1.4				
50.3	1.6			A	1.6				
50.1	1.8			A	1.9				
50	2			A	2.0				Backfill
49.9				A	2.5				
49.8	2.6	SAND - pale yellow-brown, fine to medium grained sand, damp		S			8,14,17 N = 31		
49.3	3	2.2m: brown		S	2.95				
49.1	3.5			S	3.5				
49.1	3.65	SAND - medium dense to dense, orange, fine to medium sand with some clay, damp		S	3.65				Bentonite
48.9	4			C	3.9		PL(A) = 0.22		
48.8	4.15	SANDSTONE - extremely low to very low strength sandstone		C	4.15				
48.3	4.65			C	4.65				
48.1	4.85			C	4.85				
47.9	5	SANDSTONE - low strength, slightly weathered, fractured to slightly fractured, pale brown, medium to coarse grained sandstone		C	4.95		PL(A) = 0.76		
47.6	5.29			C	5.29				Gravel Screen 4-7m
47.4	5.5			C	5.5				
47.1	5.8			C	5.8				
46.9	6	SANDSTONE - medium strength, slightly weathered then fresh, slightly fractured and fractured, medium to coarse grained sandstone		C	5.93		PL(A) = 0.71		
46.6	6.3			C	6.3				
46.3	6.6			C	6.6				
46.1	6.8			C	6.8				
45.9	6.91	- limonite staining to 4.40m		C	6.95		PL(A) = 0.71		
45.9	7	5.5m: distinct irregular bedding dipping 15°- 20°		C	7				Bentonite
45.8		6.4m: indistinct irregular bedding dipping 0°- 20°		C	7.2				
45.6	7.4			C	7.4				
45.4	7.6			C	7.6				
45.1	7.8			C	7.8				
44.9	8	SANDSTONE - medium strength, fresh, slightly fractured and unbroken, pale grey, medium to coarse grained sandstone, massive, trace carbonaceous flecks		C	7.95		PL(A) = 0.66		
44.6	8.3			C	8.38				
44.4	8.5			C	8.5				
44.1	8.8			C	8.8				
43.9	8.95			C	8.95		PL(A) = 0.95		
43.6	9.3			C	9.3				
43.4	9.5			C	9.5				
43.1	9.8			C	9.8				
42.9	9.95			C	9.95		PL(A) = 0.73		
42.6	10.3			C	10.3				
42.4	10.5			C	10.5				
42.1	10.8			C	10.8				
41.9	10.88			C	10.88		PL(A) = 0.61		
41.8	11			C	11				
41.6	11.3			C	11.3				
41.5				C	11.39				
41.3	11.6			C	11.6				
41.1	11.8			C	11.8				
40.9	11.95			C	11.95		PL(A) = 0.69		
40.8	12	SANDSTONE - medium to high strength, fresh, slightly fractured to unbroken, pale grey, medium to coarse grained sandstone, indistinct bedding typically dipping 10°- 20°		C	12				Backfill
40.6	12.3			C	12.3				
40.4	12.5			C	12.5				
40.1	12.8			C	12.8				
39.9	12.95			C	12.95		PL(A) = 1.1		
39.6	13.3			C	13.3				
39.4	13.5			C	13.5				
39.1	13.8			C	13.8				
38.9	13.95			C	13.95		PL(A) = 0.91		
38.8	14			C	14				
38.6	14.3			C	14.3				
38.5				C	14.37				
38.3	14.6	SANDSTONE - high then medium strength, fresh, unbroken, pale grey, fine to medium grained sandstone, occasional carbonaceous laminations and flecks		C	14.6				
38.1	14.8			C	14.8				
37.9	15			C	14.95		PL(A) = 1.33		
37.6	15.3			C	15.3				
37.4	15.5			C	15.5				
37.1	15.8			C	15.8				
36.9	15.93			C	15.93		PL(A) = 0.59		
36.8	16			C	16				
36.6	16.3			C	16.3				
36.4	16.5			C	16.5				
36.1	16.8			C	16.8				
35.9	17	16.78-16.97m: siltstone clasts and laminations, slightly fractured		C	17				
35.8	17.04			C	17.04		PL(A) = 0.76		
35.6	17.31	Bore discontinued at 17.31m		C	17.31				
34.9	18	- target depth reached							

RIG: Bobcat **DRILLER:** GM **LOGGED:** ARM **CASING:** HW to 3.65m

TYPE OF BORING: Diatube to 0.08m; NDD to 1.7m; Solid flight auger (TC-bit) to 3.65m; NMLC-Coring to 17.31m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 50.5 AHD
EASTING: 337038.1
NORTHING: 6245507
DIP/AZIMUTH: 90°/--

BORE No: 8 (72505.11)
PROJECT No: 72505.13
DATE: 23 - 24/1/2018
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
50.4	0.1	ASPHALTIC CONCRETE (typically <10mm diameter)							Gatic Cover
50.25	0.25			A	0.4				Backfill
50.1	0.6	ROADBASE - dark grey, angular, igneous gravel typically 40-80mm diameter		A*	0.5				
					0.6				
49.5	1	FILLING - pale grey and brown sandstone gravel and cobbles up to 100mm diameter (ripped sandstone)			0.7				Bentonite
				A	1.6				
49	1.7	SAND - pale brown, medium grained sand with a trace of fine gravel, damp							
48.4	2								Gravel Screen 2-3m
	2.6			S	2.5		7,10/10mm refusal		
48.23	2.66				2.66				
48	2.77	SANDSTONE - extremely low strength, orange-brown sandstone			2.77		PL(A) = 0.26		
	3			C	2.95				Bentonite
47.4		SANDSTONE - low to medium strength, slightly weathered, fractured to slightly fractured, orange and grey, medium to coarse grained sandstone			3.88		PL(A) = 0.43		
47	4				3.91				
46.4					4.95		PL(A) = 0.6		
	5			C					
45.55	5.45								
		SANDSTONE - high then medium strength, fresh, slightly fractured to unbroken, pale grey, medium to coarse grained sandstone with a trace of carbonaceous flecks			5.95		PL(A) = 1.12		
44.4	6	6.4-6.9m: red-brown iron staining							
					6.89		PL(A) = 0.69		
43.5	7				6.95				
					7.95		PL(A) = 0.63		
43	8	8.1-8.55m: low strength band		C	8.41		PL(A) = 0.22		
42.4					8.95		PL(A) = 0.63		
	9								
41.5					9.93		PL(A) = 1.03		
	10				9.95				
40.09	10.41	10.2-10.41m: with 25% siltstone clasts up to 20mm diameter, fragmented (possibly drilling induced)							Backfill
40	11	LAMINITE - low strength, fresh, slightly fractured, dark grey siltstone interlaminated and interbedded with 40% pale grey, fine grained sandstone			10.95		PL(A) = 0.18		
39.05	11.45			C					
39	12	SANDSTONE - high strength, fresh, slightly fractured to unbroken, pale grey, medium to coarse grained sandstone, massive			11.95		PL(A) = 2.23		
					12.75		PL(A) = 1.54		
38	13	12.84-13.03m: with 50% carbonaceous laminations 13.03-13.21: fine to medium grained			12.92				
37.5		13.21m: medium to coarse grained, irregular bedding dipping 10-20°			13.85		PL(A) = 1.19		
37	14			C					
36.5		14.8m: massive			14.95		PL(A) = 1.27		
	15								
35.5					15.89		PL(A) = 1.36		
35	16				15.95				
34.5		16.44m: irregular bedding dipping 10-20°		C					
34	17				16.95		PL(A) = 1.57		
33.11	17.39				17.39				
		Bore discontinued at 17.39m - target depth reached							
32.5	18								

RIG: Bobcat **DRILLER:** GM **LOGGED:** ARM **CASING:** HW to 2.5m; HQ to 2.7m

TYPE OF BORING: Diatube to 0.10m; Non-destructive drilling to 1.7m; Solid flight auger (TC-bit) to 2.77m; NMLC-Coring to 17.39m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 49.2 AHD
EASTING: 337026.2
NORTHING: 6245465.1
DIP/AZIMUTH: 90°/--

BORE No: 9 (72505.11)
PROJECT No: 72505.13
DATE: 23 - 25/1/2018
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
49	0.05	ASPHALTIC CONCRETE (typically <10mm diameter)		A	0.15				Gatic Cover
	0.15				0.2				Backfill
	0.4	ROADBASE - dark grey, angular, igneous gravel typically 40-80mm diameter		A	0.6				
48	1				0.7				1 Bentonite
	1.3	FILLING - pale grey and brown sandstone gravel and cobbles up to 150mm diameter (ripped sandstone)		A	1.4				
47	2				1.5				2
		SAND - dark grey, slightly silty fine to medium grained sand with a trace of rootlets, humid		A	1.9				
	2.4				2.0				
		SAND - pale grey, medium grained sand, damp		S	2.5		3,5,5 N = 10		
46	3	2.2-2.4m: dark brown, silty band			2.95				3
		SAND - medium dense, yellow-brown, fine to medium grained sand, damp							
45	4			S	4.0		5,7,7 N = 14		4 Gravel Screen 1.5-6.5m
					4.45				
44	5	5.0m: becoming clayey							5
	5.5			S	5.5		3,7,9 N = 16		
	5.8	SILTY CLAY - stiff, orange-brown and grey, silty clay with some fine sand, Mc>PL			5.95		pp = 450		
43	6				6.03		pp = 350		6
	6.03	CLAY - stiff, grey, clay with some silt, high plasticity, Mc~PL			6.1				
					6.4		pp = 550-600		
42	7	LAMINITE - extremely low strength, extremely weathered, interbedded then interlaminated pale grey sandstone and dark grey siltstone (soil like properties)		C	6.8		PL(A) = 0.05		7 Bentonite
					6.95		pp = 450-600		
	7.8	6.2-6.5m: Distinct orange iron staining			7.1				
41	8				7.95		PL(A) = 0.6		8
		SANDSTONE - medium strength, fresh, slightly fractured, pale grey, medium to coarse grained sandstone, irregular bedding dipping 10-20°			8.49				
	8.92				8.95		PL(A) = 1.11		
40	9	8.5-8.56m: 50% fine siltstone laminations							9
		SANDSTONE - high strength, fresh, slightly fractured to unbroken, pale grey, medium to coarse grained sandstone, irregular bedding dipping 10-20°		C	9.95		PL(A) = 1.04		
39	10								10
					10.9		PL(A) = 1.12		
38	11								11
					11.56				
	12				11.92		PL(A) = 0.9		12
37									Backfill
		12.48-12.58m: grey, fine to medium grained							
	13	12.58-13.48m: massive		C	12.95		PL(A) = 1.72		13
36									
	14				13.9		PL(A) = 1.38		14
35									
					14.59				
	15				14.95		PL(A) = 1.85		15
34									
	16			C	15.95		PL(A) = 1.4		16
33		16.23-17.27m: with some quartz gravel bands and carbonaceous laminations							
	17				16.95		PL(A) = 1.01		17
32									
	17.49	17.27m: massive			17.38		PL(A) = 1.13		
		Bore discontinued at 17.49m - target depth reached			17.49				
31	18								18

RIG: Bobcat **DRILLER:** GM **LOGGED:** ARM **CASING:** HW to 4.0m; HQ to 6.0m

TYPE OF BORING: Diatube to 0.10m; NDD to 1.6m; Solid flight auger (TC-bit) to 4.0 m; Rotary to 6.03 m; NMLC-Coring to 17.49m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 52.2 AHD
EASTING: 337082
NORTHING: 6245474
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 72505.13
DATE: 2-5-2018
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
52	0.07	ASPHALTIC CONCRETE		D	0.1				Gatic Cover
					0.2				
	0.6	ROADBASE: dark grey, sand fine to coarse igneous gravel, damp (typically <30 mm diameter)		D	0.6				
	0.9	FILLING: brown medium to coarse sandy filling with some silt, damp			0.7				
51	1	SAND: brown, medium sand with some silt, damp							1
									Backfill
50	2	2.1 m: medium dense		S	2.1		3,6,10 N = 16		2
					2.55				
49	3								3
				S	3.6		10,20/20 refusal		
	3.8	Possibly very low strength rock			3.8				Bentonite
48	4			C			Core Loss		4
47	5	5.0 SANDSTONE: medium strength, moderately weathered, slightly fractured, red/brown, medium grained sandstone			5.0				5
					5.13		PL(A) = 0.48		
				C					
46	6								6
	6.3	SANDSTONE: very low strength, slightly weathered, slightly fractured, grey-brown, medium grained sandstone			6.21		PL(A) = 0.08		Gravel Screen 4.3-7.3m
	6.75				6.63				
45	7	SANDSTONE: low strength, fresh stained, slightly fractured, light grey, fine to medium grained sandstone, some carbonaceuos flakes, typically indistinct bedding			7.09		PL(A) = 0.15		7
				C					
44	7.89								
	8	SILTSTONE: very low strength, slightly weathered, unbroken, dark grey siltstone with sandstone laminations (20%)			8.15		PL(A) = 0.05		8
	8.32				8.7		PL(A) = 0.85		Bentonite
		SANDSTONE: medium and medium to high strength, fresh, slightly fractured to unbroken, light grey, fine to medium grained sandstone			8.72				
43	9				9.23		PL(A) = 0.48		9
42	10			C					10
		10.47-12.9 m: cross bedding typically 5-15°			10.59		PL(A) = 0.3		
41	11								11
					11.65		PL(A) = 0.47		Backfill
					11.79				
40	12			C					12
					12.78		PL(A) = 0.98		
39	13				12.9				13
38	14			C	13.95		PL(A) = 1.08		14
					14.76		PL(A) = 0.5		
37	14.9	Bore discontinued at 14.9m Target depth reached			14.9				15
	15								

RIG: Han Jin 8D **DRILLER:** BG Drilling **LOGGED:** JAP **CASING:** HW to 4.0 m

TYPE OF BORING: Diatube to 0.1 m, Non-destructive drilling to 1.9 m, solid flight auger (TC-bit) to 3.8 m, NMLC coring to 14.9 m

WATER OBSERVATIONS: No free ground water observed whilst augering, 20% water loss from 3.8-6.0 m, 50% water loss from 11.0-11.5 m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 52.5 AHD
EASTING: 337083
NORTHING: 6245477
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 72505.13
DATE: 1-5-2018
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
52	0.07	ASPHALTIC CONCRETE							Gatic Cover
		ROADBASE: dark grey, sandy fine to coarse igneous gravel, damp, gravels (typically <30mm diameter)		A	0.1 0.2				
	0.5	FILLING: brown, medium to coarse sand filling, with some silt, damp		A	0.5 0.6				Backfill
51	1.1	SAND: loose to medium dense, yellow brown medium sand, with some dark brown silty sand bands, damp							Bentonite
				S	2.0		3,2,3 N = 5		
					2.45				
50		3.0 m: medium dense		S	3.0		4,5,7 N = 12		
					3.45				Screen 2-5m Gravel
49				S	4.0		9,15,5/20 refusal Bouncing		
	4.3	SANDSTONE: extremely low to very low strength, light brown/ red-brown, medium grained sandstone, damp 4.5m to 5.0m: low to medium strength			4.45				
48	5.0	Bore discontinued at 5.0m Limit of investigation							
47									

RIG: Han Jin 8D **DRILLER:** BG Drilling **LOGGED:** JAP **CASING:** HW to 5.0 m

TYPE OF BORING: Diatube to 0.07 m, Non-destructive drilling to 1.6 m, Solid flight auger (TC-bit) to 2.0 m, Rotary to 5.0 m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 55.7 AHD
EASTING: 337090
NORTHING: 6245535
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 72505.13
DATE: 30-4-2018
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
55.61	0.09	ASPHALTIC CONCRETE		D	0.1				Gatic Cover
					0.2				
55.1	0.6	ROADBASE: dark grey, sandy fine to coarse grain igneous gravel, damp		D	0.8				
54.9	0.8	FILLING: brown, medium to coarse sand filling, with some silt, damp			0.9				Backfill
54.5	1.2	0.8-1.2 m: with some roots.							
		SAND: medium dense, yellow brown, medium sand, damp			1.6				
				S			2,7,9 N = 16		
					2.05				
									Bentonite
					3.0				
				S			5,10,13 N = 23		
					3.45				
					4.5				
				S			6,11,13 N = 24		
					4.95				Gravel
									Screen 3.8-6.8m
				S	6.0		11/110 refusal		
49.61	6.1	SANDSTONE: high strength, slightly weathered becoming fresh, slightly fractured, pale grey, medium to coarse grained sandstone, some iron stained bedding			6.1				
					6.11				
					7.0		PL(A) = 2.42		
				C			PL(A) = 2.29		Bentonite
47.61	8.8	SANDSTONE: high strength, fresh, unbroken, pale grey, medium grained sandstone			8.79		PL(A) = 1.24		
					8.8				
		9.40-9.45 m: bedding typically 10-20°			9.81		PL(A) = 1.9		
				C					
					10.72		PL(A) = 2.54		Backfill
					11.48		PL(A) = 0.93		
					11.81				
				C	12.06		PL(A) = 1.33		
					12.27				
				C	12.55				
				C					
42.61	13.57	13.57-14.15 m: becoming slightly fractured			13.71		PL(A) = 1.2		
42.41	13.76	13.66-13.76 m: bedding typically 5 - 10°			14.0		PL(A) = 1.04		
41.61	14.15	Bore discontinued at 14.15m Target depth reached			14.15				

RIG: Han Jin 8D **DRILLER:** BG Drilling **LOGGED:** JAP **CASING:** HW to 5.5 m

TYPE OF BORING: Diatube to 0.09 m, NDD to 1.5 m, Solid flight auger (TC-bit) to 4.0 m, Rotary to 6.1 m, HQ Coring to 14.15 m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 52.0 AHD
EASTING: 337045
NORTHING: 6245565
DIP/AZIMUTH: 90°/--

BORE No: 13
PROJECT No: 72505.13
DATE: 3-5-2018
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
52	0.05	ASPHALTIC CONCRETE: (typically <10 mm diameter)							Gatic Cover
	0.11	ASPHALTIC CONCRETE: (typically <20 mm diameter)							
		ROADBASE: dark grey, angular igneous gravels, (typically 30-80 mm diameter)							Backfill
	0.4								
	0.6	FILLING: grey-brown, ripped sandstone filling, (typically 40-80mm diameter)							Bentonite
	0.9	FILLING: orange brown, medium sandy gravel filling with some coarse sandstone gravel, damp							
51	1	SAND: medium dense, pale yellow, medium sand, damp							1
					1.8				
50	2			S			2,6,9 N = 15		2
					2.25				Gravel
	2.5	SAND: medium dense to dense, brown orange, fine to medium sand with some silt, damp							Screen 1.3-3.8m
					2.8				
49	3			D					3
					3.0				
				S			14,8/80 refusal		
	3.2	SANDSTONE: extremely low to very low strength, orange brown sandstone			3.2				
	3.8	Bore discontinued at 3.8m Limit of investigation							
48	4								4
47	5								5

RIG: Han Jin 8D **DRILLER:** BG Drilling **LOGGED:** JAP **CASING:** Uncased

TYPE OF BORING: Diatube to 0.15 m, Non-destructive drilling to 1.6 m, solid flight auge (TC-bit) to 3.8 m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⊻	Water level	V	Shear vane (kPa)

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WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 47.5 AHD
EASTING: 336983
NORTHING: 6245427
DIP/AZIMUTH: 90°/--

BORE No: 14
PROJECT No: 72505.13
DATE: 4-5-2018
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
47.5	0.09	CONCRETE SLAB		A	0.1				Gatic Cover
				A	0.2				
		FILLING: light brown and brown, fine to medium sand filling with a trace of clay and gravel, damp			0.3				Backfill
					0.4				
	1.1			A	0.9				
	1.3	SILTY SAND: dark brown, fine to medium silty sand with some clay and a trace of rootlets, moist			1.0				Bentonite
				A	1.6				
	1.9	SAND: yellow, fine to medium sand, moist			1.7				
				S	2.0		2,2,3 N = 5		
		SAND: loose, orange brown, fine to medium sand with a trace of clay, moist			2.45				
					3.0		3,3,5 N = 8		
	3.2	SAND: loose, pale brown/grey, fine to medium sand, moist		S	3.45				
	4.5	SAND: loose, brown, fine to medium sand, saturated							Gravel Screen 2-7.5m
				S	5.0		2,2,2 N = 4		
					5.45				
	5.8	SILTY SAND: apparently loose, dark grey, fine to medium silty sand with trace of clay, saturated (slight hydrocarbon odour)		E	6.1				
				A	6.3				
	6.6			S	6.5		8/100mm Bouncing		
	6.9	SANDSTONE: very low to low strength, grey-brown sandstone			6.6				
					6.8		PL(A) = 0.03		
	7.64	SANDSTONE: very low strength, highly weathered, slightly fractured, pale grey and orange, medium to coarse grained sandstone with some medium strength, iron cemented bands		C	7.17				
					8.14		PL(A) = 0.14		Bentonite
	8.8	SANDSTONE: low strength, slightly and moderately weathered, slightly fractured, pale grey and orange-brown, medium to coarse grained sandstone			8.8				
		SANDSTONE: medium strength, fresh, slightly fractured, pale grey, medium to coarse grained sandstone, bedding typically 0-10°			9.83		PL(A) = 0.5		
	10.32	SANDSTONE: as above		C	10.73		PL(A) = 1.6		
		SANDSTONE: high strength, fresh, unbroken, pale grey, medium to coarse grained sandstone, bedding typically 0-10°			11.71		PL(A) = 0.48		
					11.8				
					12.24		PL(A) = 1.6		
				C					Backfill
		13.6-15.4 m: slightly fractured			13.67		PL(A) = 1.3		
					14.45				
					14.61		PL(A) = 1.2		
				C	15.78		PL(A) = 2		
					16.86		PL(A) = 1.34		
	17.52	Bore discontinued at 17.52m			17.49		PL(A) = 1.6		
		Target depth reached			17.52				

RIG: Han Jin 8D **DRILLER:** BG Drilling **LOGGED:** JAP **CASING:** HW to 6.6 m

TYPE OF BORING: Diatube to 0.09 m, Hand Auger to 1.7 m, Solid flight auger (TC-bit) to 3.0 m, Rotary to 6.8 m, NMLC-Coring to 17.52

WATER OBSERVATIONS: Ground water observed at 4.5 m, 100% water loss from 10.7 m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 55.2 AHD
EASTING: 336986
NORTHING: 6245643
DIP/AZIMUTH: 90°/--

BORE No: 16
PROJECT No: 72505.13
DATE: 8-5-2018
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
55	0.12	CONCRETE SLAB							Gatic Cover
		FILLING: brown, fine to medium sand filling with some silt and trace of igneous gravel, humid							
	0.55	SAND: yellow, fine to medium sand, damp							Backfill
54	1								1
									Bentonite
	2.0	SAND: medium dense, yellow, fine to medium sand, damp		S	2.0 2.45		4,9,11 N = 20		2
53	3								3
52	3.2	SAND: medium dense, brown, fine to medium sand with trace of clay, damp		S	3.5 3.95		7,9,20 N = 29		Gravel Screen 2.1-4.7m
	4.1	SANDSTONE: very low strength, orange-brown and light grey, medium to coarse grained sandstone		S	4.1 4.15		6/30, Bouncing		4
51	4.7	Bore discontinued at 4.7m Limit of investigation							
50	5								5

RIG: Han Jin 8D **DRILLER:** BG Drilling **LOGGED:** JAP **CASING:** HW to 4.0 m

TYPE OF BORING: Diatube to 0.12 m, Non-destructive drilling to 1.8 m, solid flight auger (TC-bit) to 2.0 m, Rotary to 4.7 m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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WELL LOG

CLIENT: LendLease Building Pty Ltd
PROJECT: Randwick Campus Redevelopment
LOCATION: Hospital Road and High, Magill and Botany Streets, Randwick

SURFACE LEVEL: 55.2 AHD
EASTING: 336983
NORTHING: 6245644
DIP/AZIMUTH: 90°/--

BORE No: 17
PROJECT No: 72505.13
DATE: 8-5-2018
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
55	0.11	CONCRETE SLAB							Gatic Cover
	0.6	FILLING: brown, fine to medium sand filling with some silt and trave of igneous and sandstone gravel, humid							
54	1	SAND: yellow-brown, fine to medium sand, damp							
53	2.0	SAND: medium dense yellow-brown fine to medium sand, damp		S	2.0 2.45		4,6,9 N = 15		Backfill
52	3.3	SAND: medium dense, brown, fine to medium sand with trace of clay, damp		S	3.5 3.95		9,10,14 N = 24		
51	4.4	SANDSTONE: very low to low strength, orange-brown and light grey, medium to coarse grained sandstone							Bentonite
50	5.08	SANDSTONE: medium strength, slightly weathered, slightly fractured, light grey and red-brown, medium to coarse grained sandstone, bedding typically 0-10°		C	5.0 5.79 5.8 6.71 7.86 8.8 8.88 9.34		PL(A) = 0.6 PL(A) = 0.8 PL(A) = 1.1 PL(A) = 0.5 PL(A) = 0.5		Gravel Screen 5.1-9.6m
49	9.5	SANDSTONE: medium strength, fresh, slightly fractured to unbroken, light grey sandstone with some low strength bands, bedding typically 10-15° with some cross bedding		C	10.0 11.0 11.85 11.95		PL(A) = 0.8 PL(A) = 0.12 PL(A) = 0.39		Bentonite
43	12.24	SANDSTONE (see over page) SANDSTONE: medium and high strength, fresh, unbroken, light grey and grey sandstone		C	12.37 13.44		PL(A) = 1.38 PL(A) = 0.69		Backfill
		13.4-13.8: Bedding typically 5-10°							
40	14.8	Bore discontinued at 14.8m Target depth reached			14.76 14.8		PL(A) = 1.16		

RIG: Han Jin 8D **DRILLER:** BG Drilling **LOGGED:** JAP **CASING:** HW to 4.5 m

TYPE OF BORING: Diatube to 0.11 m, Non-destructive drilling to 1.8 m, Auger to 2.0 m, Rotary to 5.0 m, NMLC Coring to 14.80 m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

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Appendix D

Results of Falling-Head Permeability Tests

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

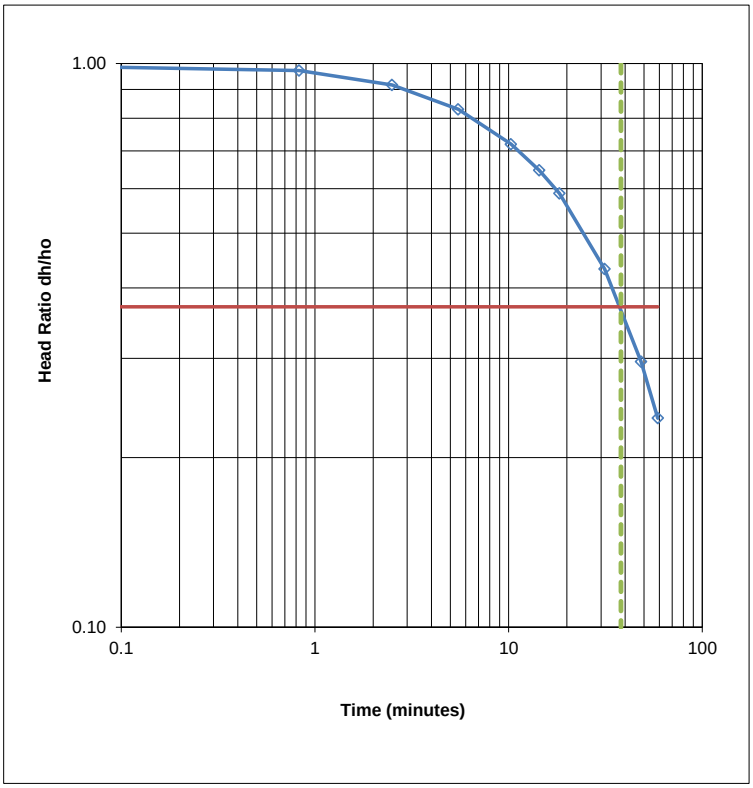
Test Location		**Test No.**	BH4	
Description:	BH4 Falling Head 1	Easting:	337045	m
Material type:	Sandstone	Northing	6245563	m
		Surface Level:	51.9	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3.6	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0.15	m
Length of well screen (Le)	3.2	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	0.15	3.45	1.000
0.83	0.25	3.35	0.972
2.50	0.44	3.16	0.916
5.50	0.74	2.86	0.829
10.30	1.12	2.48	0.719
14.40	1.37	2.23	0.646
18.30	1.57	2.03	0.588
31.34	2.11	1.49	0.432
48.30	2.58	1.02	0.296
59.00	2.79	0.81	0.235



To = 38 Min
2280 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**1.7E-07**	m/sec
	=	**0.063**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

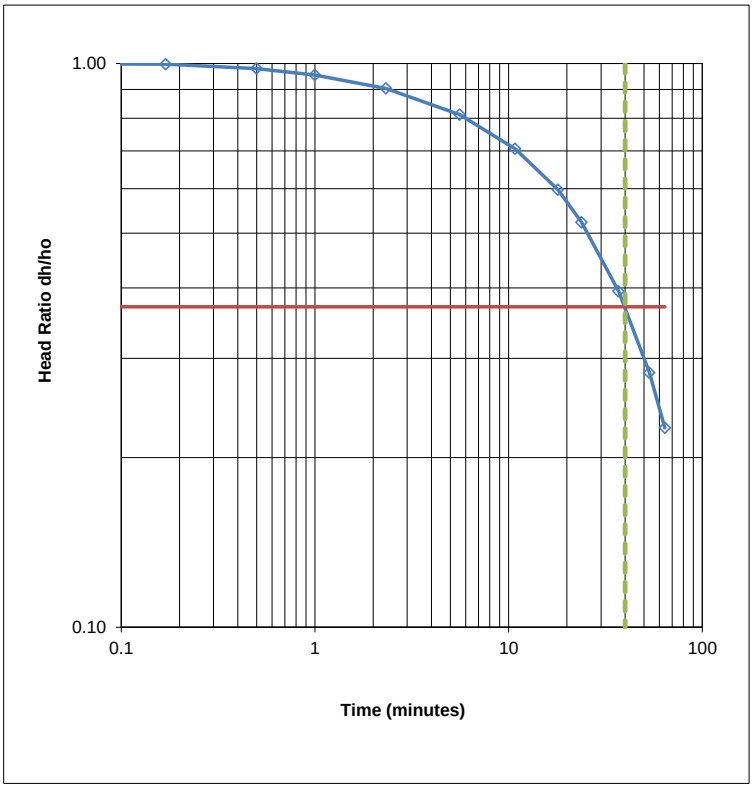
Test Location		**Test No.**	BH4	
Description:	BH4 Falling Head 2	Easting:	337045	m
Material type:	Sandstone	Northing	6245563	m
		Surface Level:	51.9	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3.7	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0.2	m
Length of well screen (Le)	3.2	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	0.20	3.50	1.000
0.17	0.21	3.49	0.997
0.50	0.27	3.43	0.980
1.00	0.36	3.34	0.954
2.33	0.54	3.16	0.903
5.60	0.86	2.84	0.811
10.83	1.23	2.47	0.706
18.00	1.61	2.09	0.597
23.80	1.87	1.83	0.523
37.00	2.32	1.38	0.394
53.30	2.71	0.99	0.283
64.17	2.91	0.79	0.226



To = 40 Min
2400 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**1.7E-07**	m/sec
	=	**0.060**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test Date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

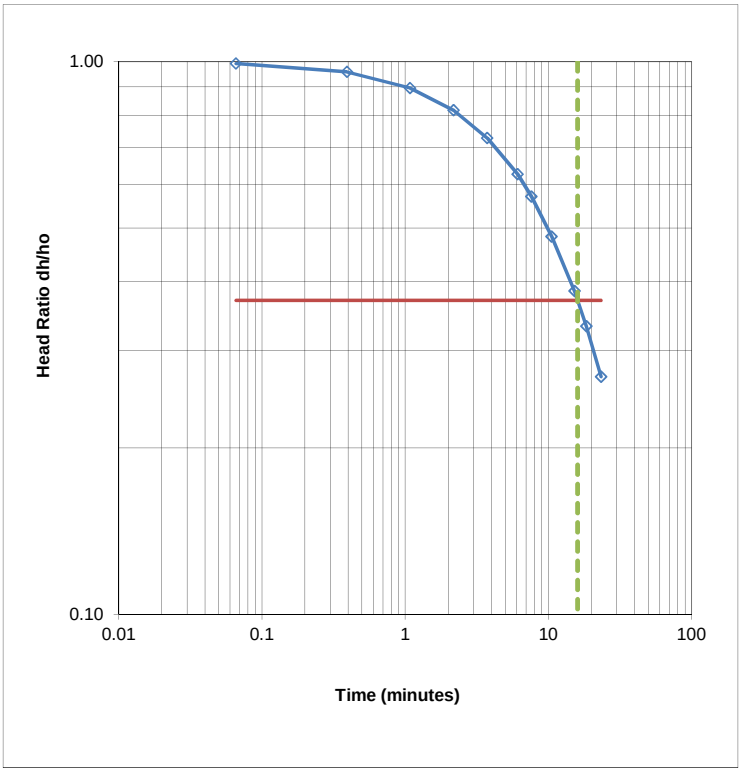
Test Location		**Test No.**	BH8	
Description:	BH8 Falling Head 1	Easting:	337038	m
Material type:	Sand	Northing	6245507	m
		Surface Level:	50.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0.14	m
Length of well screen (Le)	1.1	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.07	0.16	2.84	0.993
0.39	0.26	2.74	0.958
1.08	0.436	2.56	0.897
2.18	0.663	2.34	0.817
3.75	0.92	2.08	0.727
6.10	1.21	1.79	0.626
7.62	1.37	1.63	0.570
10.53	1.62	1.38	0.483
15.22	1.9	1.10	0.385
18.40	2.05	0.95	0.332
23.3	2.23	0.77	0.269



To = 16 Min
960 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**8.9E-07**	m/sec
	=	**0.319**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

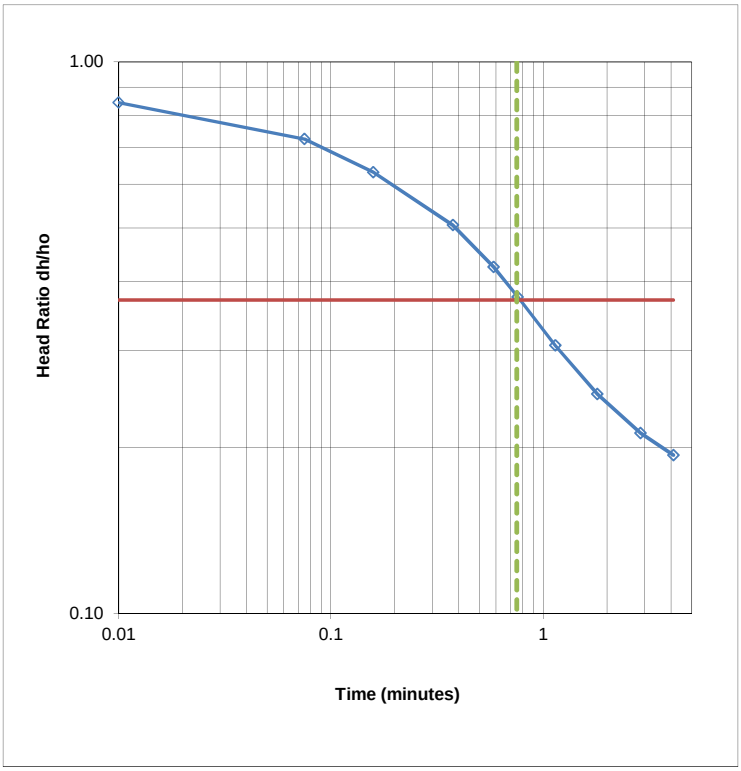
Test Location		**Test No.**	BH9	
Description:	BH9 Falling Head 1	Easting:	337026	m
Material type:	Sand	Northing	6245465	m
		Surface Level:	49.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	5.1	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	3.5	m
Length of well screen (Le)	4.73	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	3.75	1.35	0.844
0.08	3.94	1.16	0.725
0.16	4.09	1.01	0.631
0.38	4.29	0.81	0.506
0.58	4.42	0.68	0.425
0.76	4.5	0.60	0.375
1.14	4.61	0.49	0.306
1.80	4.7	0.40	0.250
2.87	4.76	0.34	0.213
4.10	4.79	0.31	0.194



To = 0.75 Min
45 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**6.5E-06**	m/sec
	=	**2.354**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

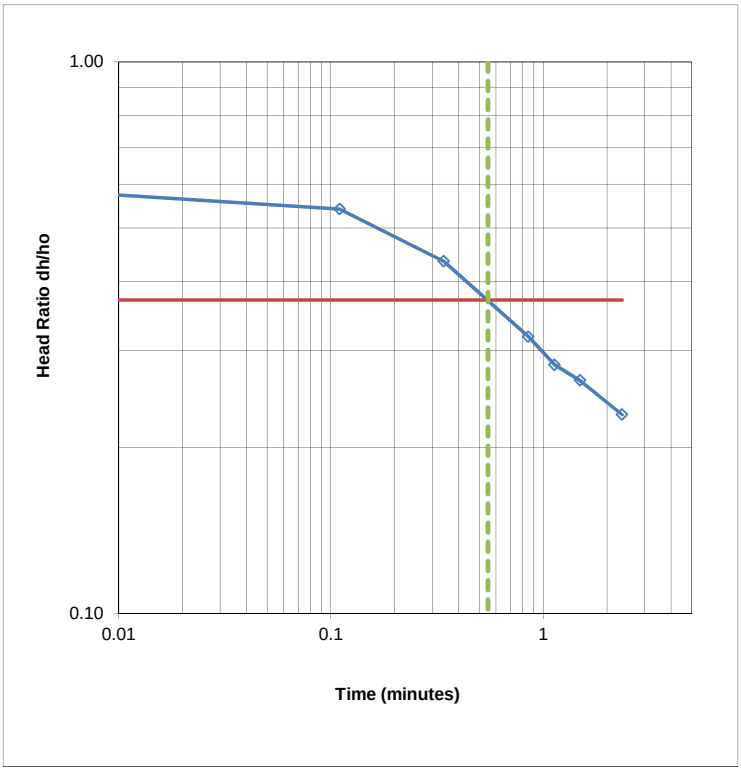
Test Location		**Test No.**	BH9	
Description:	BH9 Falling Head 2	Easting:	337026	m
Material type:	Sand	Northing	6245465	m
		Surface Level:	49.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	5.2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	3.5	m
Length of well screen (Le)	4.73	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	4.22	0.98	0.576
0.11	4.28	0.92	0.541
0.34	4.46	0.74	0.435
0.85	4.66	0.54	0.318
1.13	4.72	0.48	0.282
1.49	4.75	0.45	0.265
2.35	4.81	0.39	0.229



To = 0.55 Min
33 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**8.9E-06**	m/sec
	=	**3.210**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

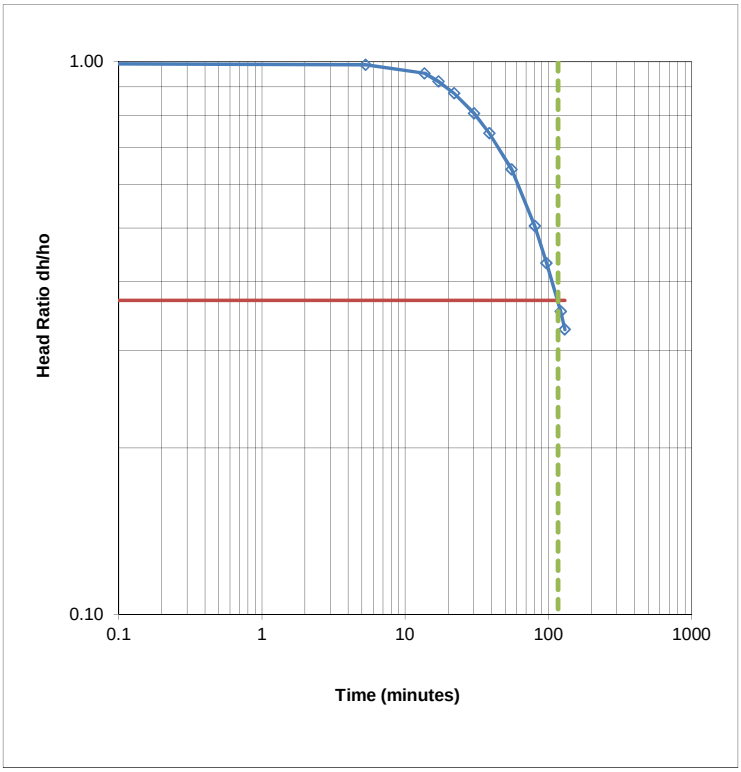
Test Location		**Test No.**	BH10	
Description:	BH10 Falling Head 1	Easting:	337082	m
Material type:	Sandstone	Northing	6245474	m
		Surface Level:	52.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.7	m
Well screen diameter (2R)	100	mm	Depth to water at start of test	0	m
Length of well screen (Le)	3.3	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.00	0.01	4.69	0.998
5.30	0.06	4.64	0.987
13.67	0.22	4.48	0.953
17.10	0.37	4.33	0.921
22.00	0.58	4.12	0.877
30.30	0.91	3.79	0.806
38.70	1.21	3.49	0.743
55.30	1.7	3.00	0.638
80.30	2.33	2.37	0.504
97.00	2.67	2.03	0.432
122	3.04	1.66	0.353
130	3.16	1.54	0.328



To = 117 Min
7020 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**5.7E-08**	m/sec
	=	**0.020**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

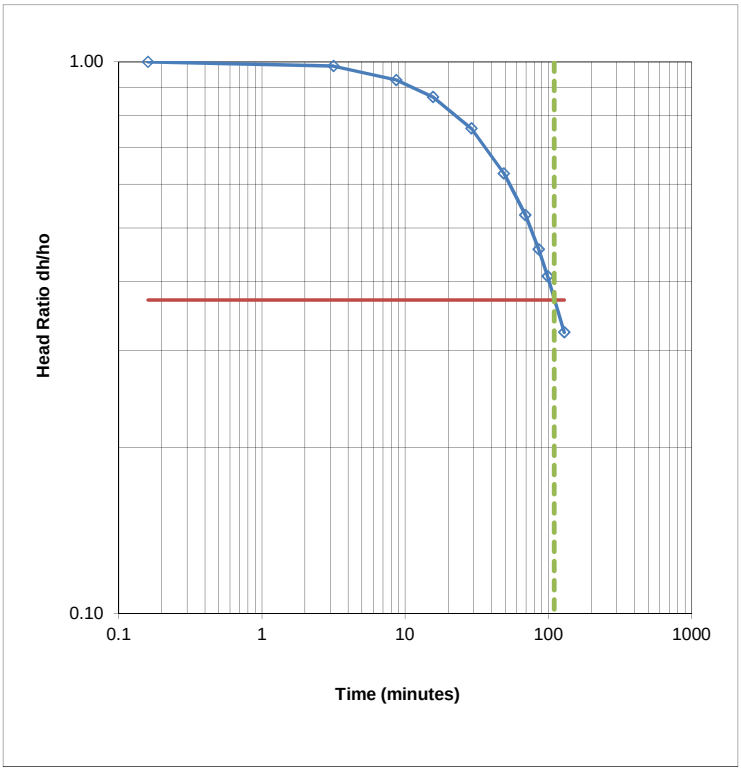
Test Location		**Test No.**	BH10	
Description:	BH10 Falling Head 2	Easting:	337082	m
Material type:	Sandstone	Northing	6245474	m
		Surface Level:	52.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.9	m
Well screen diameter (2R)	100	mm	Depth to water at start of test	0	m
Length of well screen (Le)	3.3	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.16	0.20	4.70	1.000
3.16	0.28	4.62	0.983
8.67	0.54	4.36	0.928
15.70	0.84	4.06	0.864
29.00	1.34	3.56	0.757
49.00	1.95	2.95	0.628
69.00	2.42	2.48	0.528
85.50	2.75	2.15	0.457
98.67	2.98	1.92	0.409
129.17	3.38	1.52	0.323



To = 110 Min
6600 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**6.0E-08**	m/sec
	=	**0.022**	cm/hour

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Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

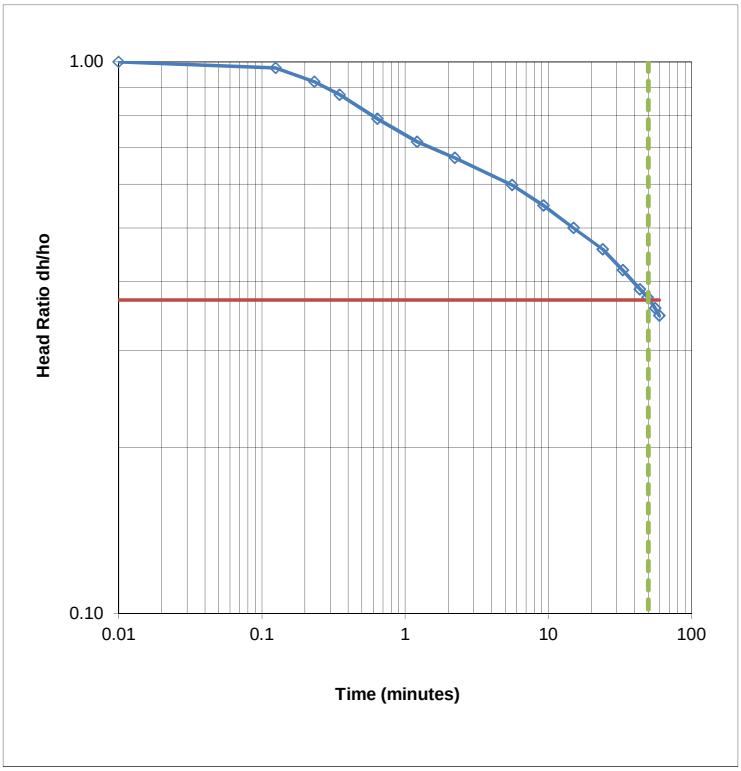
Test Location		**Test No.**	BH11	
Description:	BH11 Falling Head 1	Easting:	337083	m
Material type:	Sand	Northing	6245477	m
		Surface Level:	52.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.7	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0	m
Length of well screen (Le)	2.2	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	0.00	4.70	1.000
0.13	0.12	4.58	0.975
0.23	0.37	4.33	0.921
0.35	0.60	4.10	0.872
0.64	1.00	3.71	0.788
1.21	1.33	3.37	0.717
2.23	1.55	3.15	0.670
5.60	1.89	2.81	0.598
9.27	2.12	2.58	0.549
15.00	2.35	2.35	0.500
23.90	2.55	2.15	0.457
33.13	2.73	1.97	0.419
43.58	2.88	1.82	0.387
49.35	2.94	1.76	0.374
55.60	3.02	1.68	0.357
59.45	3.07	1.63	0.347



To = 50 Min
3000 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**1.7E-07**	m/sec
	=	**0.063**	cm/hour

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Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

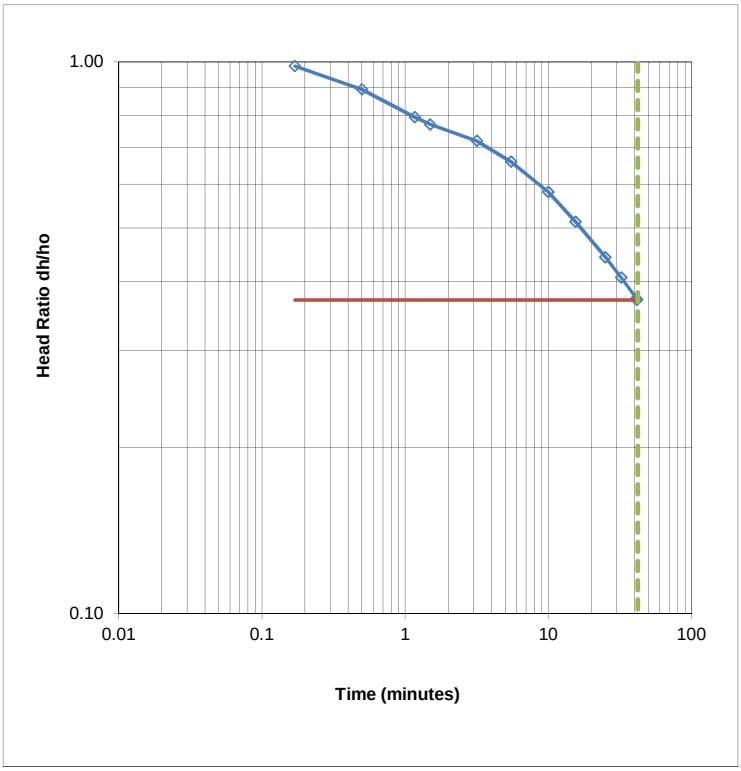
Test Location		**Test No.**	BH11	
Description:	BH11 Falling Head 2	Easting:	337083	m
Material type:	Sand	Northing	6245477	m
		Surface Level:	52.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.7	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0.83	m
Length of well screen (Le)	2.2	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.17	0.08	4.62	0.983
0.50	0.51	4.19	0.891
1.17	0.97	3.73	0.794
1.50	1.08	3.62	0.770
3.17	1.32	3.38	0.719
5.50	1.60	3.10	0.660
10.00	1.97	2.73	0.581
15.50	2.29	2.41	0.513
25.00	2.62	2.08	0.443
32.30	2.79	1.91	0.406
41.17	2.95	1.75	0.372
41.50	2.96	1.74	0.370



To = 42 Min
2520 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**2.1E-07**	m/sec
	=	**0.075**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

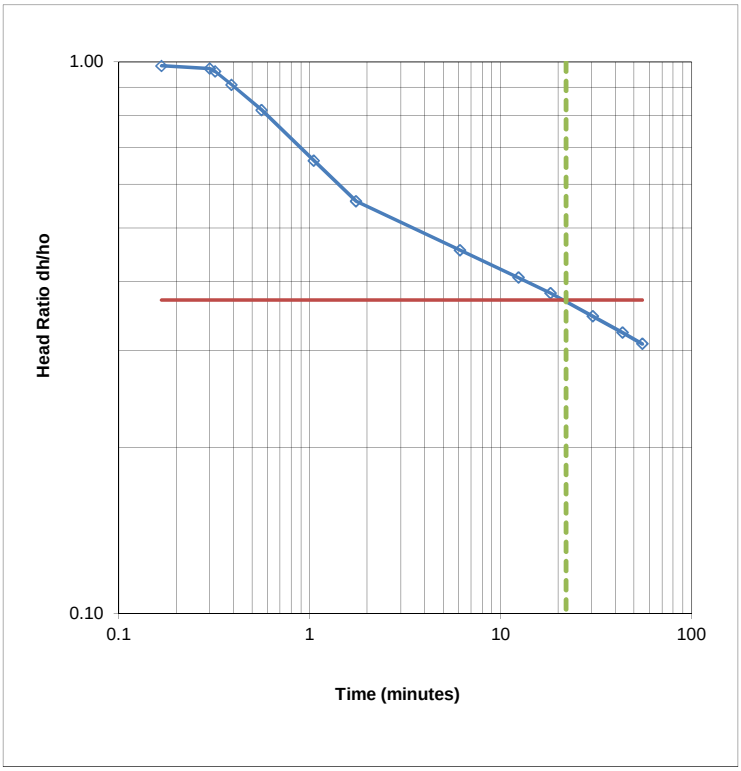
Test Location		**Test No.**	BH12	
Description:	BH12 Falling Head 1	Easting:	337090	m
Material type:	Sand	Northing	6245535	m
		Surface Level:	55.7	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	6.1	m
Well screen diameter (2R)	118	mm	Depth to water at start of test	0	m
Length of well screen (Le)	3.1	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.17	0.10	6.00	0.984
0.30	0.17	5.93	0.972
0.32	0.24	5.86	0.961
0.39	0.55	5.55	0.909
0.56	1.11	4.99	0.818
1.05	2.06	4.04	0.662
1.75	2.69	3.41	0.559
6.13	3.32	2.78	0.456
12.40	3.62	2.48	0.407
18.25	3.776	2.32	0.381
30.40	3.99	2.11	0.346
43.55	4.13	1.97	0.323
55.2	4.22	1.88	0.308



To = 22 Min
1320 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**3.0E-07**	m/sec
	=	**0.109**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

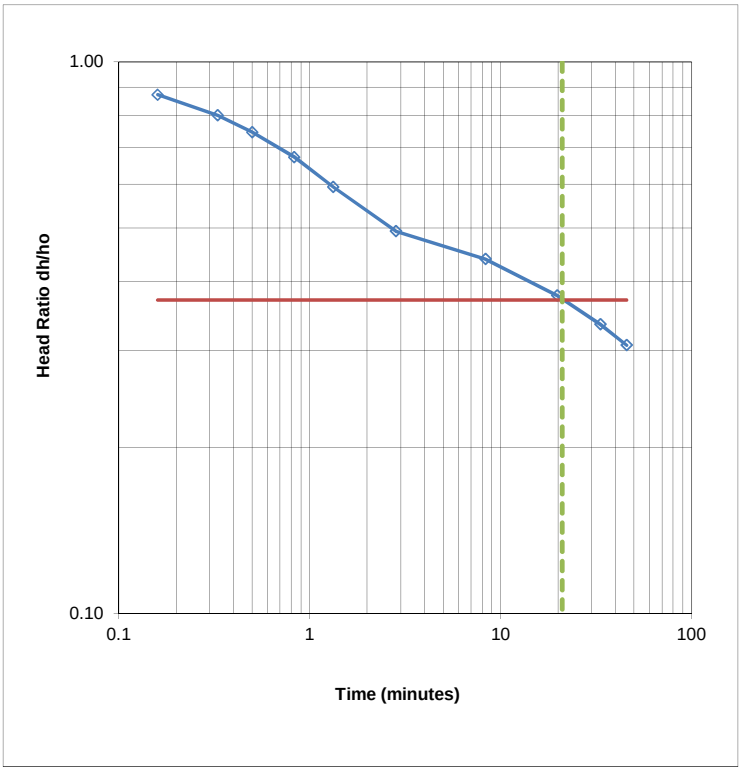
Test Location		**Test No.**	BH12	
Description:	BH12 Falling Head 2	Easting:	337090	m
Material type:	Sand	Northing	6245535	m
		Surface Level:	55.7	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	6.1	m
Well screen diameter (2R)	118	mm	Depth to water at start of test	0	m
Length of well screen (Le)	3.1	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.16	0.78	5.32	0.872
0.33	1.22	4.88	0.800
0.50	1.55	4.55	0.746
0.83	2	4.10	0.672
1.33	2.48	3.62	0.593
2.83	3.09	3.01	0.493
8.33	3.42	2.68	0.439
19.83	3.8	2.30	0.377
33.30	4.06	2.04	0.334
45.67	4.23	1.87	0.307



To = 21 Min
1260 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**3.2E-07**	m/sec
	=	**0.114**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

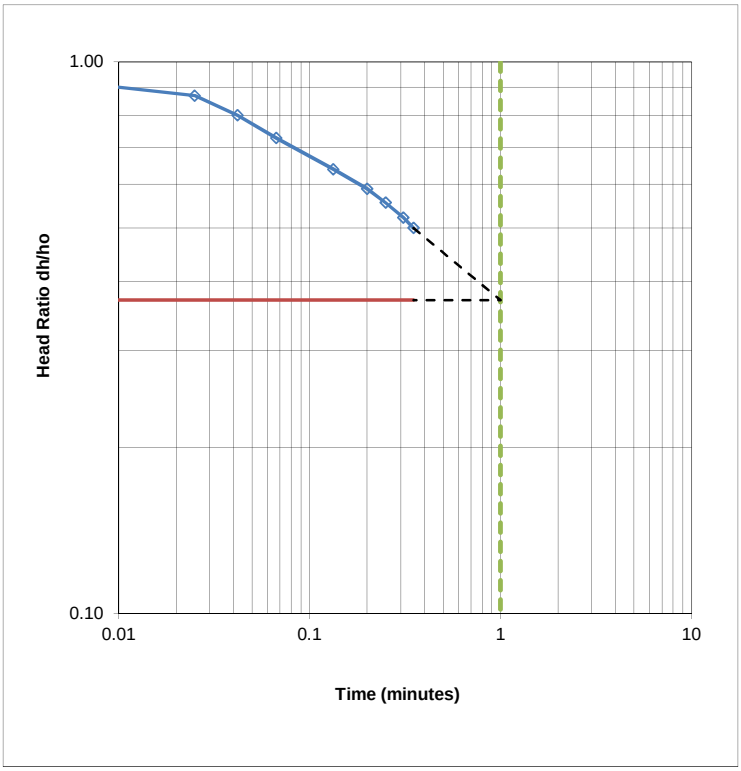
Test Location		**Test No.**	BH13	
Description:	BH13 Falling Head 1	Easting:	337045	m
Material type:	Sand	Northing	6245565	m
		Surface Level:	52.0	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3.8	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	2	m
Length of well screen (Le)	2.2	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.00	2.03	1.77	0.983
0.03	2.24	1.56	0.869
0.04	2.36	1.44	0.800
0.07	2.49	1.31	0.728
0.13	2.65	1.15	0.639
0.20	2.74	1.06	0.589
0.25	2.8	1.00	0.556
0.31	2.86	0.94	0.522
0.35	2.9	0.90	0.500



To = 1 Min
60 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**8.7E-06**	m/sec
	=	**3.144**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

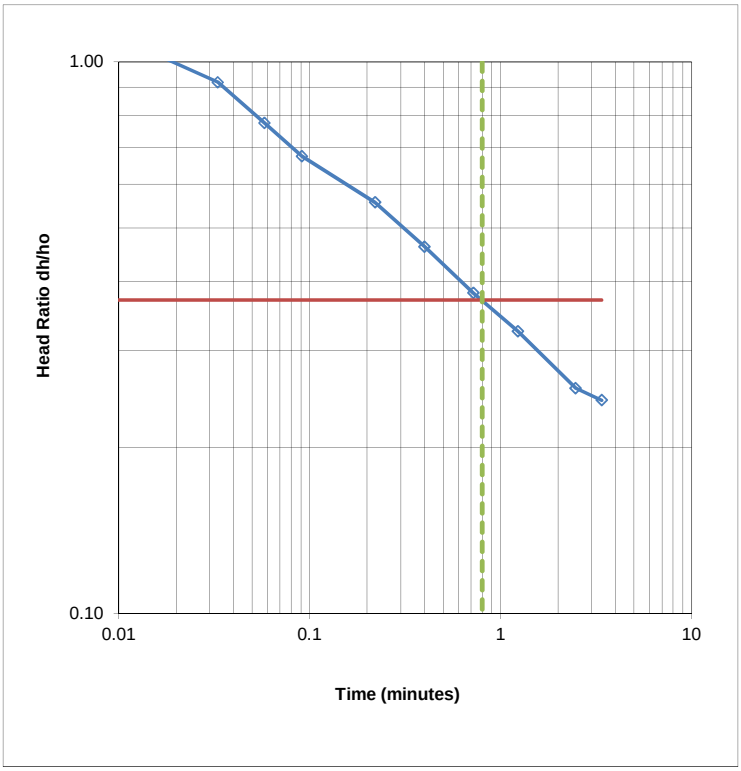
Test Location		**Test No.**	BH13	
Description:	BH13 Falling Head 2	Easting:	337045	m
Material type:	Sand	Northing	6245565	m
		Surface Level:	52.0	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3.5	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	1.9	m
Length of well screen (Le)	2.2	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	1.57	1.93	1.206
0.02	1.87	1.63	1.019
0.03	2.03	1.47	0.919
0.06	2.26	1.24	0.775
0.09	2.42	1.08	0.675
0.22	2.61	0.89	0.556
0.40	2.76	0.74	0.463
0.72	2.89	0.61	0.381
1.23	2.98	0.52	0.325
2.47	3.09	0.41	0.256
3.38	3.11	0.39	0.244



To = 0.8 Min
48 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**1.1E-05**	m/sec
	=	**3.930**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

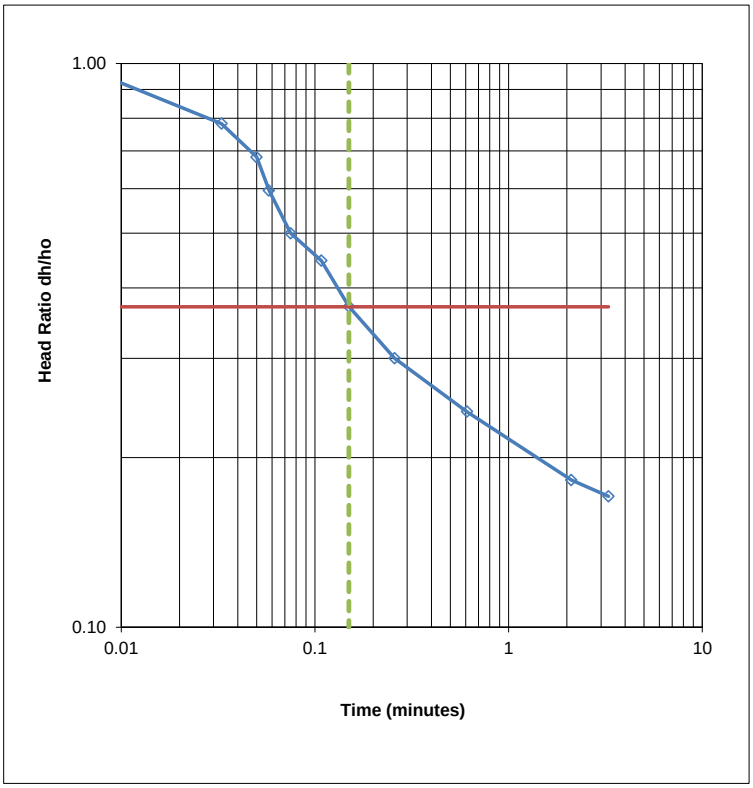
Test Location		**Test No.**	BH14	
Description:	BH14 Falling Head 1	Easting:	336983	m
Material type:	Sand	Northing	6245427	m
		Surface Level:	47.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.5	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	2.8	m
Length of well screen (Le)	5.1	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	2.88	1.62	0.953
0.03	3.17	1.33	0.782
0.05	3.34	1.16	0.682
0.06	3.49	1.01	0.595
0.08	3.65	0.85	0.500
0.11	3.74	0.76	0.447
0.15	3.87	0.63	0.371
0.26	3.99	0.51	0.300
0.61	4.09	0.41	0.241
2.11	4.19	0.31	0.182
3.28	4.21	0.29	0.171



To = 0.15 Min
9 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**3.1E-05**	m/sec
	=	**11.102**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

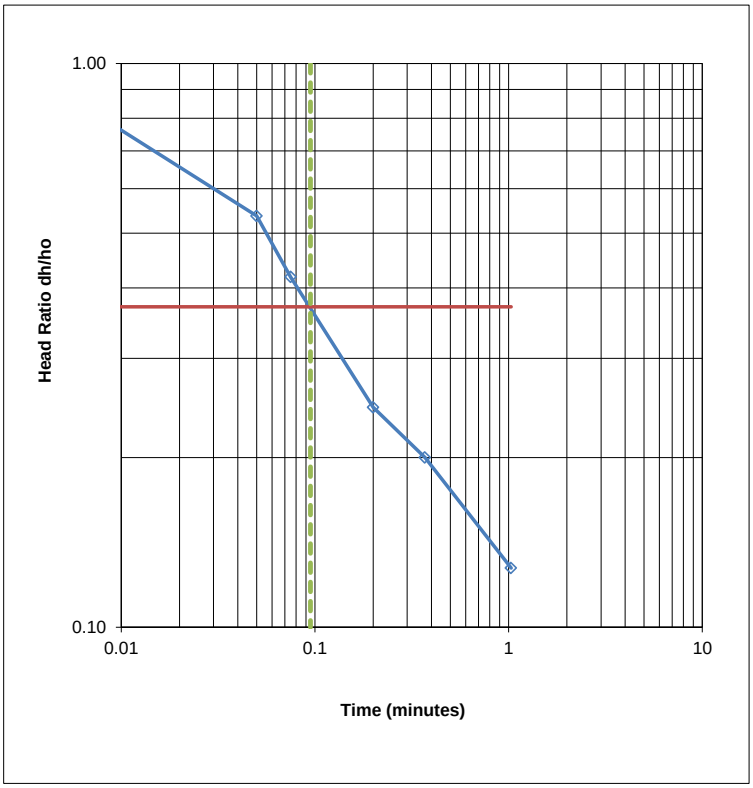
Test Location		**Test No.**	BH14	
Description:	BH14 Falling Head 2	Easting:	336983	m
Material type:	Sand	Northing	6245427	m
		Surface Level:	47.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	3.1	m
Length of well screen (Le)	5.1	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.00	3.09	1.11	1.009
0.01	3.32	0.88	0.800
0.05	3.61	0.59	0.536
0.08	3.74	0.46	0.418
0.20	3.93	0.27	0.245
0.37	3.98	0.22	0.200
1.03	4.06	0.14	0.127



To = 0.095 Min
5.7 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**4.9E-05**	m/sec
	=	**17.530**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

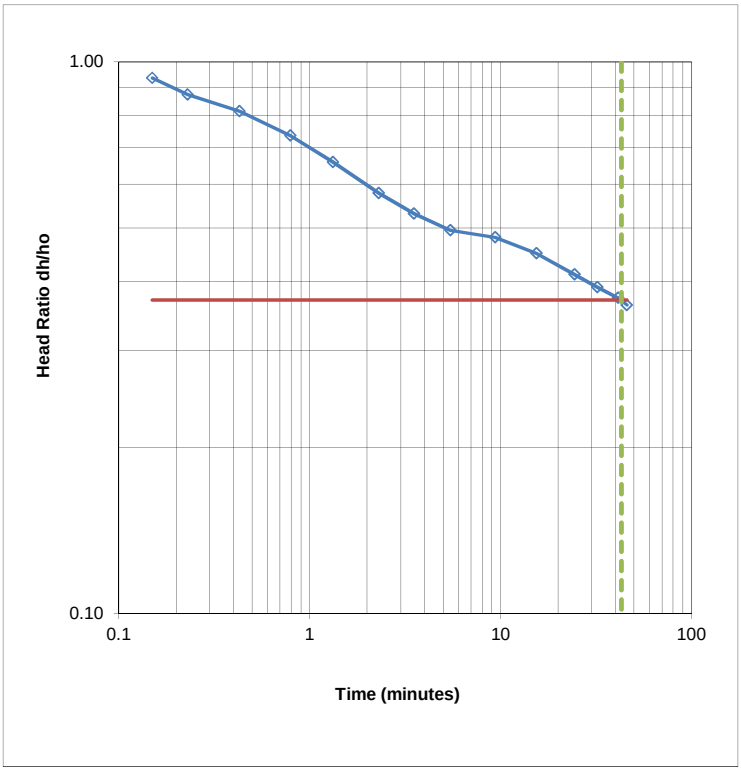
Test Location		**Test No.**	BH16	
Description:	BH16 Falling Head 1	Easting:	336986	m
Material type:	Sand	Northing	6245643	m
		Surface Level:	55.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0	m
Length of well screen (Le)	2.1	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.15	0.27	3.93	0.936
0.23	0.53	3.67	0.873
0.43	0.78	3.42	0.814
0.79	1.11	3.09	0.736
1.33	1.43	2.77	0.659
2.30	1.77	2.43	0.579
3.52	1.97	2.23	0.531
5.45	2.12	2.08	0.495
9.35	2.18	2.02	0.481
15.40	2.31	1.89	0.450
24.38	2.47	1.73	0.412
32.12	2.56	1.64	0.390
41.2	2.63	1.57	0.374
45.77	2.677	1.523	0.363



To = 43 Min
2580 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**2.1E-07**	m/sec
	=	**0.076**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

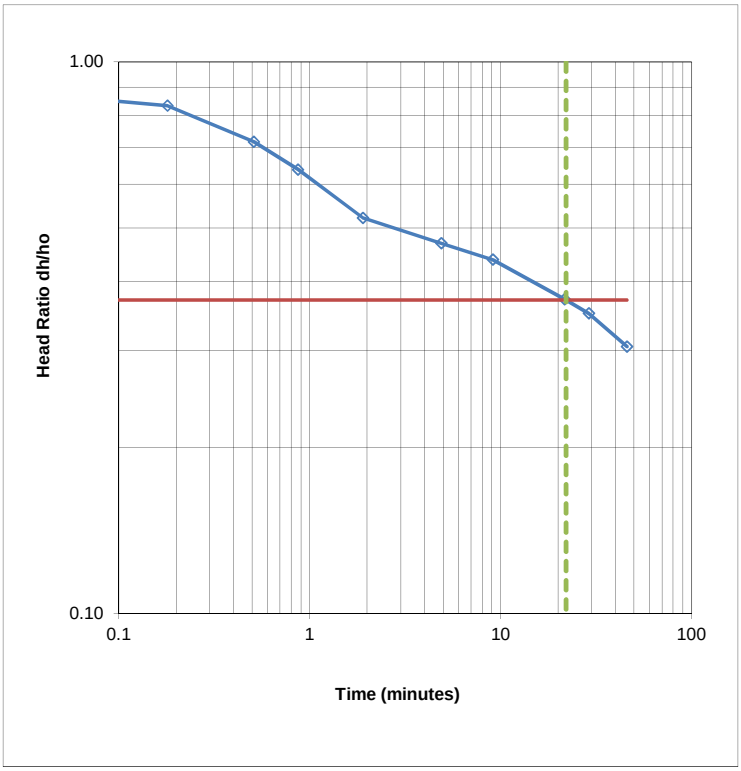
Test Location		**Test No.**	BH16	
Description:	BH16 Falling Head 2	Easting:	336986	m
Material type:	Sand	Northing	6245643	m
		Surface Level:	55.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.2	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	0	m
Length of well screen (Le)	2.1	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	0.35	3.85	0.917
0.18	0.70	3.50	0.833
0.51	1.19	3.01	0.717
0.87	1.52	2.68	0.638
1.90	2.01	2.19	0.521
4.90	2.23	1.97	0.469
9.10	2.36	1.84	0.438
21.60	2.64	1.56	0.371
29.00	2.73	1.47	0.350
45.85	2.92	1.28	0.305



To = 22 Min
1320 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**4.1E-07**	m/sec
	=	**0.148**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test Date:	10-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

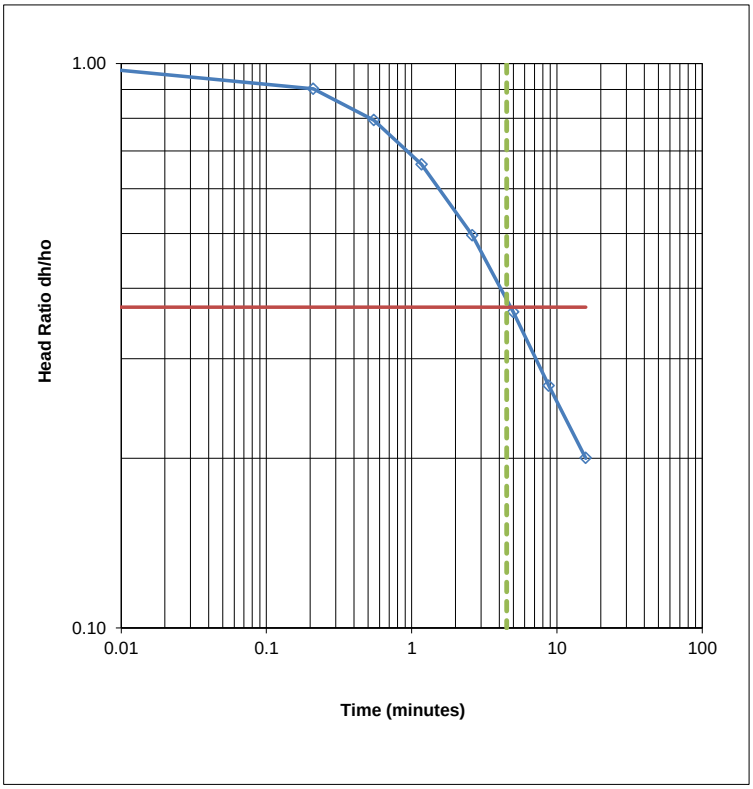
Test Location		**Test No.**	BH17	
Description:	BH17 Falling Head 1	Easting:	336983	m
Material type:	Sandstone	Northing	6245644	m
		Surface Level:	55.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	5.1	m
Well screen diameter (2R)	100	mm	Depth to water at start of test	0	m
Length of well screen (Le)	5	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.01	0.11	4.99	0.978
0.21	0.50	4.60	0.902
0.55	1.05	4.05	0.794
1.17	1.72	3.38	0.663
2.62	2.57	2.53	0.496
5.01	3.25	1.85	0.363
8.78	3.73	1.37	0.269
15.77	4.08	1.02	0.200



To = 4.5 Min
270 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**1.1E-06**	m/sec
	=	**0.384**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	LendLease Building Pty Ltd	Project No:	72505.13
Project:	Randwick Campus Redevelopment	Test Date:	17-May-18
Location:	Hospital Rd and High, Magill and Botany Sts, Randwick	Tested by:	JAP

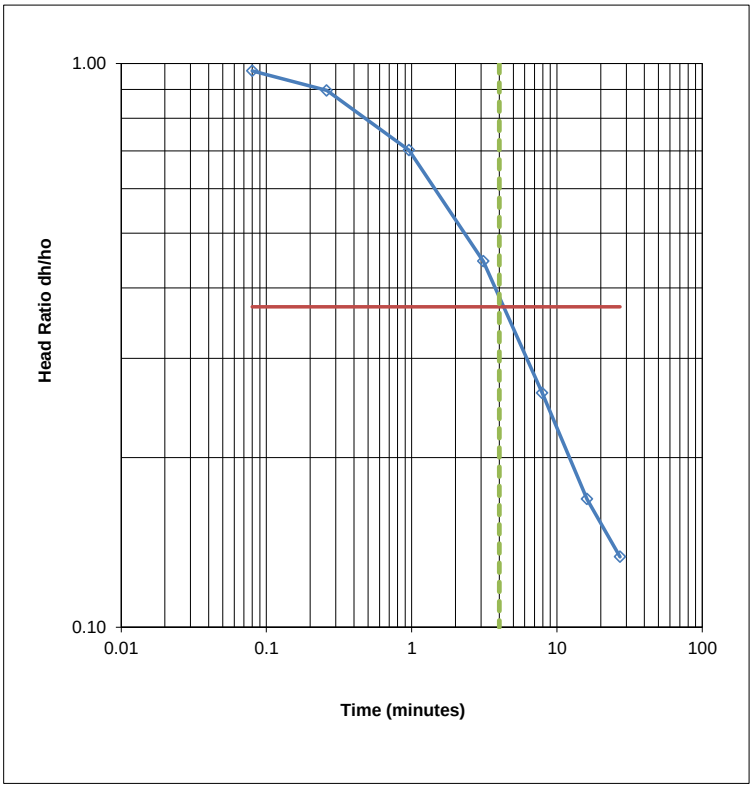
Test Location		**Test No.**	BH17	
Description:	BH17 Falling Head 2	Easting:	336983	m
Material type:	Sandstone	Northing	6245644	m
		Surface Level:	55.2	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	4.8	m
Well screen diameter (2R)	100	mm	Depth to water at start of test	0	m
Length of well screen (Le)	5	m			

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0.08	0.14	4.66	0.971
0.26	0.50	4.30	0.896
0.96	1.43	3.37	0.702
3.11	2.66	2.14	0.446
7.90	3.55	1.25	0.260
16.10	3.99	0.81	0.169
27.20	4.16	0.64	0.133



To = 4 Min
240 Sec

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

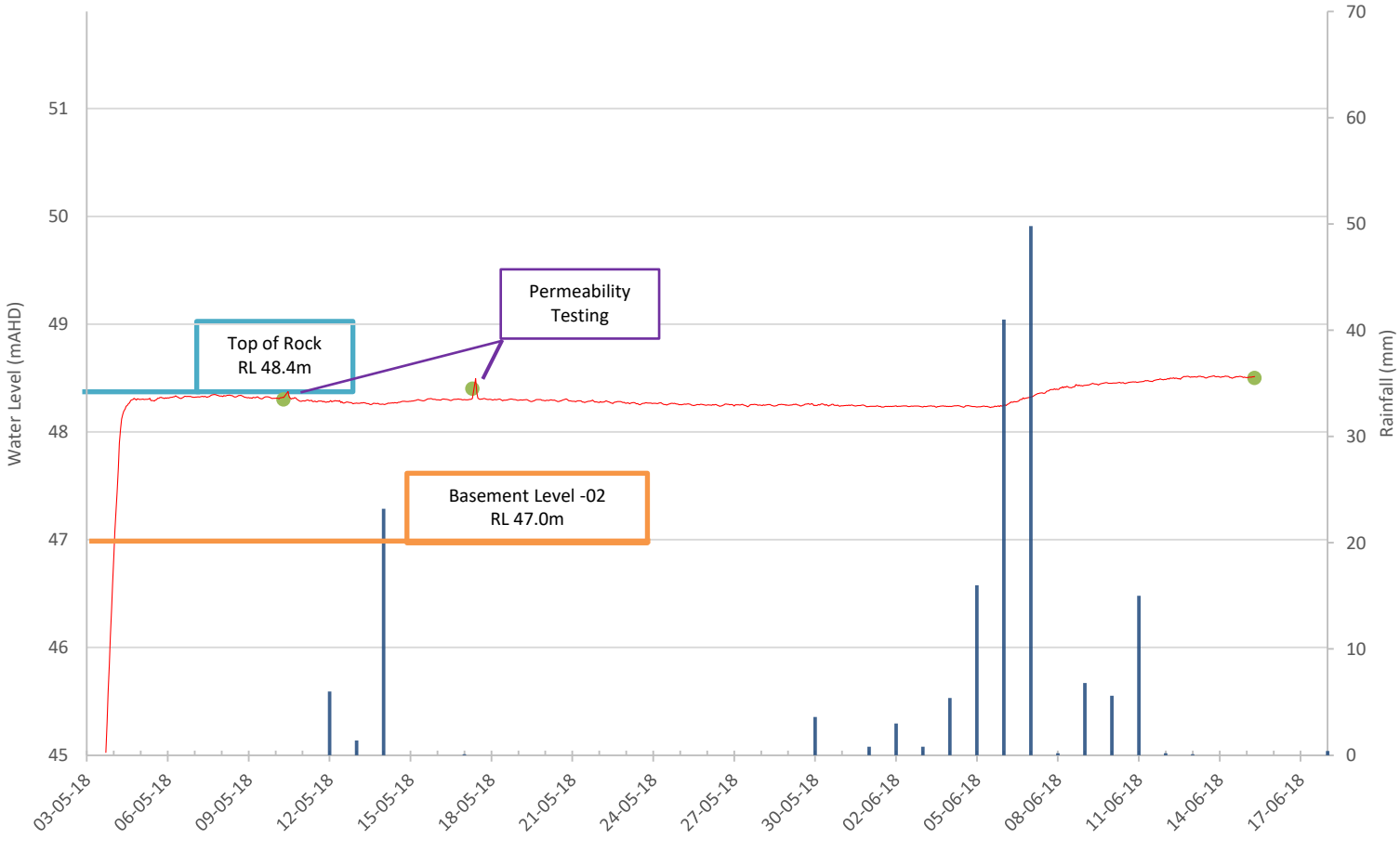
where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**1.2E-06**	m/sec
	=	**0.432**	cm/hour

Appendix E

Results of Groundwater Monitoring and Rainfall Data

BH4



Note: Reading Interval = 1 hour

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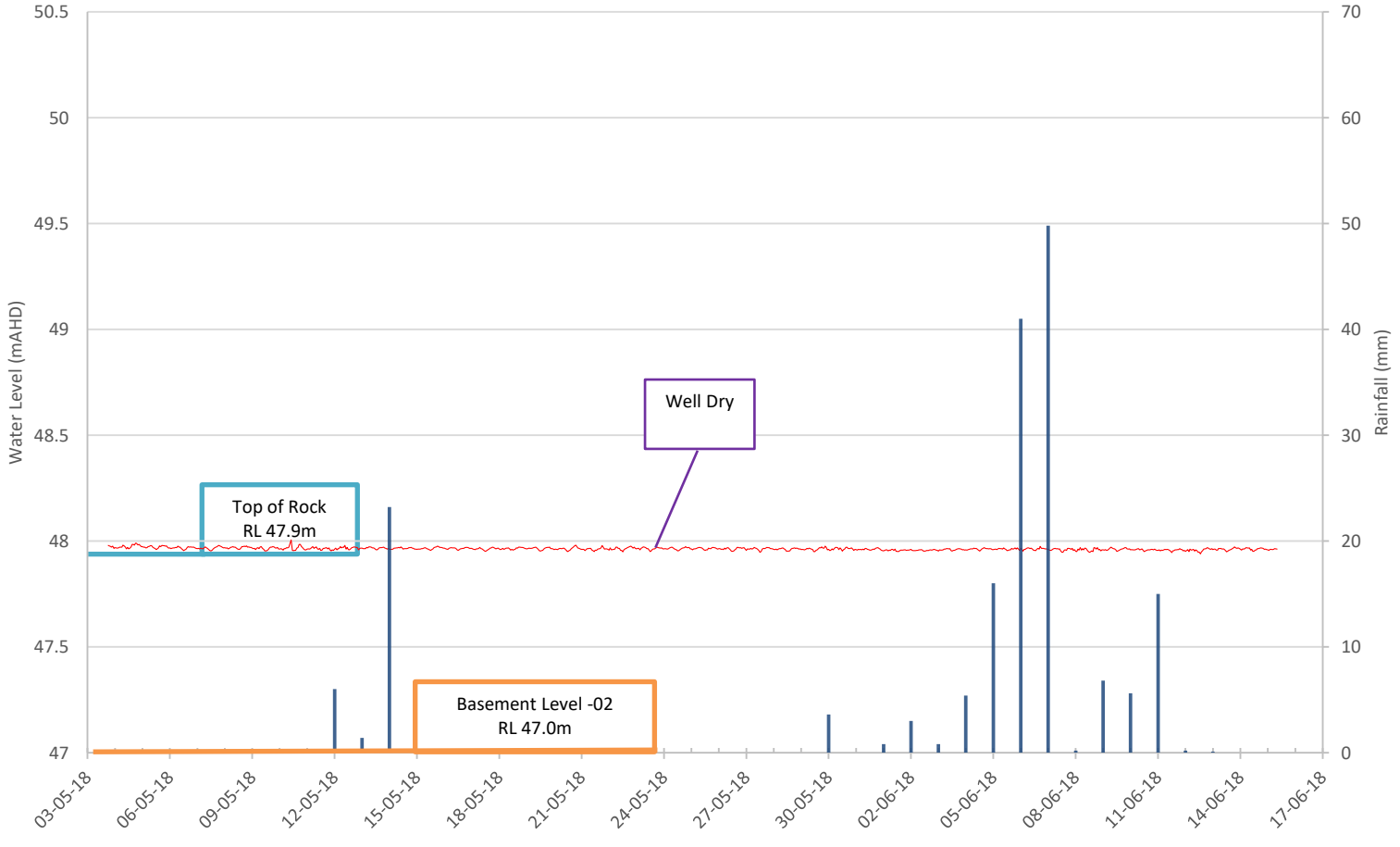
Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	03-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH8



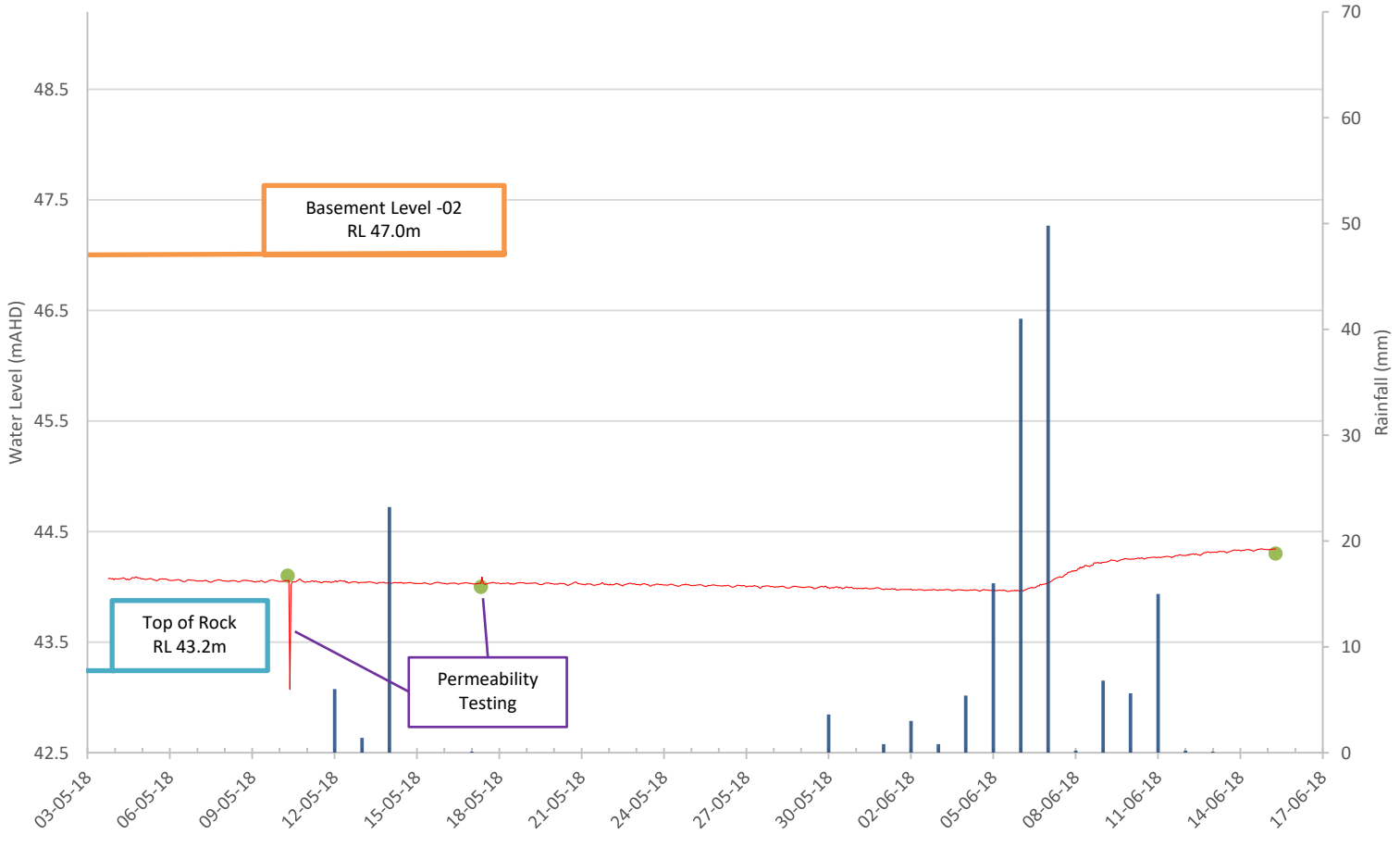
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	03-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH9



Note: Reading Interval = 1 hour

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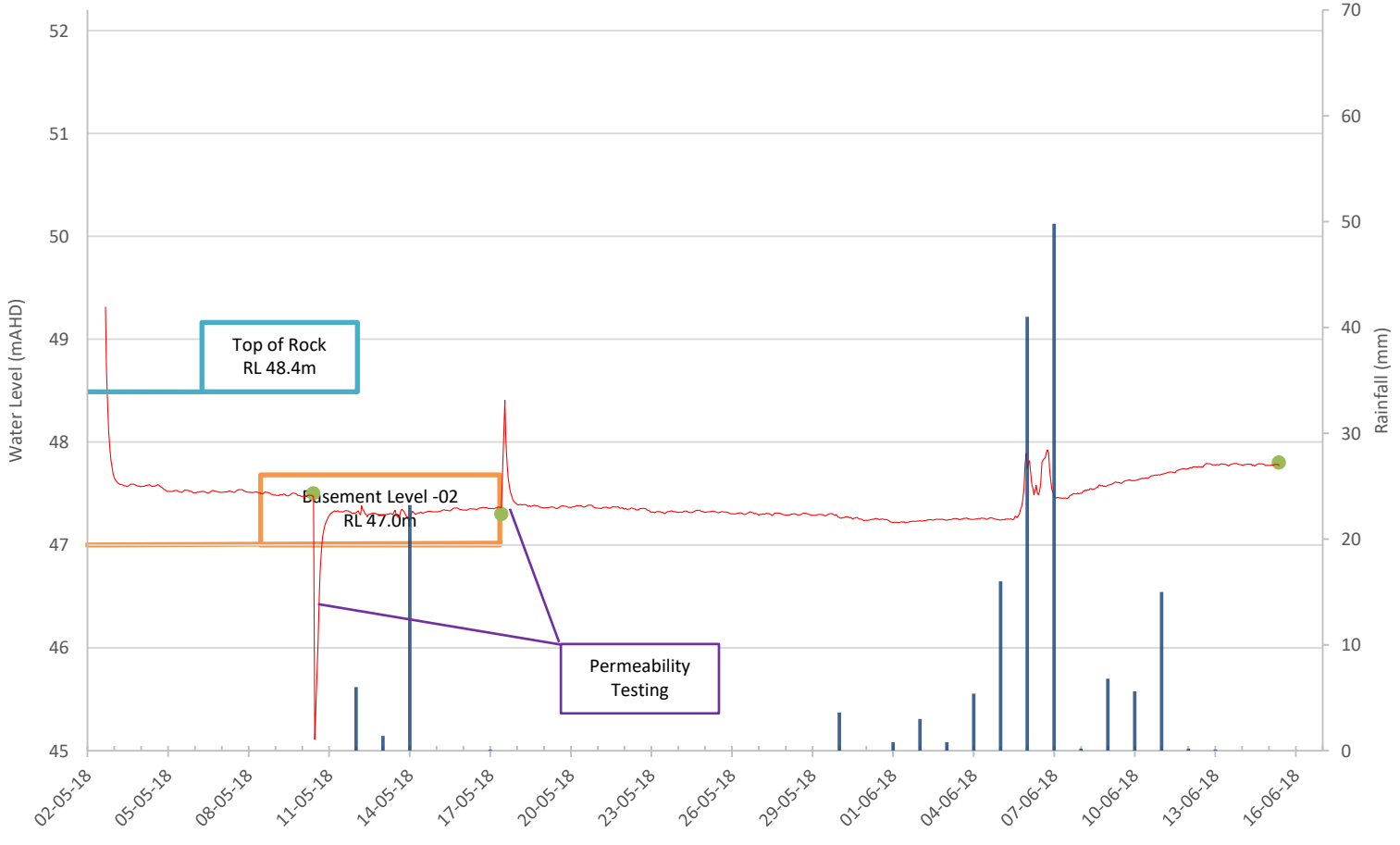
Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	03-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH10



Note: Reading Interval = 1 hour

Douglas Partners
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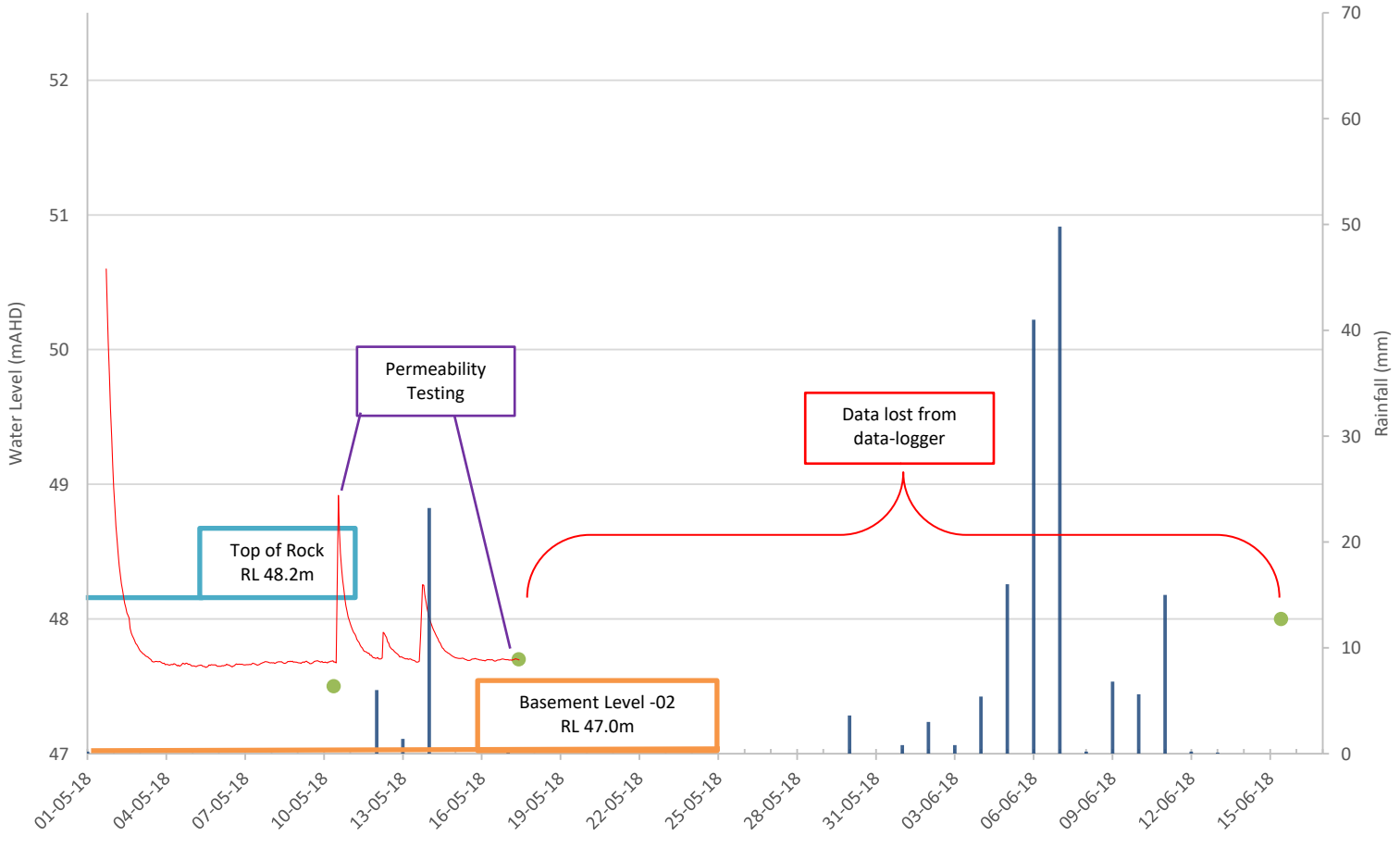
Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	02-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH11



Note: Reading Interval = 1 hour

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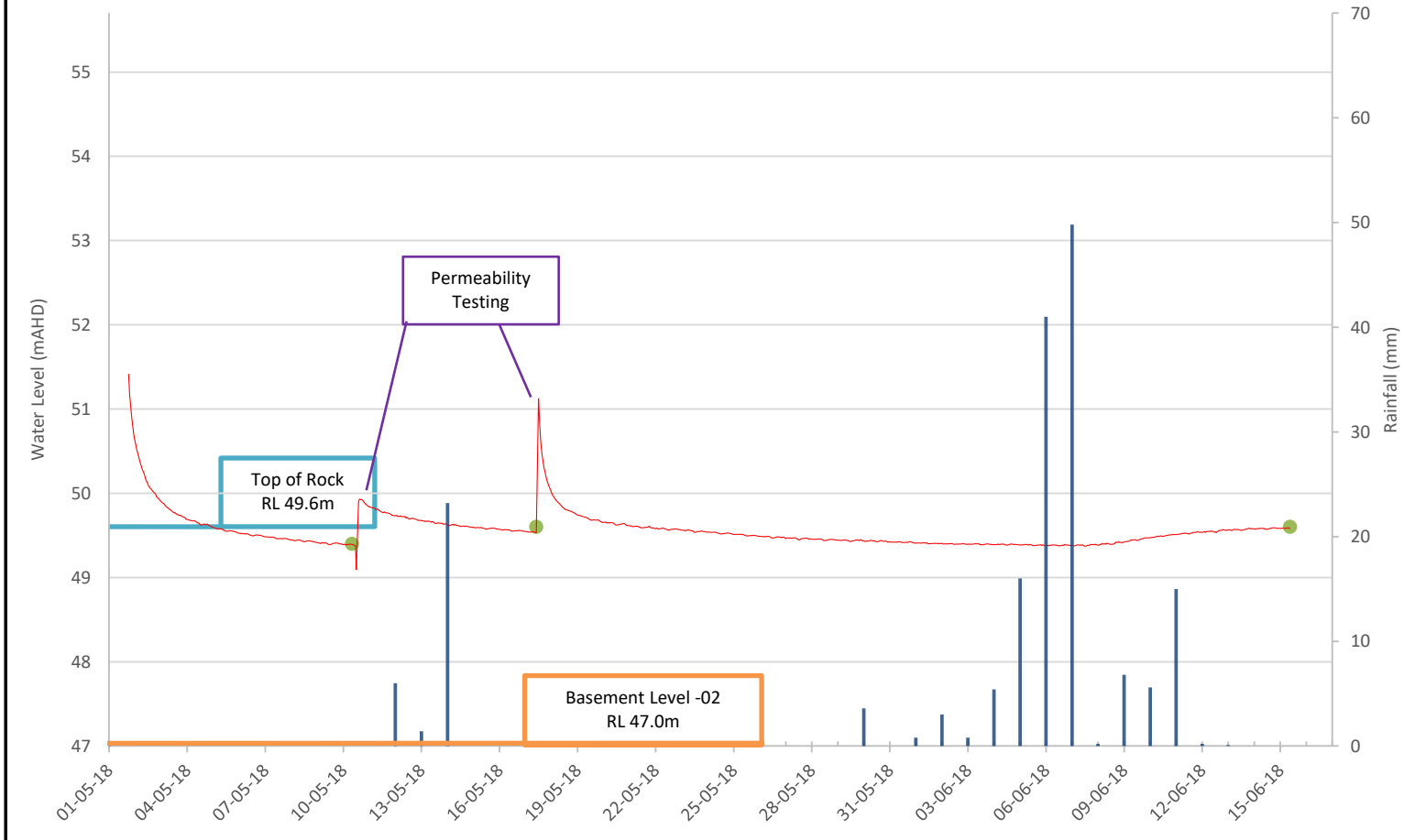
Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	01-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH12



Note: Reading Interval = 1 hour

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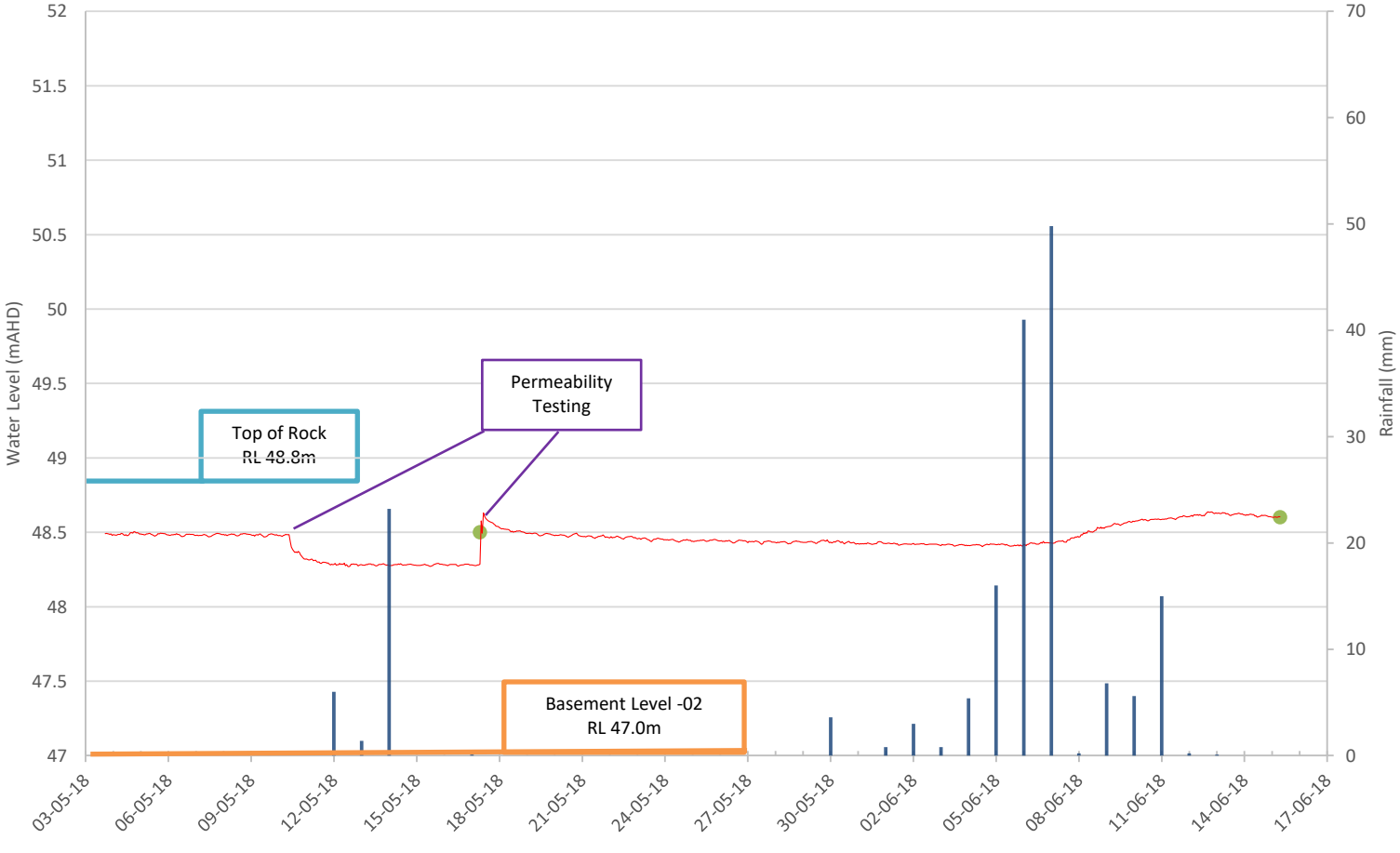
Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	01-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH13



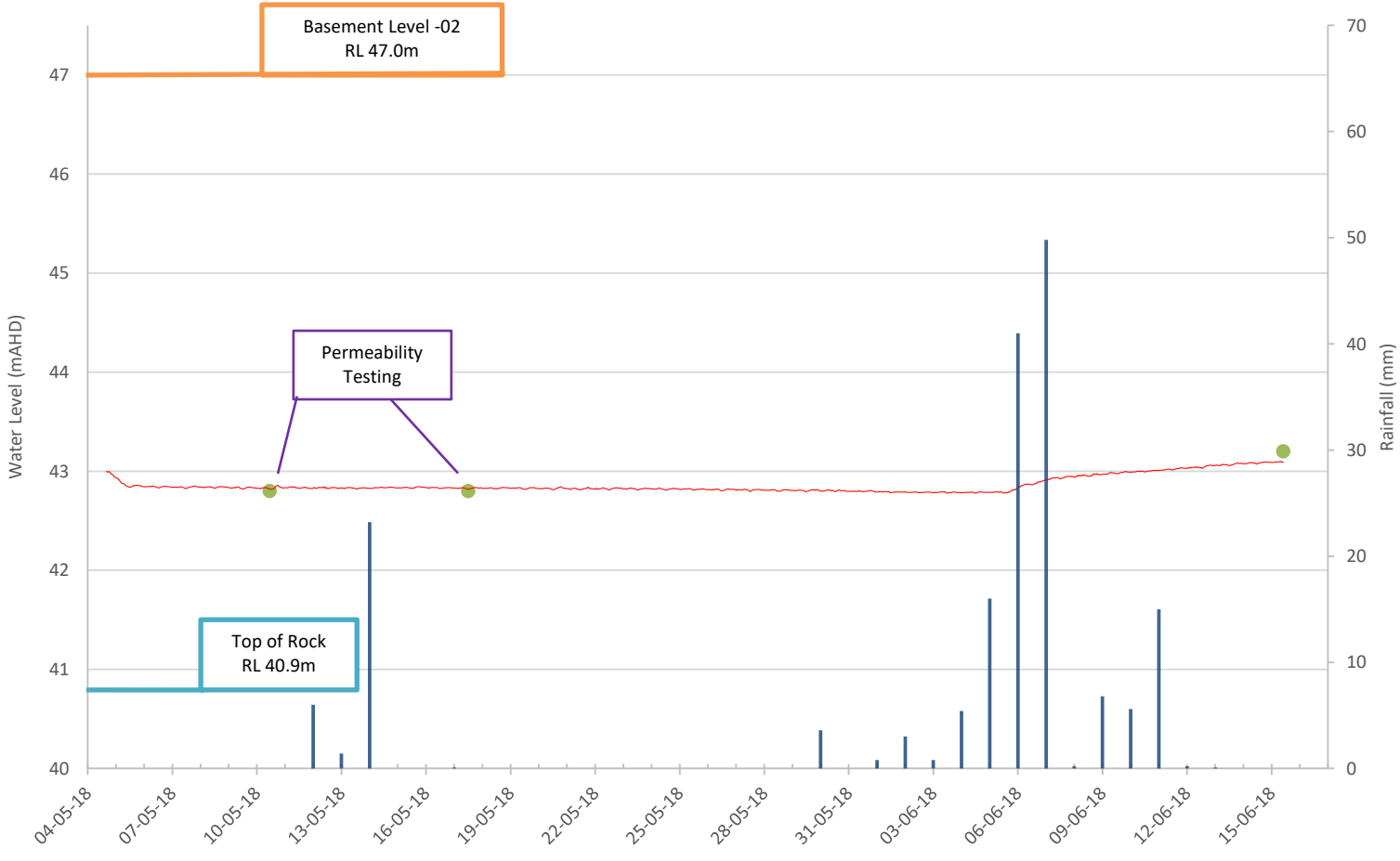
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	03-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH14



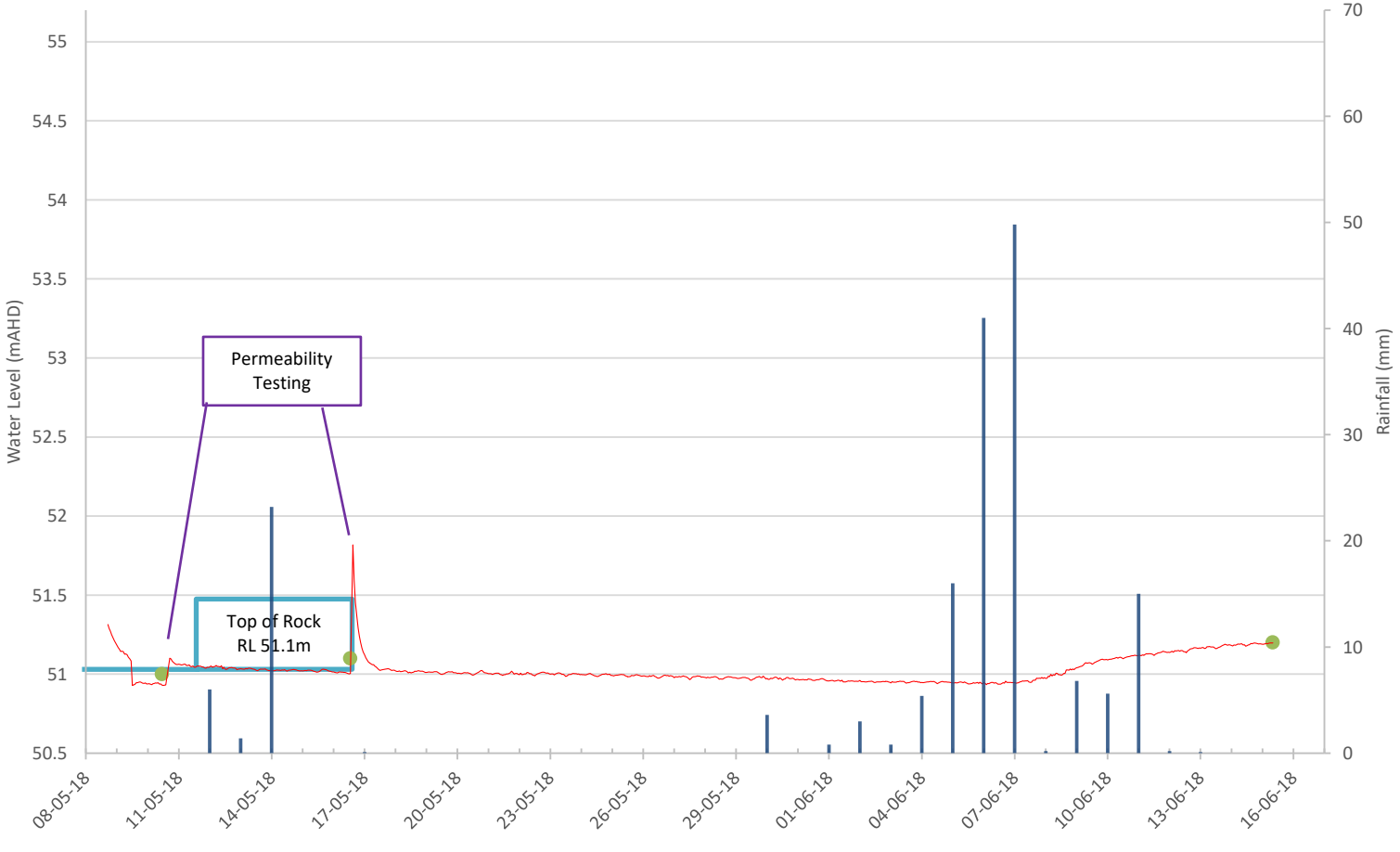
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	04-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	15-06-18	LJH

BH16



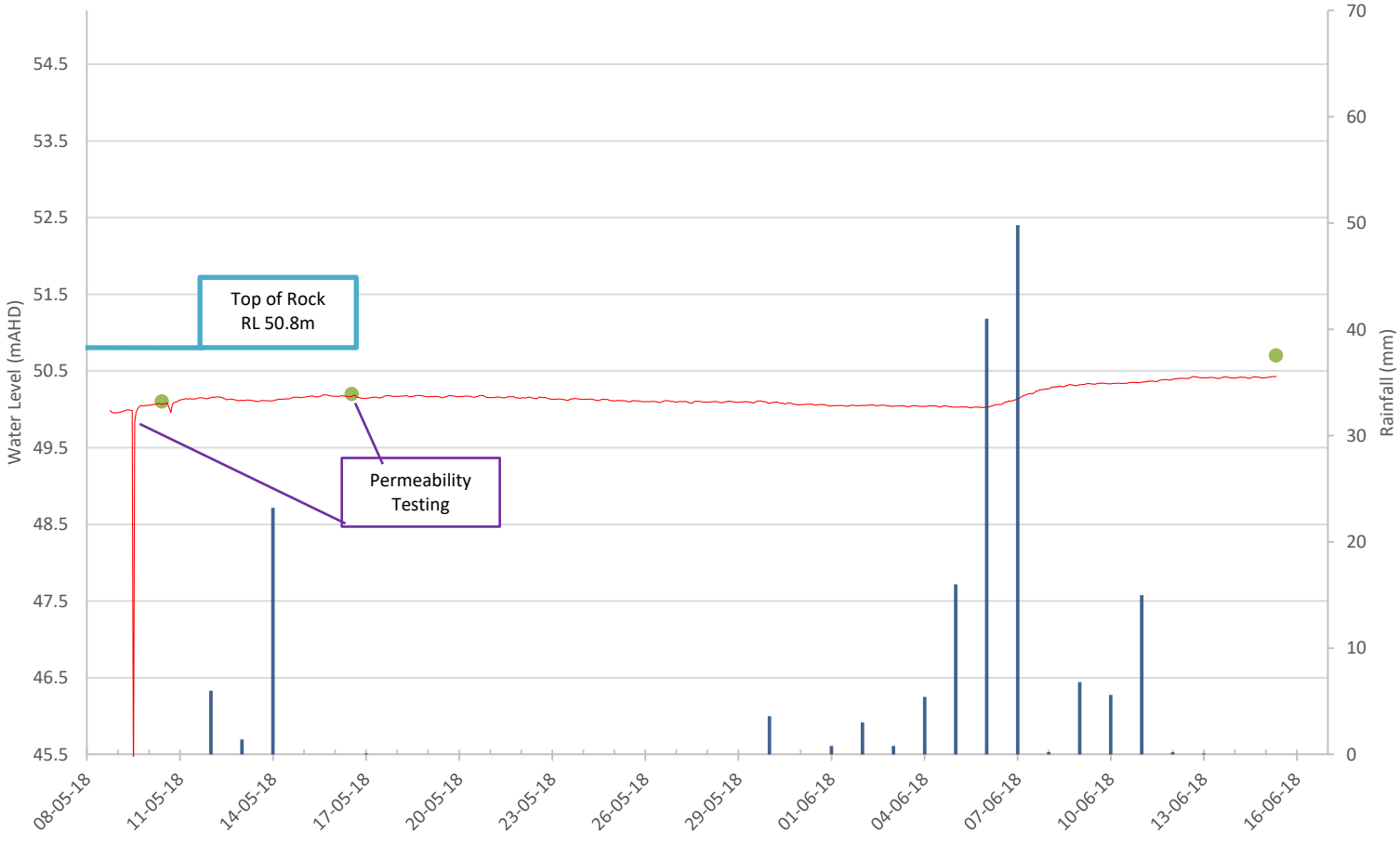
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	08-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	17-06-18	LJH

BH17



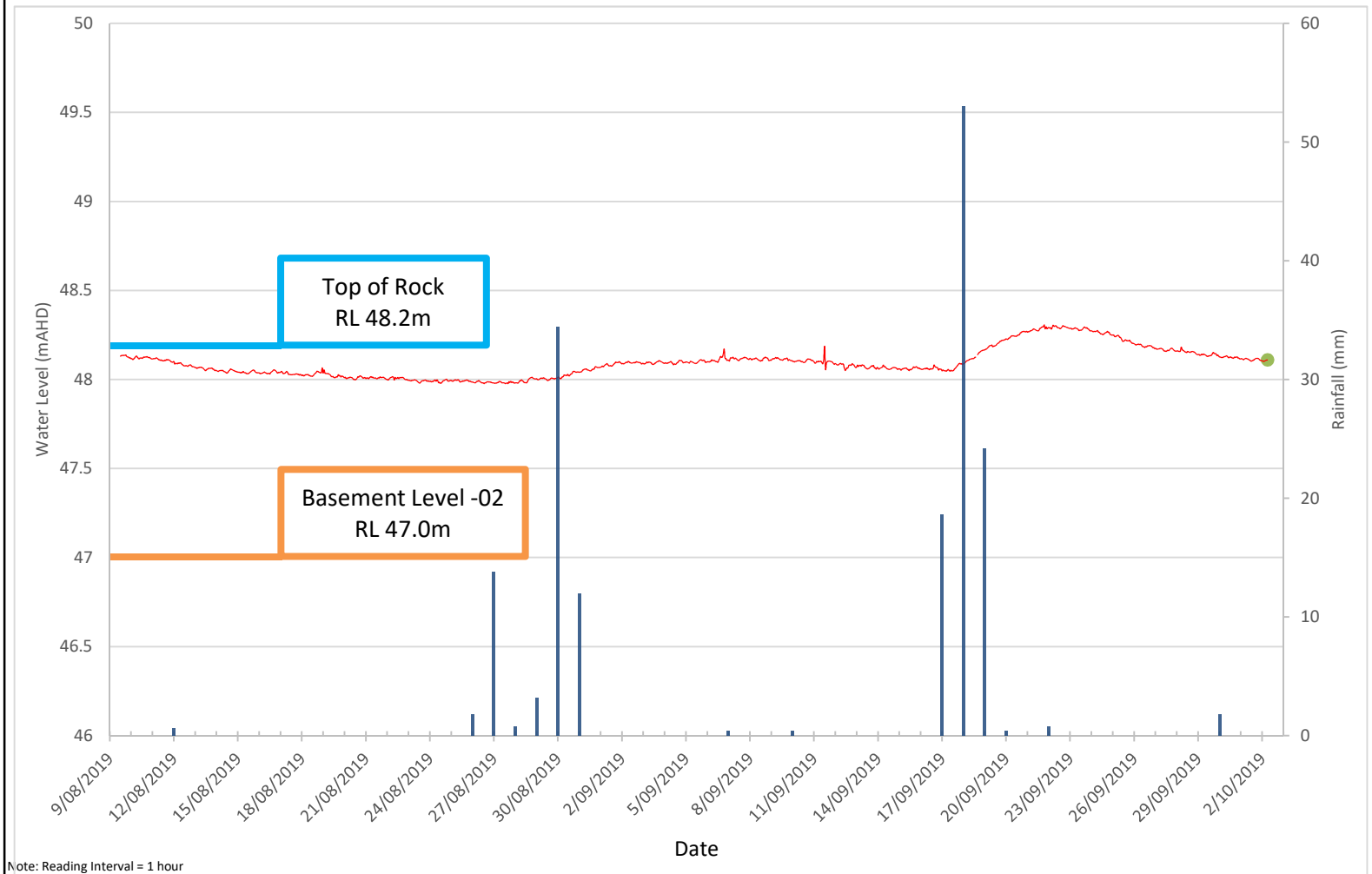
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Water Level
Manual Levels
Rainfall data

Date:	From:	Drawn:
15-03-19	08-05-18	JAP
Project:	**To:**	**Checked:**
72505.13	17-06-18	LJH

BH11



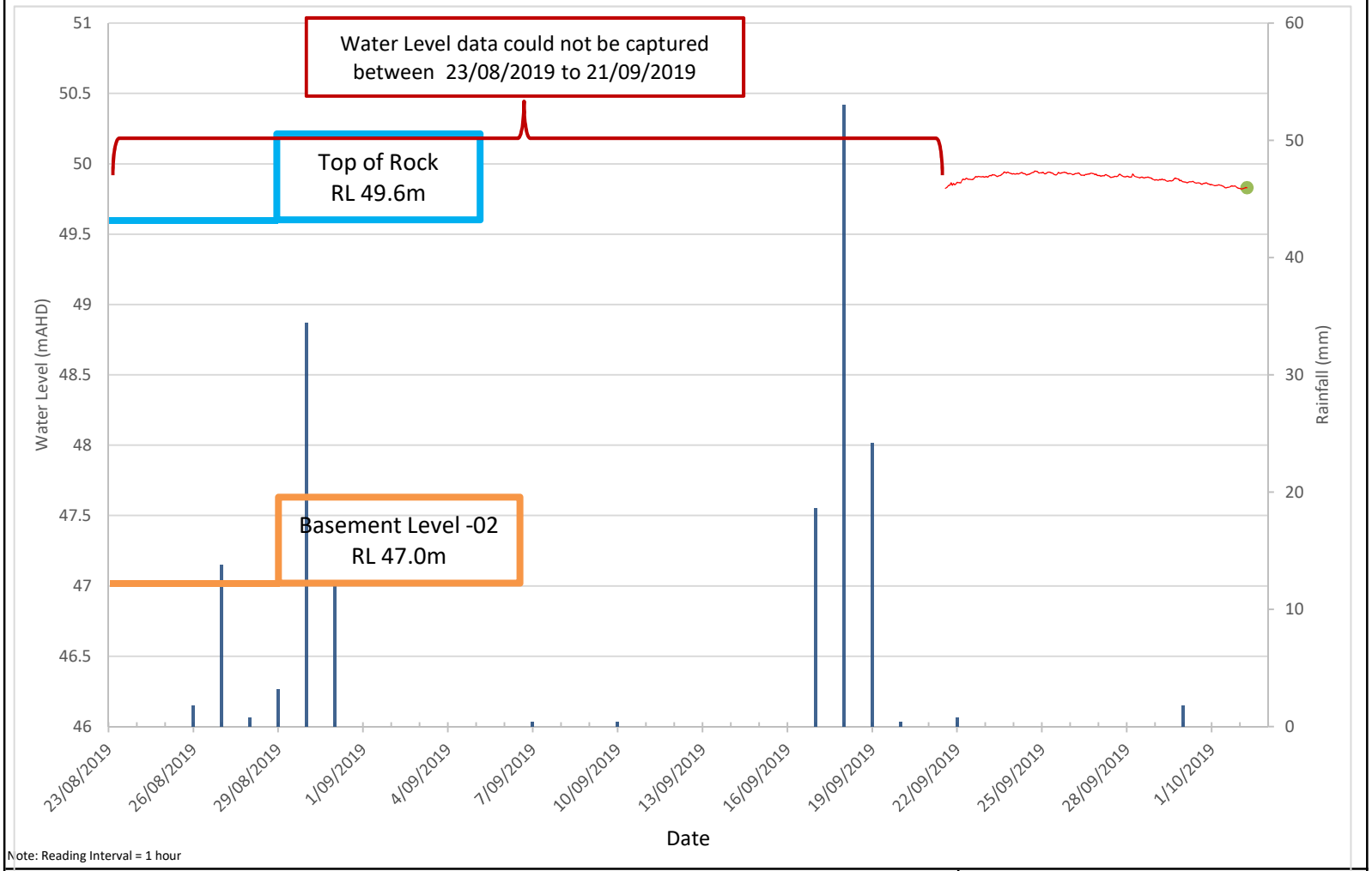
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Manual Levels
Water Level
Rainfall data (ST: 066052)

Date:	From	Drawn:
13/10/2019	9/08/2019	KR
Project:	**To**	**Checked:**
72505.13	10/10/2019	PAV

BH12



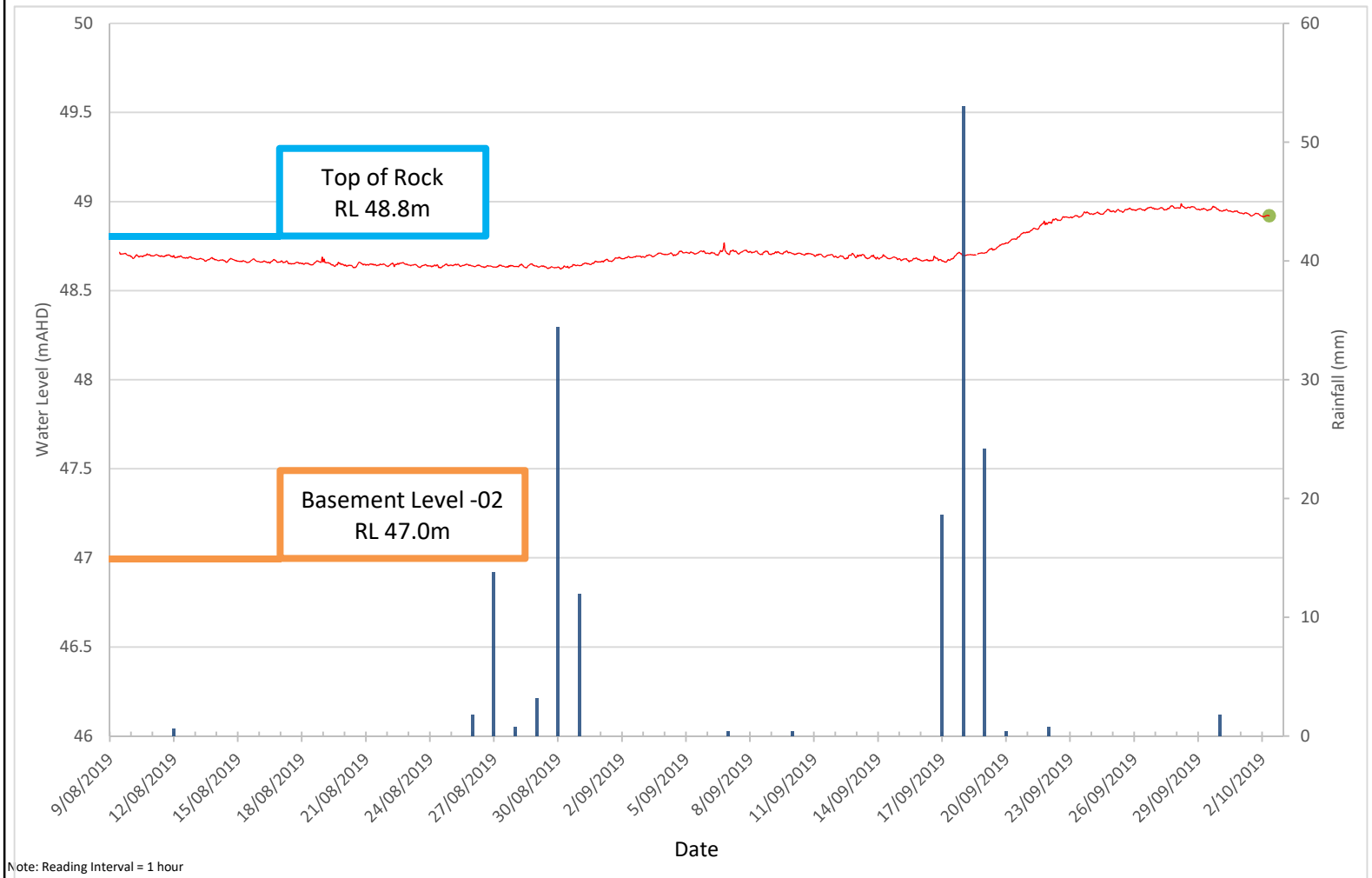
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Manual Levels
Water Level
Rainfall data (ST: 066052)

Date:	From	Drawn:
13/10/2019	23/08/2019	KR
Project:	**To**	**Checked:**
72505.13	10/10/2019	PAV

BH13



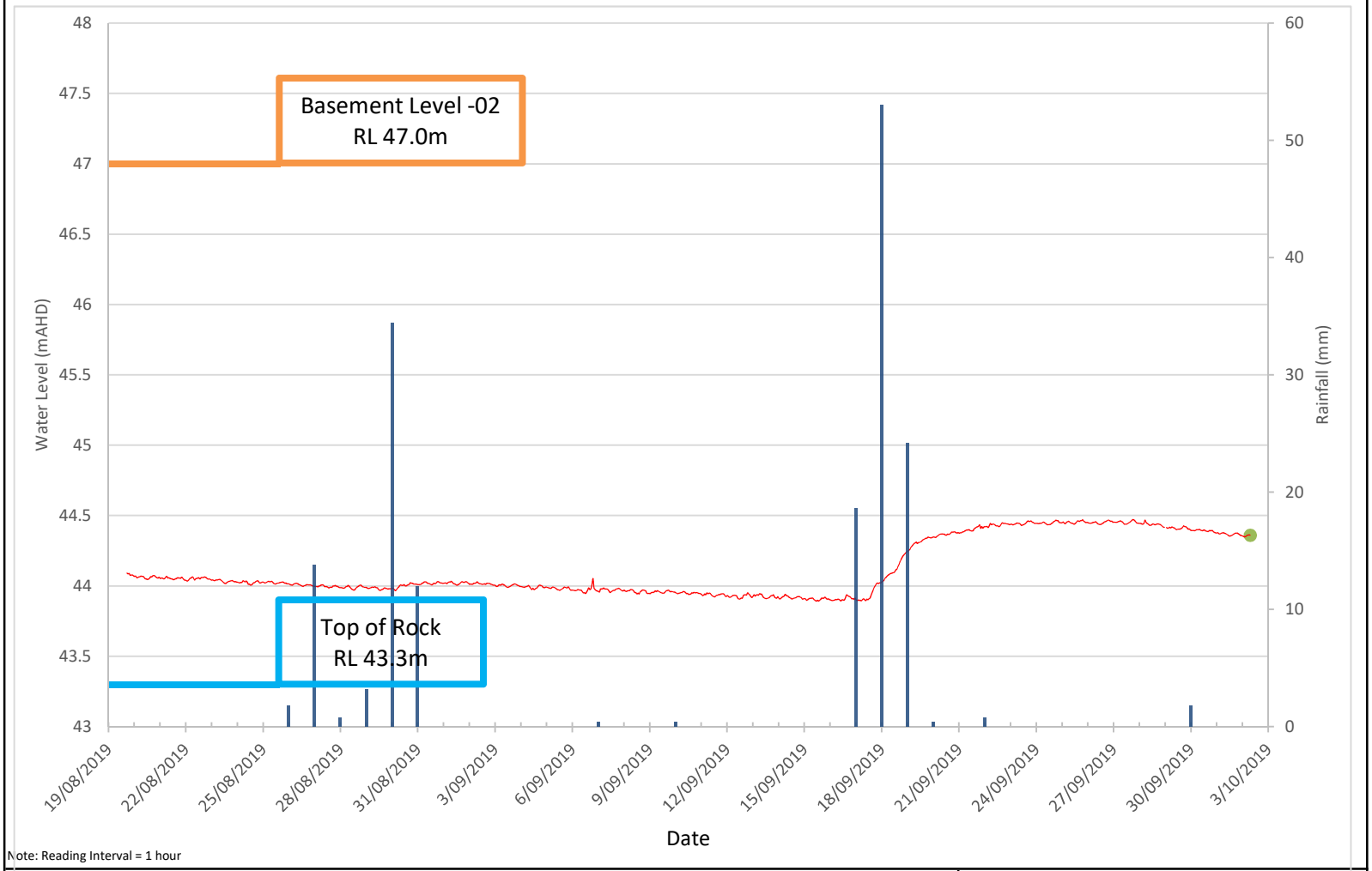
Note: Reading Interval = 1 hour

Douglas Partners
Geotechnics / Environment / Groundwater

Manual Levels
Water Level
Rainfall data (ST: 066052)

Date:	From	Drawn:
13/10/2019	9/08/2019	KR
Project:	**To**	**Checked:**
72505.13	10/10/2019	PAV

BH501



Note: Reading Interval = 1 hour

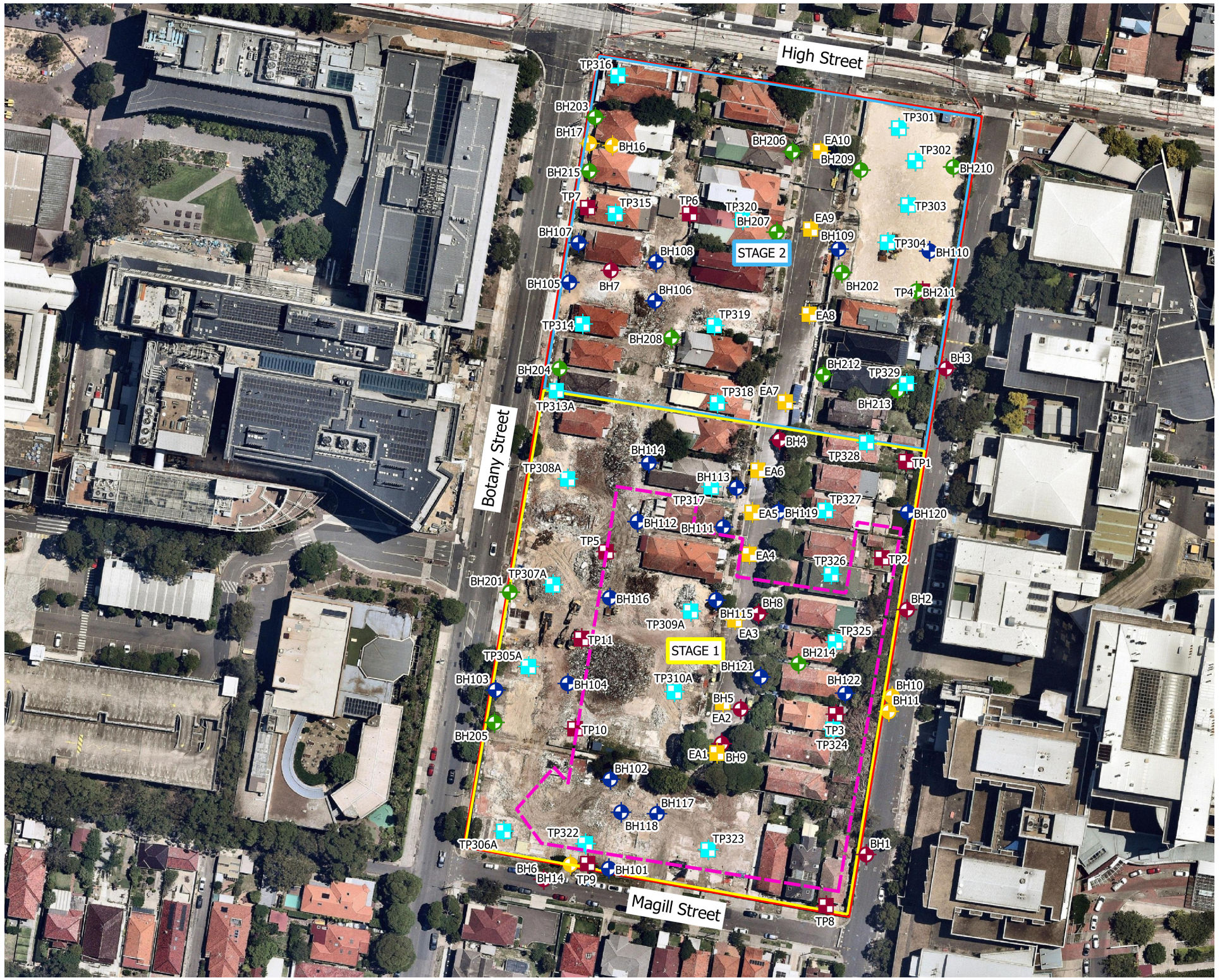
Douglas Partners
Geotechnics / Environment / Groundwater

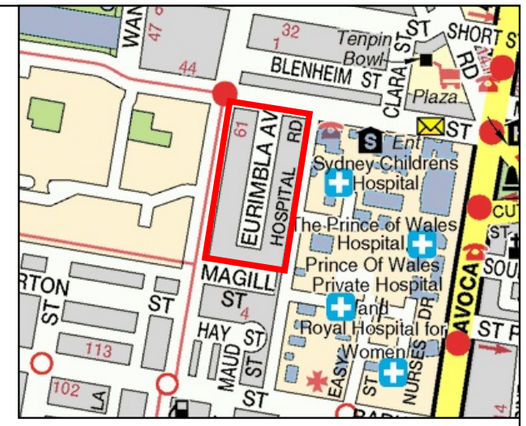
Manual Levels
Water Level
Rainfall data (ST: 066052)

Date:	From	Drawn:
13/10/2019	19/08/2019	KR
Project:	**To**	**Checked:**
72505.13	10/10/2019	PAV

Appendix F

Results of Laboratory Tests





Locality Plan

NOTE:
1: Base drawing from Nearmap.com (Dated 27/12/2018)

Legend

- Site Boundary
- Stage 1 Boundary
- Stage 2 Boundary
- Proposed Acute Services Building
- Post Demolition Test Pit (Current Investigation)
- Aggregrate Sampling Test Pits (Current Investigation)
- DP Test Pit Location (Aug. 2018)
- DP Environmental borehole (Jan. 2018)
- DP borehole location (Oct. 2017)
- DP borehole location (June, 2018)
- Existing Groundwater Well

0 25 50 75 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Lend Lease Building		
OFFICE:	Sydney	DRAWN BY:	JJH
SCALE:	1:1250	DATE:	15/02/2019

TITLE: **Test Locations of Previous and Current Boreholes and Test Pits**
Randwick Campus Development
Hospital Road, and High, Magill and Botany Streets, RANDWICK

PROJECT No:	72505.14
DRAWING No:	1A
REVISION:	1

Douglas Partners
Geotechnics | Environment | Groundwater

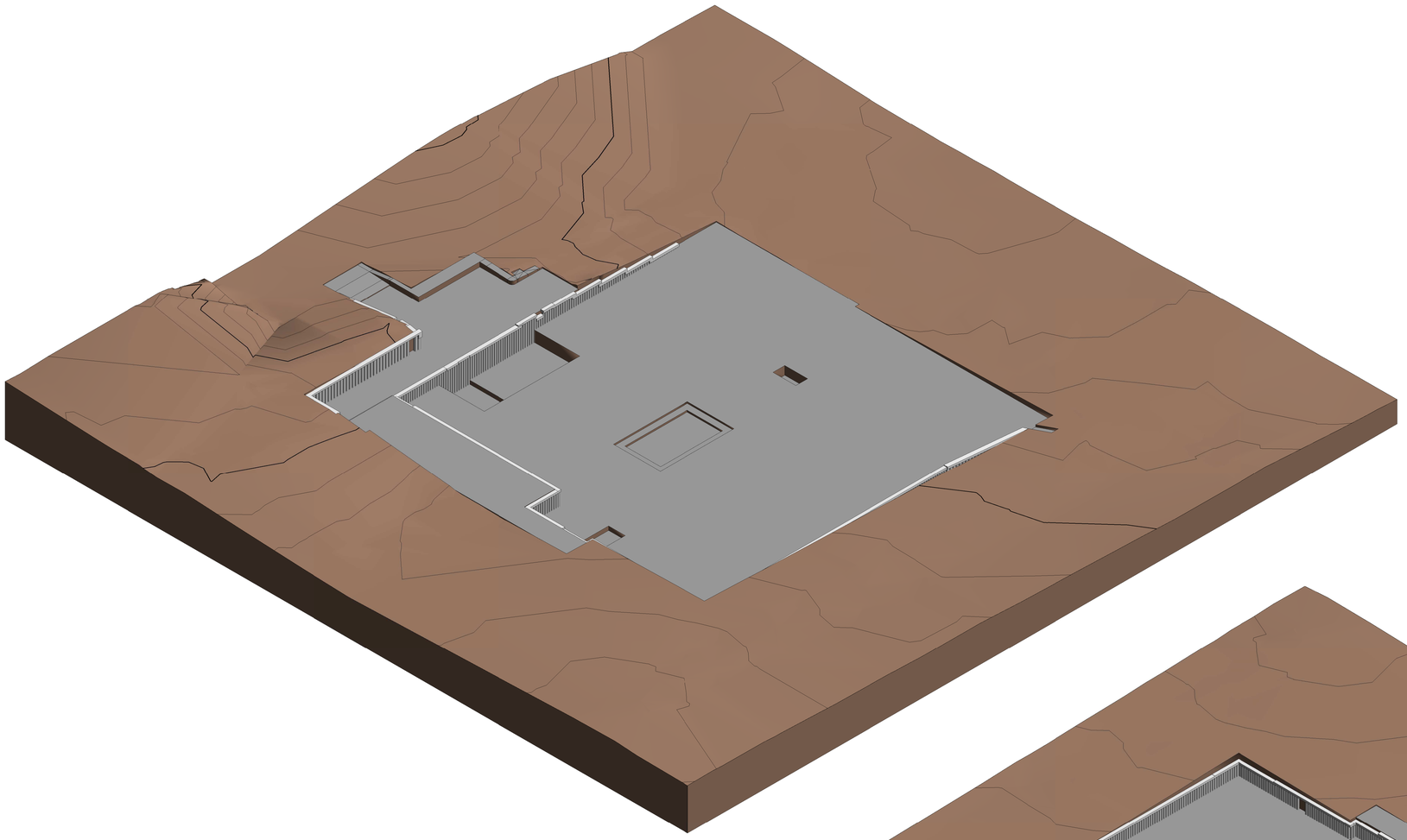
Table C2 - Groundwater results

		Metals								TRH		MAH						VOCs																PAH		Phenols
		Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	F2-NAPHTHALENE	C6-C10 less BTEX (F1)	Benzene	Ethylbenzene	Toluene	Xylene (m&p)	Xylene (o)	Styrene	1,1,2-trichloroethane	1,1-dichloroethene	1,2-dichloroethane	Carbon tetrachloride	Chloroform	Hexachlorobutadiene	Tetrachloroethene	Vinyl chloride	1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Chlorobenzene	Benzo(a) pyrene	Naphthalene	Phenol
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.0001	0.001	0.001	0.001	0.00005	0.001	0.001	0.05	0.01	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.0001	0.0002	0.05
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																																		
2-4m										1	1	0.8	NL	NL																			NL	
ANZG 2018 DGV GILs, Freshwater, slightly to moderately disturbed system		0.024	0.0005	0.0004	0.0014	0.0014	0.00006	0.028	0.021	-	-	0.95	-	-	0.075	0.35	-	6.5	-	-	-	-		-	-	0.003	0.085	0.16	0.26	0.06	-	0.0001	0.016	-
Field ID	**Sampled Date**																																	
DP (2019)																																		
BH14	12/02/2019	<0.001	0.0006	<0.001	0.007	<0.001	<0.00005	0.002	<0.001	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05
BH10	12/02/2019	<0.001	<0.1	<0.001	<0.001	<0.001	<0.00005	<0.001	0.008	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05
DP (2018b)																																		
BH202		<0.001	0.0001	<0.001	0.002	<0.001	<0.00005	0.005	0.031	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH204		<0.001	<0.0001	<0.001	0.008	<0.001	<0.00005	0.002	0.028	<0.05	0.039	<0.001	0.001	<0.001	0.009	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH11		<0.001	<0.0001	<0.001	0.005	<0.001	<0.00005	<0.001	0.013	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH14		<0.001	0.0001	<0.001	0.007	<0.001	<0.00005	<0.001	0.055	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH16		<0.001	<0.0001	<0.001	0.012	<0.001	<0.00005	0.001	0.007	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH17		<0.001	<0.0001	<0.001	0.003	<0.001	<0.00005	<0.001	0.008	0.074	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BD1/20180706		<0.001	0.0001	<0.001	0.001	<0.001	<0.00005	0.004	0.026	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
DP (2018)																																		
BD13102017	13/10/2017	<0.001	<0.0001	<0.001	0.007	<0.001	<0.00005	0.002	0.022	<0.05	0.012	<0.001	<0.001	0.001	<0.002	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0001	<0.0002	<0.05
GW7	13/10/2017	<0.001	<0.0001	<0.001	0.007	<0.001	<0.00005	0.002	0.024	<0.05	0.013	<0.001	<0.001	0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0002	<0.05

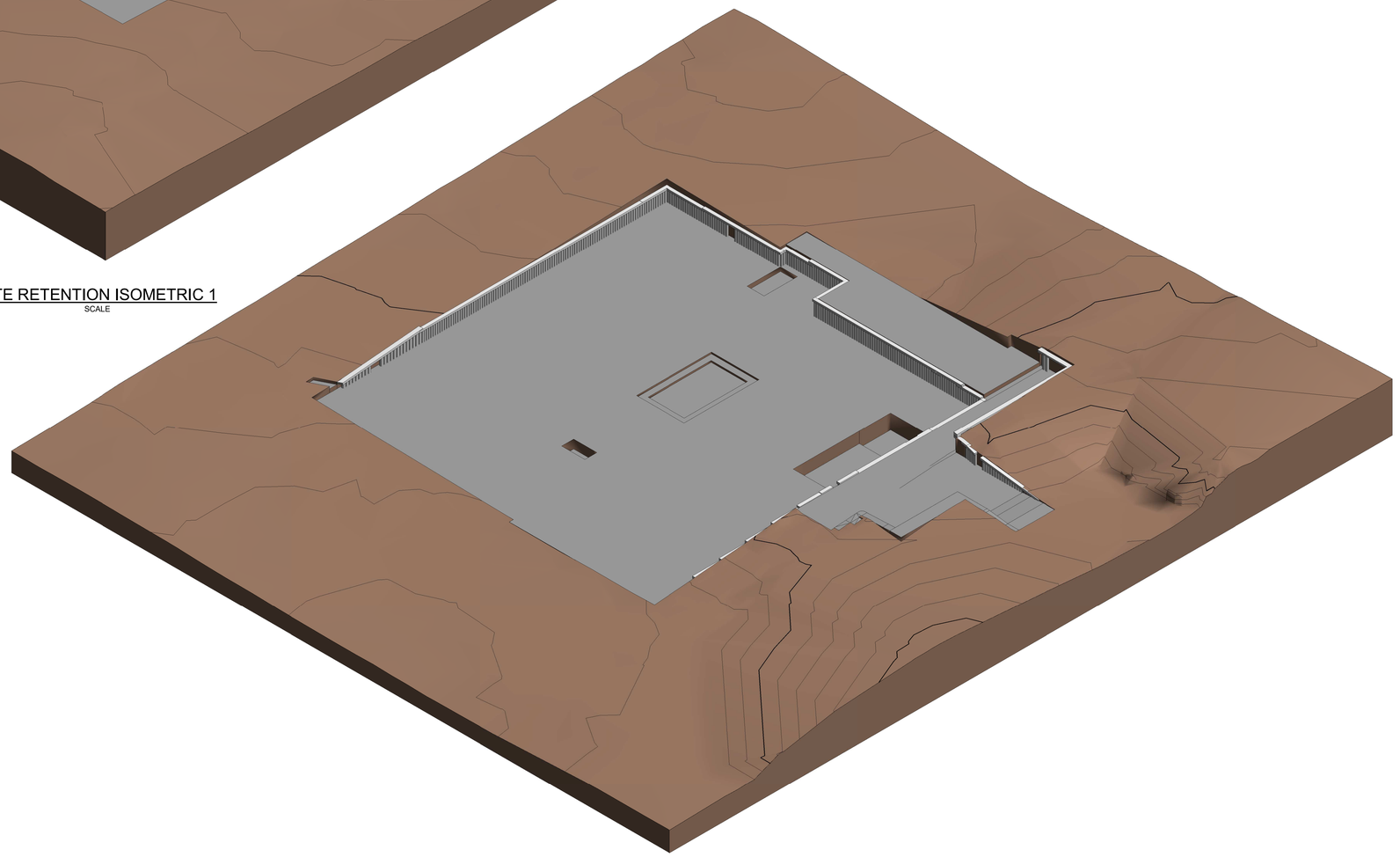
Appendix G

Drawings – Proposed Lowering of Hospital Road

FOR GENERAL NOTES REFER TO DRAWING RCR-ENS-STR-50-DRW-001-01



SITE RETENTION ISOMETRIC 1
SCALE



SITE RETENTION ISOMETRIC 2
SCALE

CONFIDENTIAL & COMMERCIAL-IN-CONFIDENCE

C:\Users\jreyburn\Documents\Revit User Files\5385-ST-ASB-R\T[ER19_CENTRAL_jreyburn.rvt 7/11/2019 4:13:05 PM

enstruct

enstruct group pty ltd

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Milsons Point NSW 2061
Australia

Telephone (02) 8904 1444
Facsimile (02) 8904 1555
http: //www.enstruct.com.au

NOTE

CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING

ISSUE	DATE	FOR
A	14.06.18	ISSUED FOR COORDINATION
B	28.06.18	50% DD ISSUE
C	03.08.18	ISSUED FOR COODINATION
D	20.08.18	100% DD ISSUE
E	07.09.18	100% DD UPDATES
F	14.09.18	100% DD UPDATES
1	11.12.18	ISSUED FOR CONSTRUCTION
2	21.12.18	ISSUED FOR CONSTRUCTION
3	26.02.19	CC1 ISSUE
4	29.04.19	CC1 ISSUE
5	04.07.19	IASB SSDA ISSUE
6	02.09.19	IASB SSDA ISSUE
7	18.10.19	IASB SSDA TENDER ISSUE
8	07.11.19	IASB SSDA TENDER ISSUE

PROJECT MANAGEMENT

PWC

ARCHITECTS

BVN / TERROIR

MECHANICAL ENGINEERING

LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING

WOOD & GRIEVE ENGINEERS

HYDRAULIC ENGINEERING

ACOR CONSULTANTS

CONSTRUCTION MANAGER

CLIENT

HEALTH INFRASTRUCTURE

CLIENT NUMBER

130487

PROJECT

RANDWICK CAMPUS REDEVELOPMENT

BAKER ST
RANDWICK NSW 2031
AUSTRALIA

ENSTRUCT PROJECT NUMBER

5385

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

@81 DO NOT SCALE

STATUS

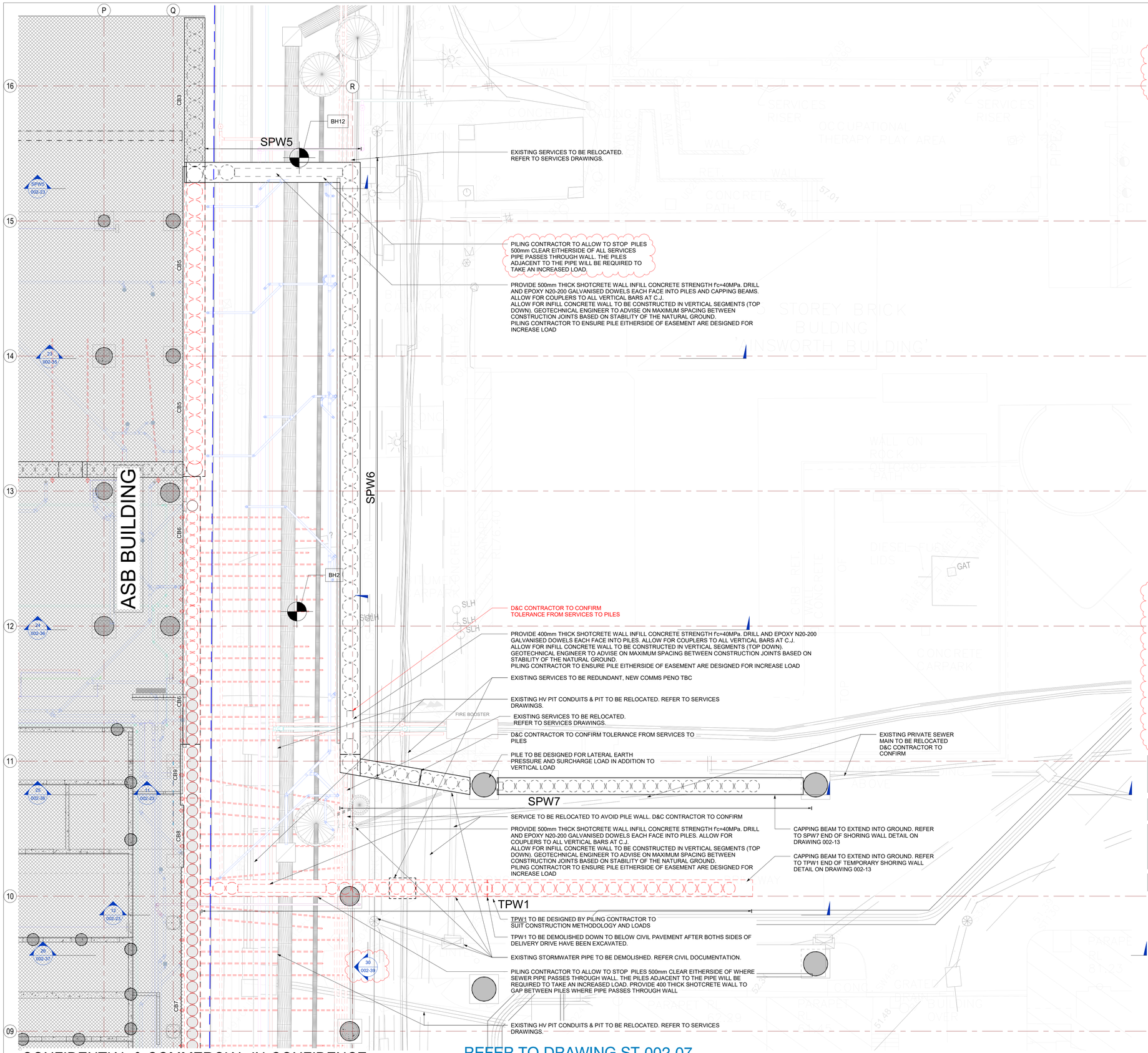
FOR CONSTRUCTION

DRAWING

BUILDING 50
SITE RETENTION ISOMETRICS

DRAWING NUMBER	ISSUE
RCR-ENS-STR-50-DRW-002-02	8

FOR GENERAL NOTES REFER TO DRAWING RCR-ENS-STR-50-DRW-001-01



CONFIDENTIAL & COMMERCIAL-IN-CONFIDENCE

REFER TO DRAWING ST-002-07

SITE RETENTION - GENERAL ARRANGEMENT - ZONE 6

SCALE 1 : 100

SITE RETENTION NOTES:

GEOTECHNICAL REPORT
- THE CONTRACTOR SHALL OBTAIN A COPY OF THE GEOTECHNICAL REPORT 72505.13.R.001 REVISION 2 AND SUPPLEMENTARY REPORT 72505.13.R.001 JUNE 18 BY DOUGLAS PARTNERS AND ADHERE TO THE RECOMMENDATIONS CONTAINED THEREIN.
- REFER TO GEOTECHNICAL REPORT 72505.13.R.001 REVISION 2 BY DOUGLAS PARTNERS DATED NOVEMBER 2017 AND SUPPLEMENTARY REPORTS 72505.13.R.001 DATED JUNE 2018 & 72505.13.R.014 DATED MARCH 2019 FOR ALL GROUND CONDITIONS

SITE SURVEY
- SURVEY INFORMATION PROVIDED AS REFERENCE ONLY. PLEASE REFER TO LATEST SURVEY INFORMATION.

SPECIFICATION
- THESE NOTES ARE TO BE READ IN CONJUNCTION WITH THE STRUCTURAL AND OTHER SPECIFICATIONS.

DUST CONTROL
- THE CONTRACTOR IS TO ENSURE THAT THE DUST PREVENTION METHODS THEY ADOPT ARE SUFFICIENT TO MEET THE REQUIREMENTS OF THE RANDWICK CITY COUNCIL. IT IS THE CONTRACTORS' RESPONSIBILITY TO ACQUAINT THEMSELF WITH THE REQUIREMENTS.

SITE SETOUT
- REFER TO THE ARCHITECTS DRAWINGS FOR THE ACCURATE SETOUT OF ALL BUILDINGS, DRIVEWAYS, PARKING AREAS ETC. CALCULATE AND CUT BATTERS FROM ARCHITECT'S PLANS AND SURVEY. CROSSOVER PROFILES TO COUNCIL REQUIREMENTS.

GENERALLY
- PROCEED WITH BULK EARTHWORKS AND SHORING TO PROVIDE A STABLE SUBGRADE AND WORK SPACE FOR THE CONSTRUCTION OF THE PROPOSED DEVELOPMENT. REDUCE SITE TO LEVELS INDICATED AND DISPOSE OF ALL UNWANTED MATERIAL LEGALLY.

SITE RETENTION
- RETAINING WALLS HAVE NOT BEEN DESIGNED FOR HYDROSTATIC PRESSURE. CONTRACTOR TO PROVIDE STRIP DRAINS TO PREVENT ANY WATER PRESSURE BUILD UP. DESIGN AS PART OF RETENTION SYSTEM

SUPERVISION
- A GEOTECHNICAL ENGINEER IS TO PROVIDE LEVEL 1 SUPERVISION (AS3798) FOR ALL EARTHWORKS DURING THE COURSE OF CONSTRUCTION. AT THE COMPLETION OF THE BULK EXCAVATION CONTRACT, THE GEOTECHNICAL ENGINEER IS TO PROVIDE CERTIFICATION THAT THE WORKS HAVE BEEN CARRIED OUT IN ACCORDANCE WITH BULK EARTHWORKS SPECIFICATION.
- GEOTECHNICAL SUPERVISION AND ROCK MAPPING OF ALL EXCAVATION FACES IS TO BE UNDERTAKEN

DRAINAGE DURING CONSTRUCTION
- PROVIDE ADEQUATE DRAINAGE DURING CONSTRUCTION TO ENSURE MINIMUM DISRUPTION FROM RAIN.

SERVICES
- IT IS ASSUMED THAT ALL SERVICES WILL BE RELOCATED WITH THE EXCEPTION OF THE STORMWATER AND SEWER WHICH WILL BE LOWERED AT THE LOADING DOCK CROSSING. DURING PILING AND EXCAVATION COORDINATE WITH ALL SERVICES INCLUDING SEWER, GAS AND POWER.
- THE CONTRACTOR IS TO OBTAIN A COPY OF SERVICES LOCATOR DRAWINGS AND ENSURE ALL PILES AND ANCHORS AVOID ALL SERVICES.

BULK EARTHWORKS PROCEDURE AND SPECIFICATION
- AT THE COMPLETION OF THE BULK EARTHWORKS, THE CONTRACTOR SHALL PROVIDE TEMPORARY OR PERMANENT DRAINAGE TO ENSURE NO SURFACE WATER IS RETAINED ON THE SITE, OR THAT SURFACE WATER FLOW DETRIMENTALLY SCOURS THE PREPARED BASE.

GEOTECHNICAL ENGINEER NOTES:
- EXCAVATION TO BE CARRIED OUT UNDER GEOTECHNICAL ENGINEER'S SUPERVISION.
- GEOTECHNICAL ENGINEER TO COMMENT ON SUITABILITY OF THE SUBCONTRACTOR'S METHOD OF EXCAVATION AS REMOVAL PROCEEDS.

HYDRAULICS ENGINEER
- DURING EXCAVATION COORDINATE WITH ALL HYDRAULIC ENGINEERS REQUIREMENTS FOR SEWER, GAS AND STORMWATER LINES.

AS-BUILT DRAWING
- PROVIDE AN AS-BUILT DRAWING PREPARED BY A REGISTERED SURVEYOR TO CONFIRM BULK EARTHWORKS IS COMPLETED TO REQUIRED DIMENSIONS AND LEVELS.

DILAPIDATION REPORT
- THE APPROVED SHORING WALL CONTRACTOR SHALL PREPARE A DILAPIDATION REPORT OF STREET, FOOTPATH AND ROAD FEATURES PRIOR TO INSTALLATION OF SHORING WALL.

COMPACTION NOTES
- COMPACTION BEHIND INTERNAL FORMED RETAINING WALL BY EXCAVATION CONTRACTOR USING HAND HELD RAMMERS TO ACHIEVE 98% MODIFIED DENSITY.
- COMPACT IN MAXIMUM 300mm THICK LAYERS AT OPTIMUM MOISTURE CONTENT OF ±3%.

CONTRACTORS NOTES
- INFERRED SUBSURFACE CONDITIONS HAVE BEEN ASSUMED OR PREPARED BY INTERPOLATION AND/OR EXTRAPOLATION FROM DISCRETE TEST HOLE DATA AND AS SUCH THE CONDITIONS SHOWN ARE AN INTERPRETATION AND MUST BE CONSIDERED AS A GUIDE ONLY. LOCAL VARIATIONS OR ANOMALIES IN GROUND CONDITIONS CAN OCCUR IN THE NATURAL ENVIRONMENT, PARTICULARLY BETWEEN DISCRETE TEST HOLE LOCATIONS.
- CONTRACTOR IS TO OBTAIN EXISTING BUILDING DRAWINGS AND ALLOW FOR INVESTIGATION OF EXISTING GROUND ANCHORS / ROCK BOLTS FROM THE EXISTING CHILDRENS HOSPITAL.
- SPECIFIC SUPPORT REQUIREMENTS CAN ONLY BE ASSESSED DURING EXCAVATION. VERIFICATION OF THE GEOTECHNICAL ASSUMPTIONS AND/OR MODEL AND SITE RETENTION SYSTEM IS AN INTEGRAL PART OF THE DESIGN PROCESS. THE CONTRACTOR SHALL MAKE ALLOWANCE TO ENGAGE THE ABOVE MENTIONED GEOTECHNICAL ENGINEER TO CARRY OUT FULL TIME INSPECTIONS AS THE EXCAVATION PROGRESSES FOR THE PURPOSE OF INVESTIGATION, CONSTRUCTION VERIFICATION AND PERFORMANCE MONITORING.
- DESIGN OF GROUND ANCHORS TO BE D&C BY THE CONTRACTOR. DETAILS AND CALCULATIONS TO BE SUBMITTED FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- SOIL/ROCK RL'S ARE BASED ON GEOTECHNICAL INVESTIGATION REPORT, REFER TO ABOVE MENTIONED DOCUMENT. THIS MAY VARY FROM ACTUAL SITE CONDITIONS
- CONTRACTOR TO LOCATE ALL SERVICES ON AND AROUND THE SITE AND ENSURE ALL GROUND ANCHORS AND ROCK BOLTS AVOID ALL SERVICES.
- CONTRACTOR TO DEVELOP SEQUENCING OF WORKS ALLOWING FOR ALL SERVICES RELOCATION REQUIREMENTS AND SUBMIT SEQUENCING METHODOLOGY FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- REFER TO GEOTECHNICAL ADVICE FOR EXCAVATION AND METHODOLOGY AND MONITORING REQUIREMENTS.

SITE RETENTION LOADING
15kPa MINIMUM SURCHARGE
REFER TO DRG. ST-297-00 TO ST-297-01 AND ST-299-00 TO 299-01
CONTRACTOR FOR CONSTRUCTION LOADING REQUIREMENTS

NOTE:
ALLOW TO FORM UP ALL PILES ABOVE NATURAL GROUND

NOTE:
EXISTING ASB PILE WALLS HAVE TEMPORARY GROUND ANCHORS. ENSURE ANCHORS ARE DESTRESSED AND REMOVED PRIOR TO CONSTRUCTION AND EXCAVATION OF HOSPITAL ROAD.

— — - DENOTES DEMOLISHED STRUCTURE

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A	04.07.19	IASB SSDA ISSUE
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C	18.10.19	IASB SSDA TENDER ISSUE
D	04.11.19	ISSUED FOR SYDNEY WATER
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PROJECT MANAGEMENT
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ACOR CONSULTANTS

CONSTRUCTION MANAGER
tenderlease

CLIENT
NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE
CLIENT NUMBER
130487

PROJECT
RANDWICK CAMPUS REDEVELOPMENT

BAKER ST
RANDWICK NSW 2031
AUSTRALIA

ENSTRUCT PROJECT NUMBER
5385

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000

SCALE
1 : 100@B1 DO NOT SCALE

STATUS
FOR TENDER

DRAWING
BUILDING 50
SITE RETENTION GENERAL
ARRANGEMENT - ZONE 6

DRAWING NUMBER ISSUE
RCR-ENS-STR-50-DRW-002-06 E

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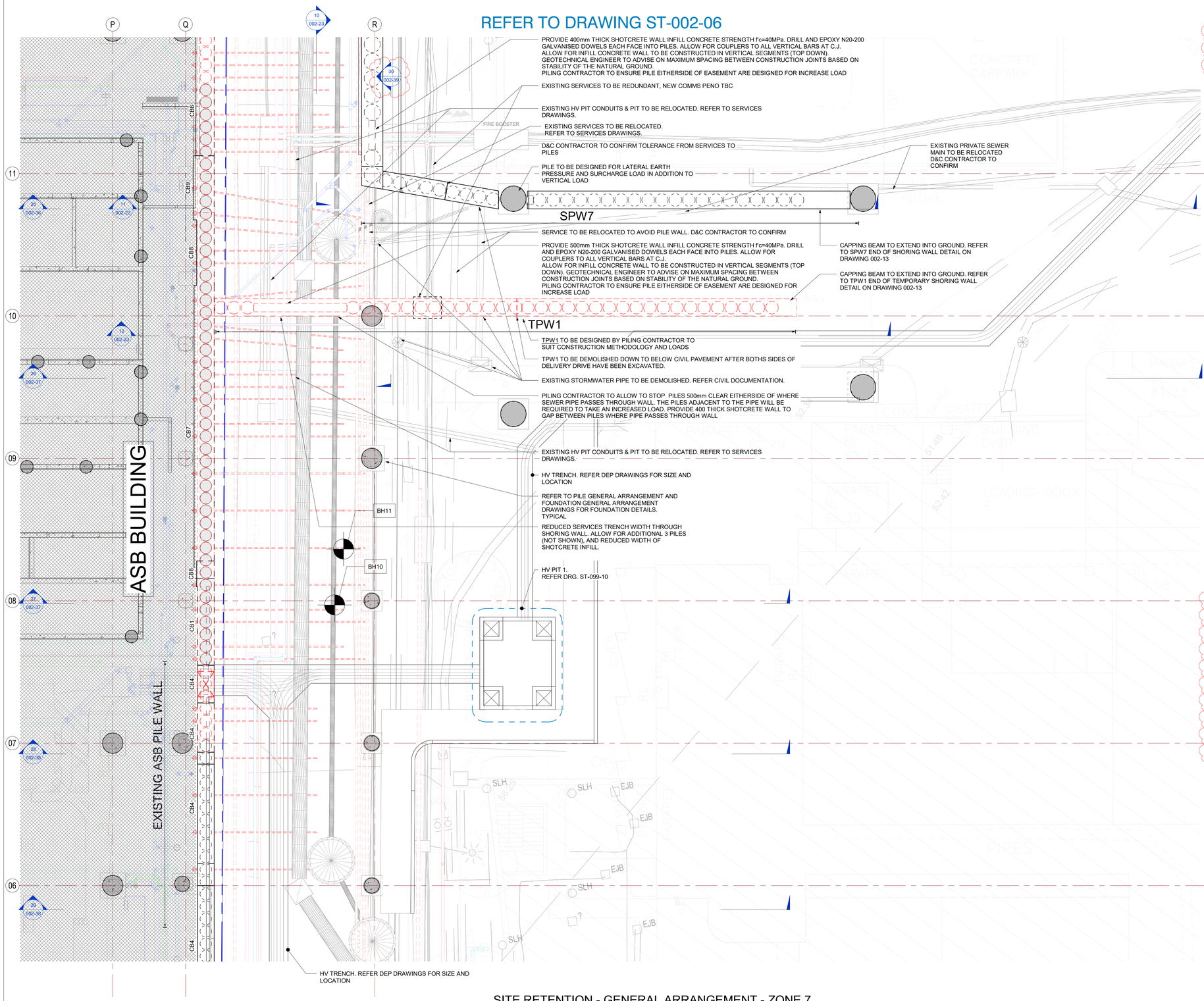

SITE RETENTION NOTES:

GEOTECHNICAL REPORT
- THE CONTRACTOR SHALL OBTAIN A COPY OF THE GEOTECHNICAL REPORT 72505.13.R.001 REVISION 2 AND SUPPLEMENTARY REPORT 72505.13.R.001 JUNE 18 BY DOUGLAS PARTNERS AND ADHERE TO THE RECOMMENDATIONS CONTAINED THEREIN.
- REFER TO GEOTECHNICAL REPORT 72505.13.R.001 REVISION 2 BY DOUGLAS PARTNERS DATED NOVEMBER 2017 AND SUPPLEMENTARY REPORTS 72505.13.R.001 DATED JUNE 2018 & 72505.13.R.014 DATED MARCH 2019 FOR ALL GROUND CONDITIONS

SITE SURVEY
- SURVEY INFORMATION PROVIDED AS REFERENCE ONLY. PLEASE REFER TO LATEST SURVEY INFORMATION.

SPECIFICATION
- THESE NOTES ARE TO BE READ IN CONJUNCTION WITH THE STRUCTURAL AND OTHER SPECIFICATIONS.

DUST CONTROL
- THE CONTRACTOR IS TO ENSURE THAT THE DUST PREVENTION METHODS THEY ADOPT ARE SUFFICIENT TO MEET THE REQUIREMENTS OF THE RANDWICK CITY COUNCIL. IT IS THE CONTRACTORS' RESPONSIBILITY TO ACQUAINT THEMSELF WITH THE REQUIREMENTS.

SITE SETOUT
- REFER TO THE ARCHITECTS DRAWINGS FOR THE ACCURATE SETOUT OF ALL BUILDINGS, DRIVEWAYS, PARKING AREAS ETC. CALCULATE AND CUT BATTERS FROM ARCHITECT'S PLANS AND SURVEY. CROSSOVER PROFILES TO COUNCIL REQUIREMENTS.

GENERALLY
- PROCEED WITH BULK EARTHWORKS AND SHORING TO PROVIDE A STABLE SUBGRADE AND WORK SPACE FOR THE CONSTRUCTION OF THE PROPOSED DEVELOPMENT. REDUCE SITE TO LEVELS INDICATED AND DISPOSE OF ALL UNWANTED MATERIAL LEGALLY.

SITE RETENTION
- RETAINING WALLS HAVE NOT BEEN DESIGNED FOR HYDROSTATIC PRESSURE. CONTRACTOR TO PROVIDE STRIP DRAINS TO PREVENT ANY WATER PRESSURE BUILD UP. DESIGN AS PART OF RETENTION SYSTEM

SUPERVISION
- A GEOTECHNICAL ENGINEER IS TO PROVIDE LEVEL 1 SUPERVISION (AS3798) FOR ALL EARTHWORKS DURING THE COURSE OF CONSTRUCTION. AT THE COMPLETION OF THE BULK EXCAVATION CONTRACT, THE GEOTECHNICAL ENGINEER IS TO PROVIDE CERTIFICATION THAT THE WORKS HAVE BEEN CARRIED OUT IN ACCORDANCE WITH BULK EARTHWORKS SPECIFICATION.
- GEOTECHNICAL SUPERVISION AND ROCK MAPPING OF ALL EXCAVATION FACES IS TO BE UNDERTAKEN

DRAINAGE DURING CONSTRUCTION
- PROVIDE ADEQUATE DRAINAGE DURING CONSTRUCTION TO ENSURE MINIMUM DISRUPTION FROM RAIN.

SERVICES
- IT IS ASSUMED THAT ALL SERVICES WILL BE RELOCATED WITH THE EXCEPTION OF THE STORMWATER AND SEWER WHICH WILL BE LOWERED AT THE LOADING DOCK CROSSING. DURING PILING AND EXCAVATION COORDINATE WITH ALL SERVICES INCLUDING SEWER, GAS AND POWER.
- THE CONTRACTOR IS TO OBTAIN A COPY OF SERVICES LOCATOR DRAWINGS AND ENSURE ALL PILES AND ANCHORS AVOID ALL SERVICES.

BULK EARTHWORKS PROCEDURE AND SPECIFICATION
- AT THE COMPLETION OF THE BULK EARTHWORKS, THE CONTRACTOR SHALL PROVIDE TEMPORARY OR PERMANENT DRAINAGE TO ENSURE NO SURFACE WATER IS RETAINED ON THE SITE, OR THAT SURFACE WATER FLOW DETRIMENTALLY SCOURS THE PREPARED BASE.

GEOTECHNICAL ENGINEER NOTES:
- EXCAVATION TO BE CARRIED OUT UNDER GEOTECHNICAL ENGINEER'S SUPERVISION.
- GEOTECHNICAL ENGINEER TO COMMENT ON SUITABILITY OF THE SUBCONTRACTOR'S METHOD OF EXCAVATION AS REMOVAL PROCEEDS.

HYDRAULICS ENGINEER
- DURING EXCAVATION COORDINATE WITH ALL HYDRAULIC ENGINEERS REQUIREMENTS FOR SEWER, GAS AND STORMWATER LINES.

AS-BUILT DRAWING
- PROVIDE AN AS-BUILT DRAWING PREPARED BY A REGISTERED SURVEYOR TO CONFIRM BULK EARTHWORKS IS COMPLETED TO REQUIRED DIMENSIONS AND LEVELS.

DILAPIDATION REPORT
- THE APPROVED SHORING WALL CONTRACTOR SHALL PREPARE A DILAPIDATION REPORT OF STREET, FOOTPATH AND ROAD FEATURES PRIOR TO INSTALLATION OF SHORING WALL.

COMPACTION NOTES
- COMPACTION BEHIND INTERNAL FORMED RETAINING WALL BY EXCAVATION CONTRACTOR USING HAND HELD RAMMERS TO ACHIEVE 98% MODIFIED DENSITY.
- COMPACT IN MAXIMUM 300mm THICK LAYERS AT OPTIMUM MOISTURE CONTENT OF ±3%.

CONTRACTORS NOTES
- INFERRED SUBSURFACE CONDITIONS HAVE BEEN ASSUMED OR PREPARED BY INTERPOLATION AND/OR EXTRAPOLATION FROM DISCRETE TEST HOLE DATA AND AS SUCH THE CONDITIONS SHOWN ARE AN INTERPRETATION AND MUST BE CONSIDERED AS A GUIDE ONLY. LOCAL VARIATIONS OR ANOMALIES IN GROUND CONDITIONS CAN OCCUR IN THE NATURAL ENVIRONMENT, PARTICULARLY BETWEEN DISCRETE TEST HOLE LOCATIONS.
- CONTRACTOR IS TO OBTAIN EXISTING BUILDING DRAWINGS AND ALLOW FOR INVESTIGATION OF EXISTING GROUND ANCHORS / ROCK BOLTS FROM THE EXISTING CHILDRENS HOSPITAL.
- SPECIFIC SUPPORT REQUIREMENTS CAN ONLY BE ASSESSED DURING EXCAVATION. VERIFICATION OF THE GEOTECHNICAL ASSUMPTIONS AND/OR MODEL AND SITE RETENTION SYSTEM IS AN INTEGRAL PART OF THE DESIGN PROCESS. THE CONTRACTOR SHALL MAKE ALLOWANCE TO ENGAGE THE ABOVE MENTIONED GEOTECHNICAL ENGINEER TO CARRY OUT FULL TIME INSPECTIONS AS THE EXCAVATION PROGRESSES FOR THE PURPOSE OF INVESTIGATION, CONSTRUCTION VERIFICATION AND PERFORMANCE MONITORING.
- DESIGN OF GROUND ANCHORS TO BE D&C BY THE CONTRACTOR. DETAILS AND CALCULATIONS TO BE SUBMITTED FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- SOIL/ROCK RL'S ARE BASED ON GEOTECHNICAL INVESTIGATION REPORT, REFER TO ABOVE MENTIONED DOCUMENT. THIS MAY VARY FROM ACTUAL SITE CONDITIONS
- CONTRACTOR TO LOCATE ALL SERVICES ON AND AROUND THE SITE AND ENSURE ALL GROUND ANCHORS AND ROCK BOLTS AVOID ALL SERVICES.
- CONTRACTOR TO DEVELOP SEQUENCING OF WORKS ALLOWING FOR ALL SERVICES RELOCATION REQUIREMENTS AND SUBMIT SEQUENCING METHODOLOGY FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- REFER TO GEOTECHNICAL ADVICE FOR EXCAVATION AND METHODOLOGY AND MONITORING REQUIREMENTS.

SITE RETENTION LOADING
15kPa MINIMUM SURCHARGE
REFER TO DRG. ST-297-00 TO ST-297-01 AND ST-299-00 TO 299-01
CONTRACTOR FOR CONSTRUCTION LOADING REQUIREMENTS

NOTE:
ALLOW TO FORM UP ALL PILES ABOVE NATURAL GROUND

NOTE:
EXISTING ASB PILE WALLS HAVE TEMPORARY GROUND ANCHORS. ENSURE ANCHORS ARE DESTRESSED AND REMOVED PRIOR TO CONSTRUCTION AND EXCAVATION OF HOSPITAL ROAD.

— — - DENOTES DEMOLISHED STRUCTURE

SITE RETENTION - GENERAL ARRANGEMENT - ZONE 7

SCALE 1 : 100

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HEALTH INFRASTRUCTURE
CLIENT NUMBER
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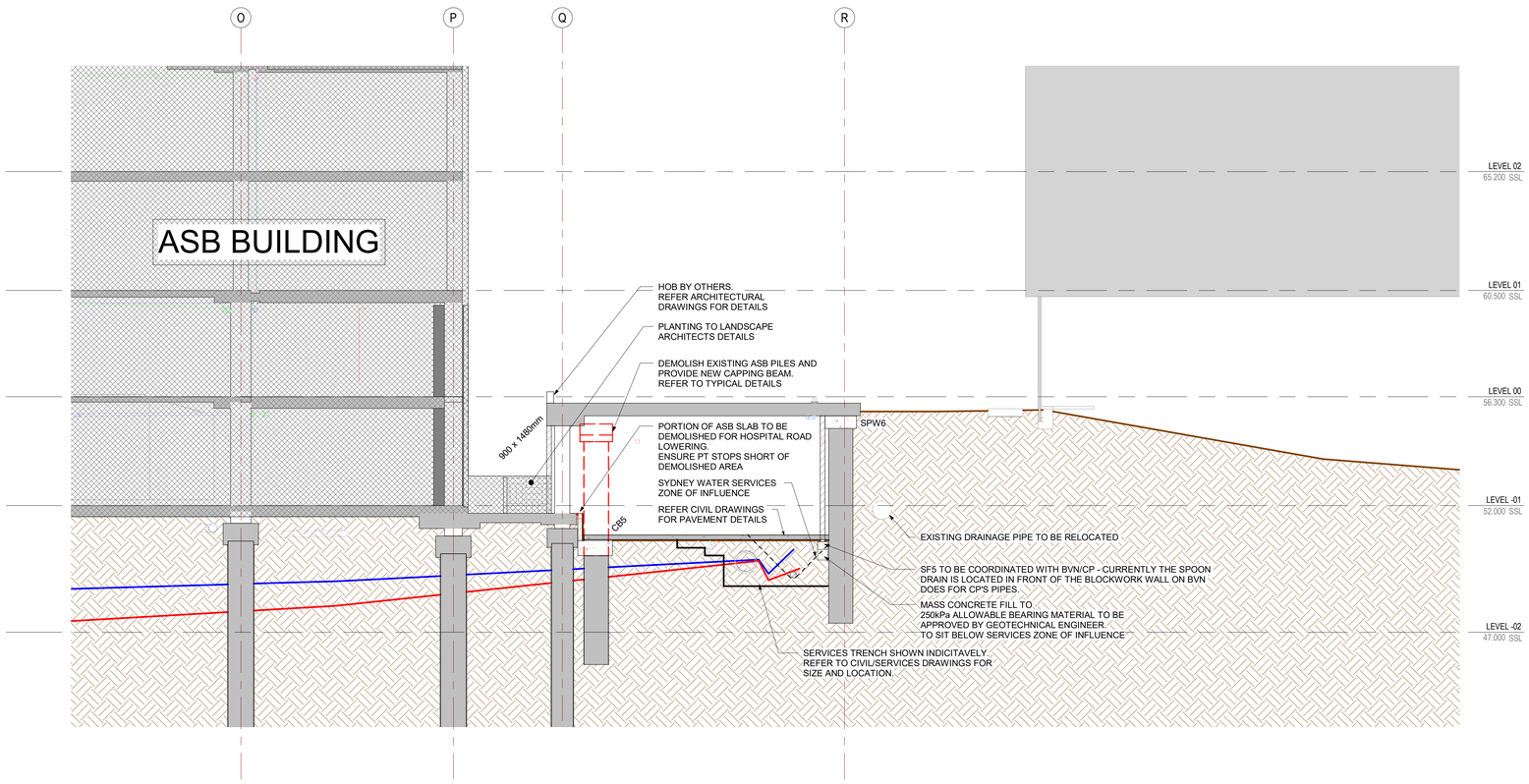
BAKER ST
RANDWICK NSW 2031
AUSTRALIA
ENSTRUCT PROJECT NUMBER
5385
DRAWING KEY

TRUE NORTH PROJECT NORTH
GRAPHIC SCALE
0 2000 5000
SCALE
1 : 100@B1 DO NOT SCALE
STATUS
FOR TENDER
DRAWING
BUILDING 50
SITE RETENTION GENERAL ARRANGEMENT - ZONE 7

DRAWING NUMBER	ISSUE
RCR-ENS-STR-50-DRW-002-07	C

FOR GENERAL NOTES REFER TO DRAWING RCR-ENS-STR-50-DRW-001-01



SECTION 23
1 : 100 002-06

NOTES:
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– – - DENOTES DEMOLISHED STRUCTURE

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DRAWING KEY

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GRAPHIC SCALE
0 2000 5000

SCALE
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STATUS
FOR TENDER

DRAWING
BUILDING 50
SITE RETENTION SECTIONS - SHEET 6

DRAWING NUMBER ISSUE
RCR-ENS-STR-50-DRW-002-35 E

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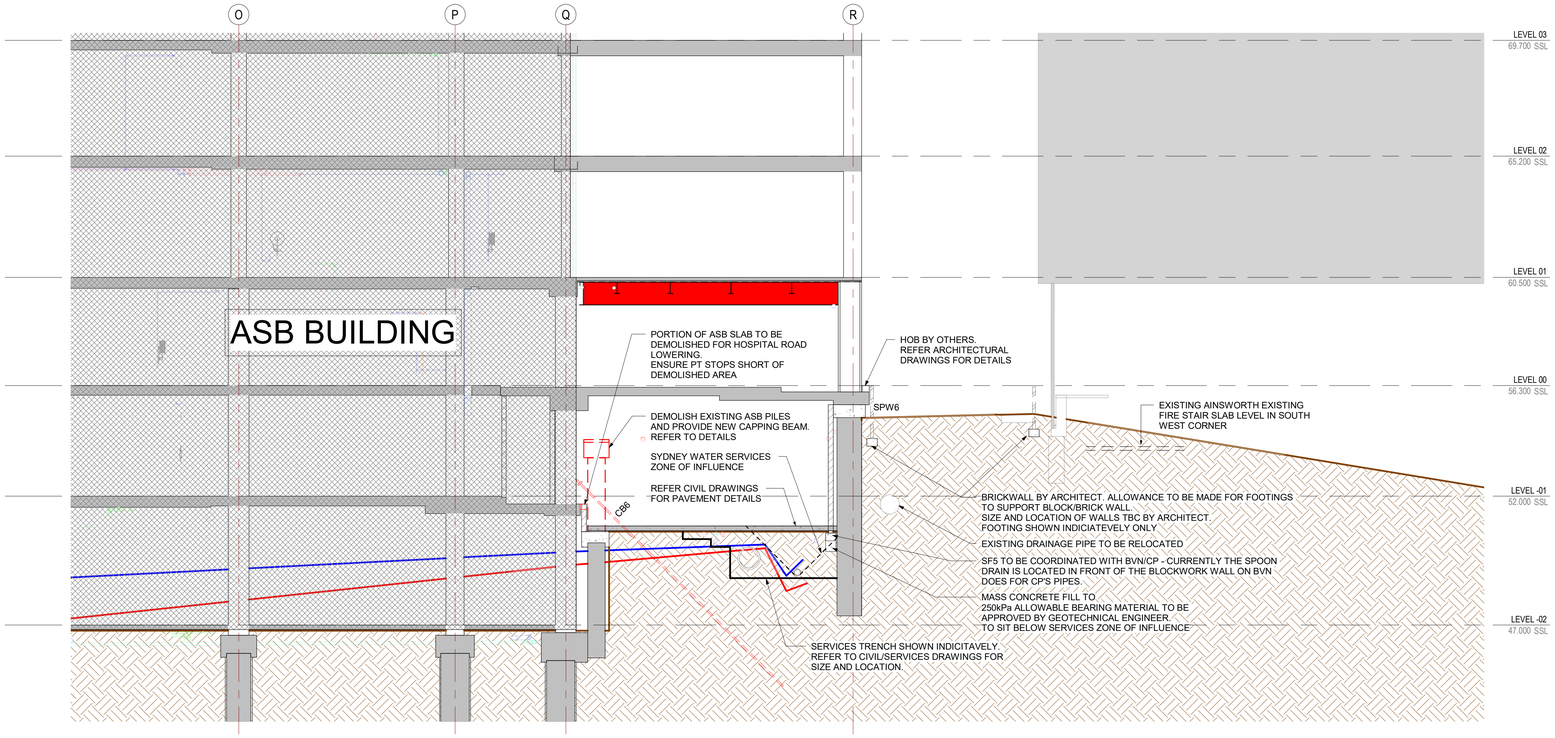

SECTION 24
1 : 100 002-06

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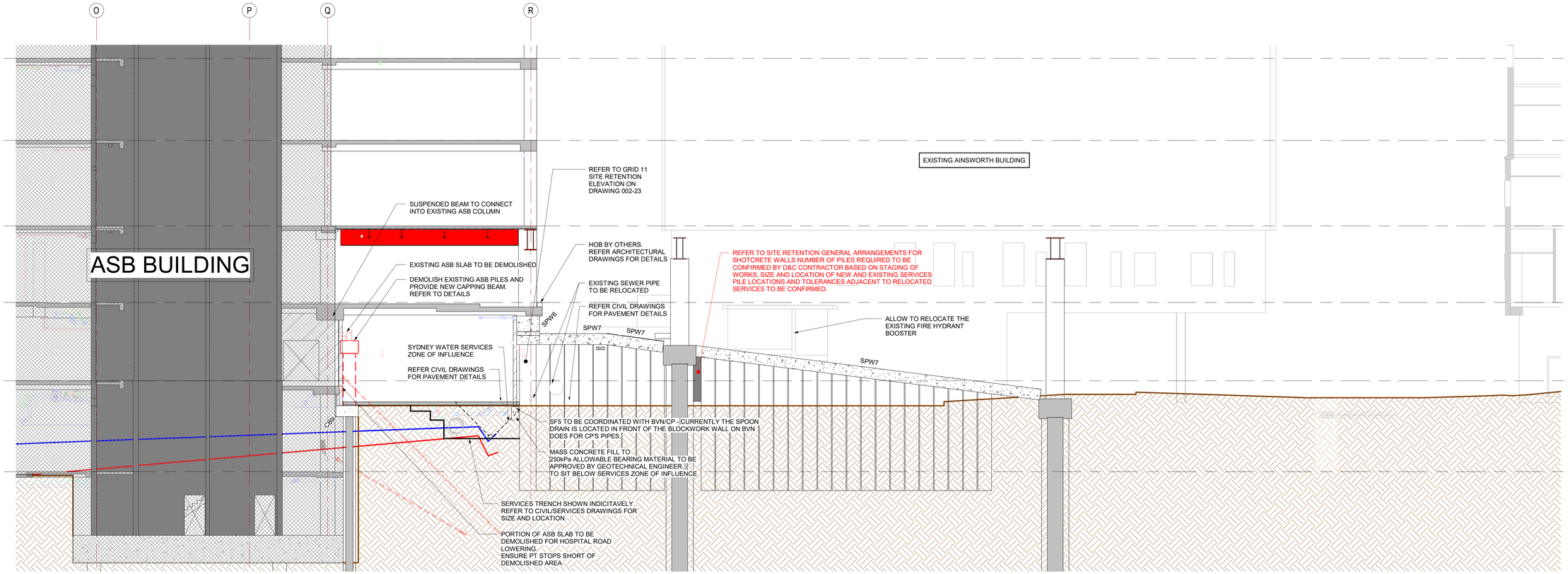

SECTION 25
1 : 100 002-00

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CONSTRUCTION MANAGER
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BAKER ST
RANDWICK NSW 2031
AUSTRALIA
ENSTRUCT PROJECT NUMBER

5385
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
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SCALE
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STATUS
FOR TENDER

DRAWING
BUILDING 50
SITE RETENTION SECTIONS - SHEET 7

DRAWING NUMBER | ISSUE
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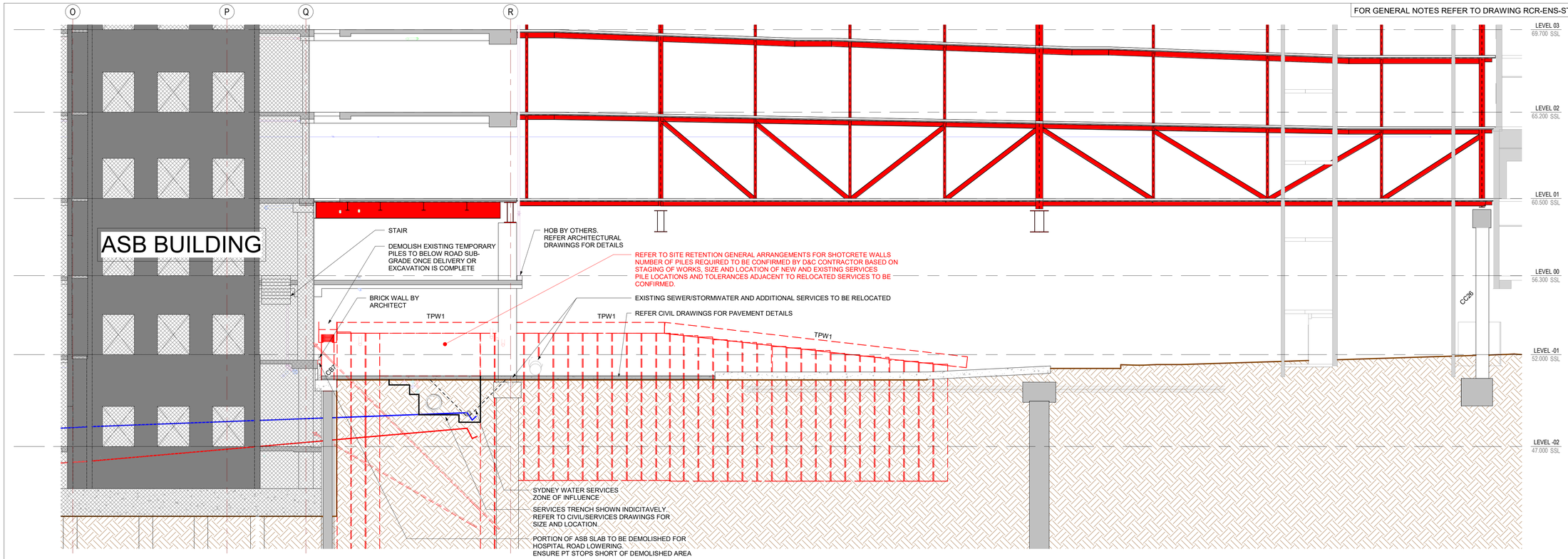
FOR GENERAL NOTES REFER TO DRAWING RCR-ENS-STR-50-DRW-001-01



SECTION 26
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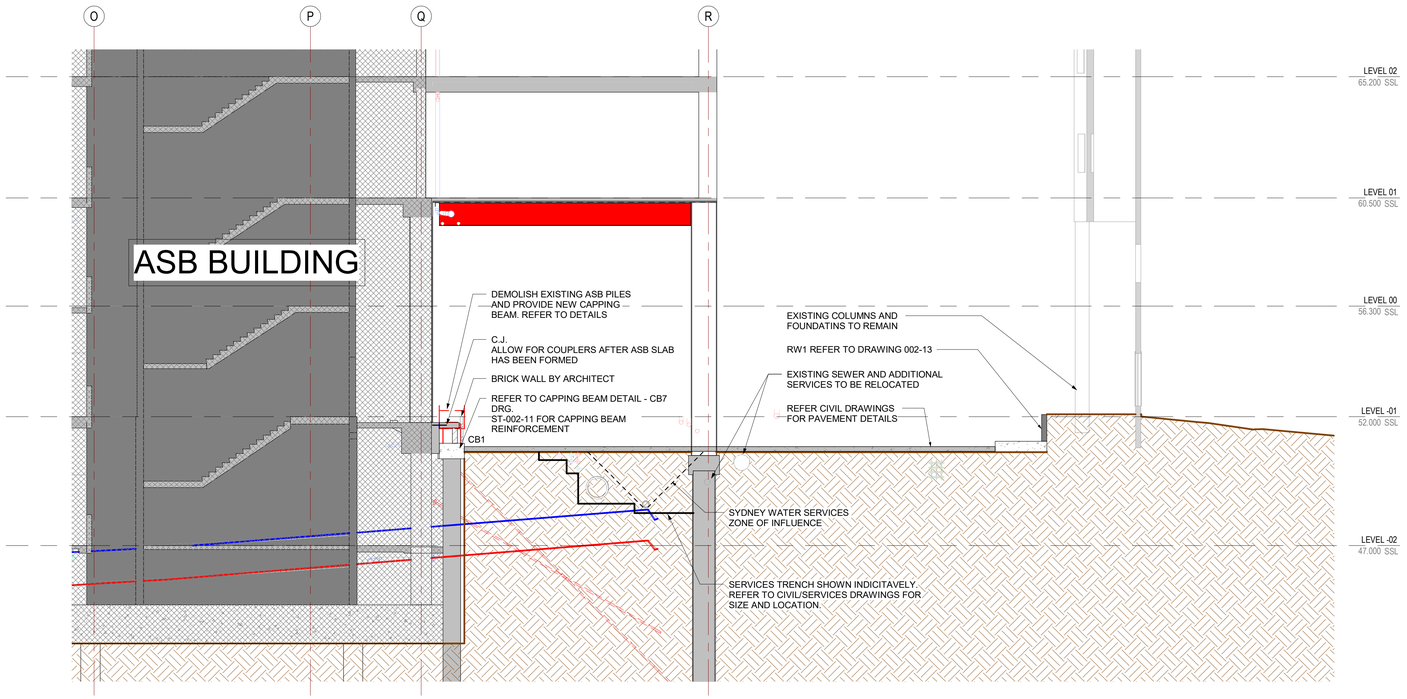

SECTION 27
1 : 100 002-00

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BAKER ST
RANDWICK NSW 2031
AUSTRALIA
ENSTRUCT PROJECT NUMBER

5385
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000
SCALE
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STATUS
FOR TENDER
DRAWING
BUILDING 50
SITE RETENTION SECTIONS - SHEET 8

DRAWING NUMBER ISSUE
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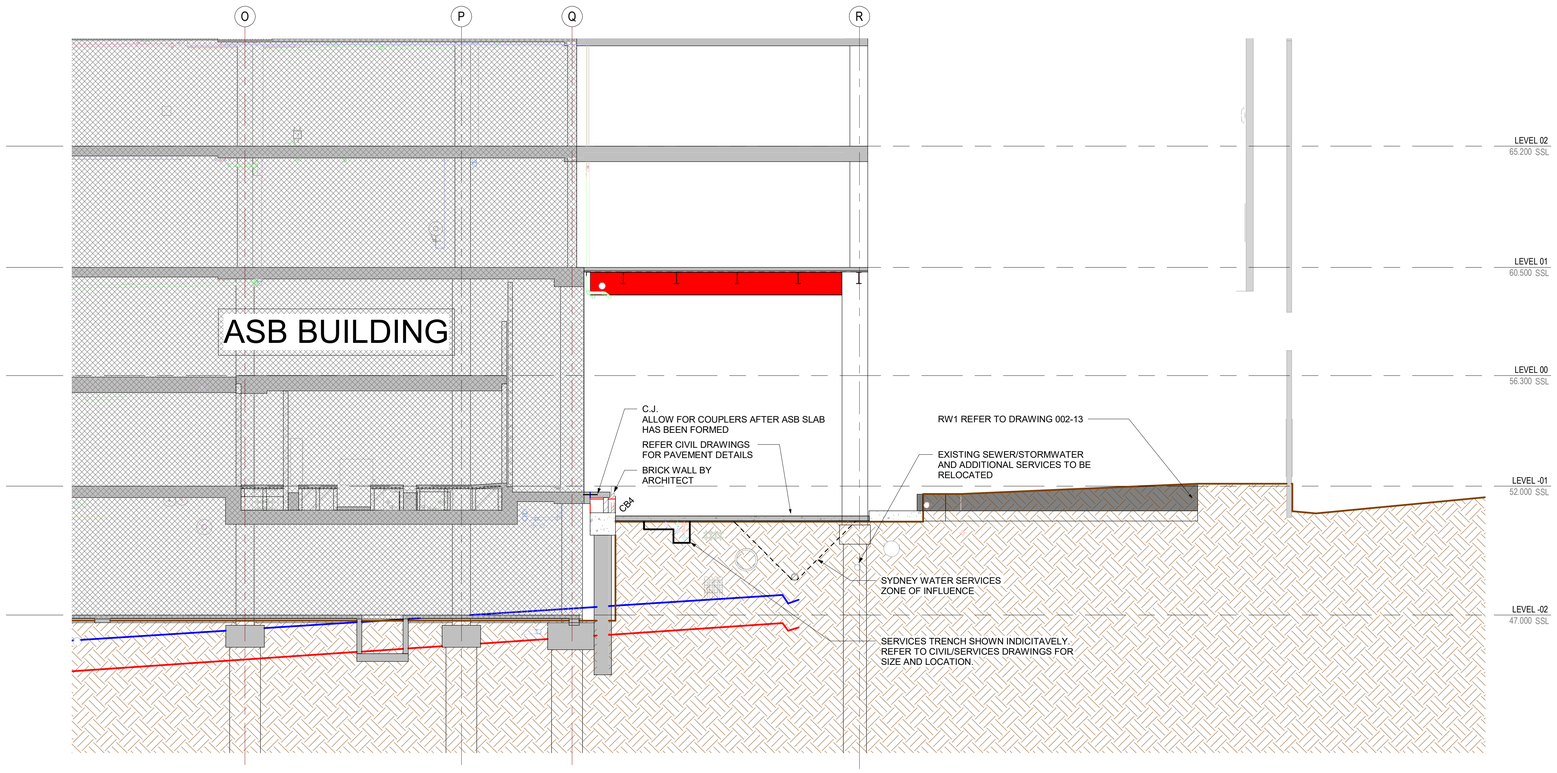

SECTION 28
1 : 100 002-07

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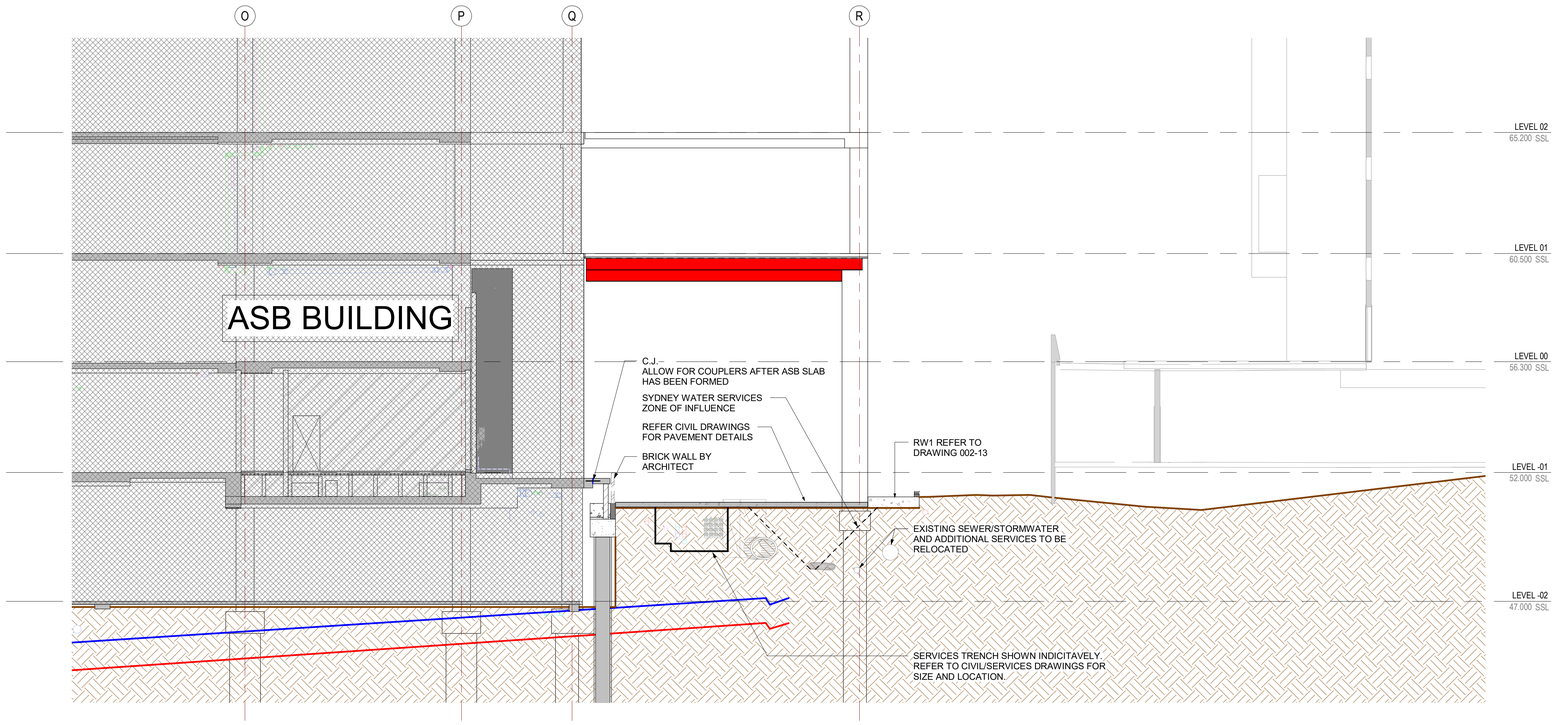
— — - DENOTES DEMOLISHED STRUCTURE



SECTION 29
1 : 100 002-07

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DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

1 : 100@B1 DO NOT SCALE

STATUS

FOR TENDER

DRAWING

BUILDING 50
SITE RETENTION SECTIONS - SHEET 9

DRAWING NUMBER	ISSUE
RCR-ENS-STR-50-DRW-002-38	E

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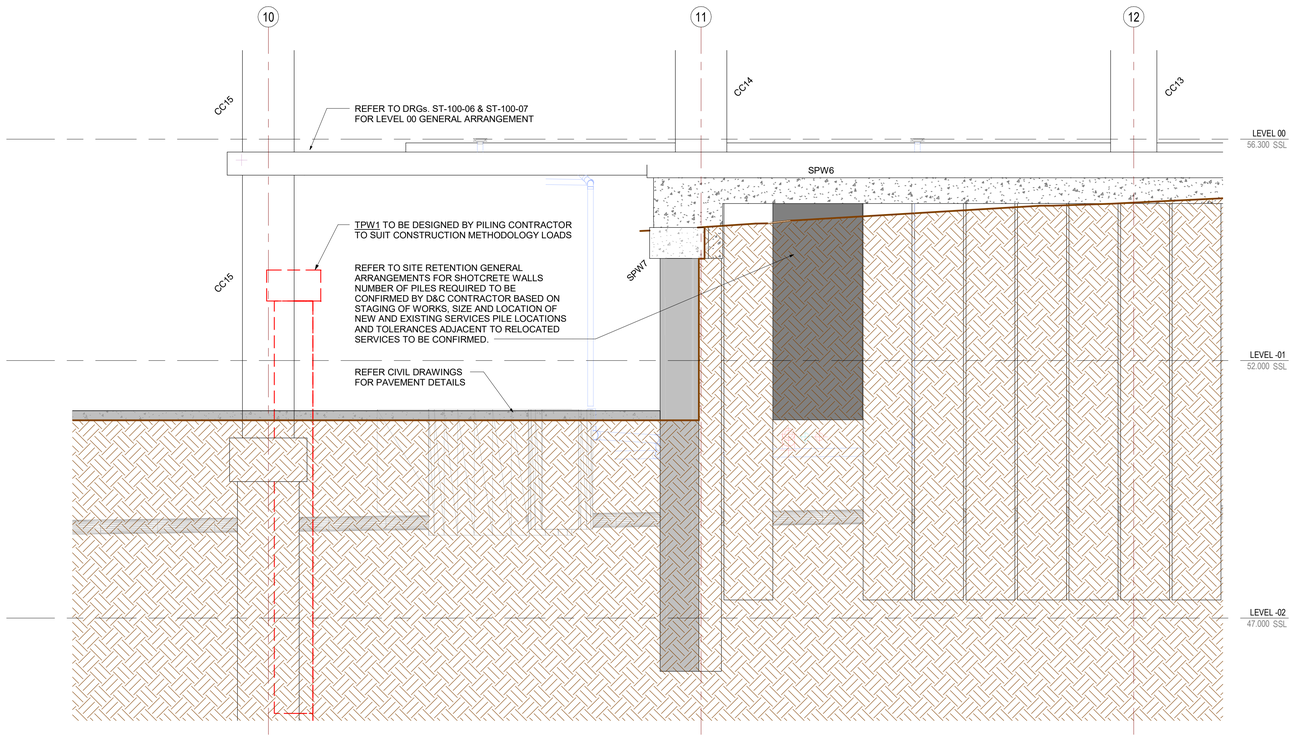

SECTION 30
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– – - DENOTES DEMOLISHED STRUCTURE

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GRAPHIC SCALE

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SCALE

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STATUS

FOR TENDER

DRAWING

BUILDING 50
SITE RETENTION SECTIONS - SHEET 10

DRAWING NUMBER	ISSUE
RCR-ENS-STR-50-DRW-002-39	A

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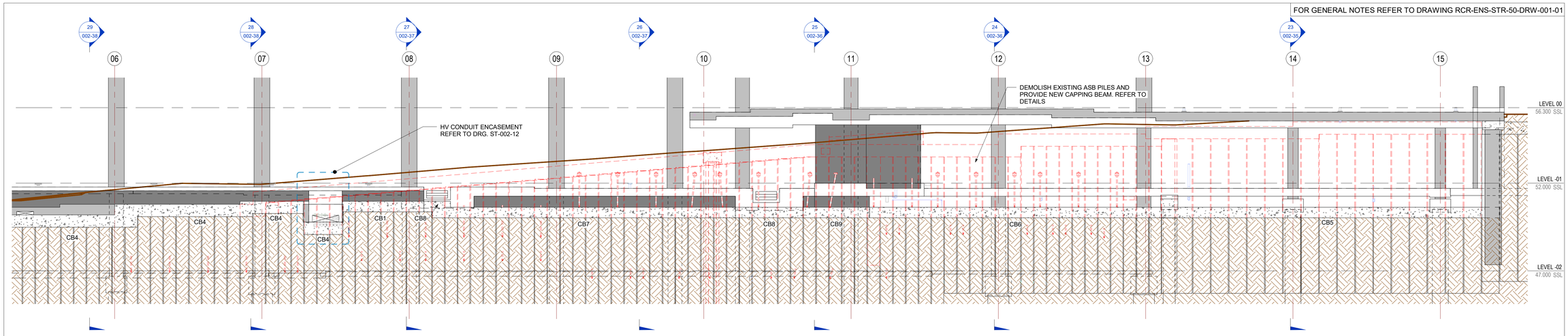
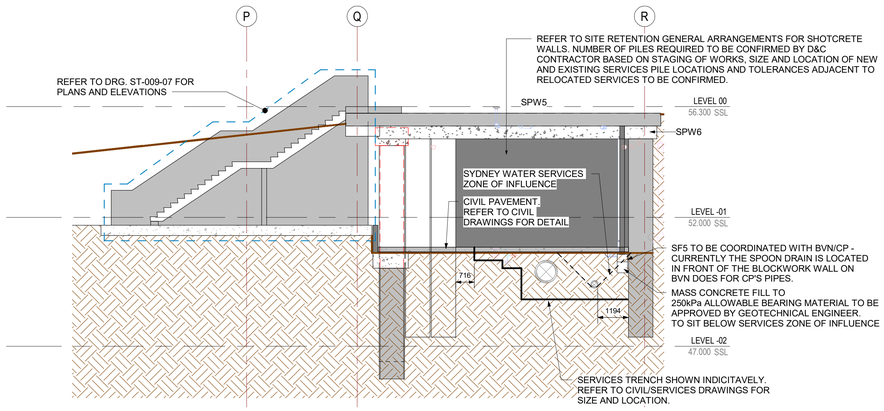


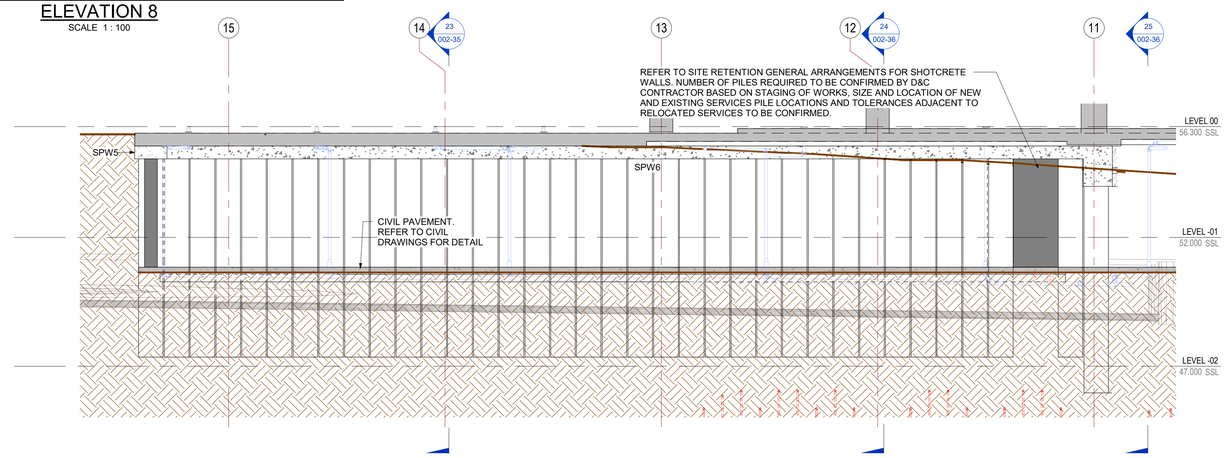
SITE RETENTION - HOSPITAL ROAD LOWERING GRID Q ELEVATION 8

SCALE 1 : 100



SITE RETENTION - HOSPITAL ROAD LOWERING - ELEVATION 9

SCALE 1 : 100

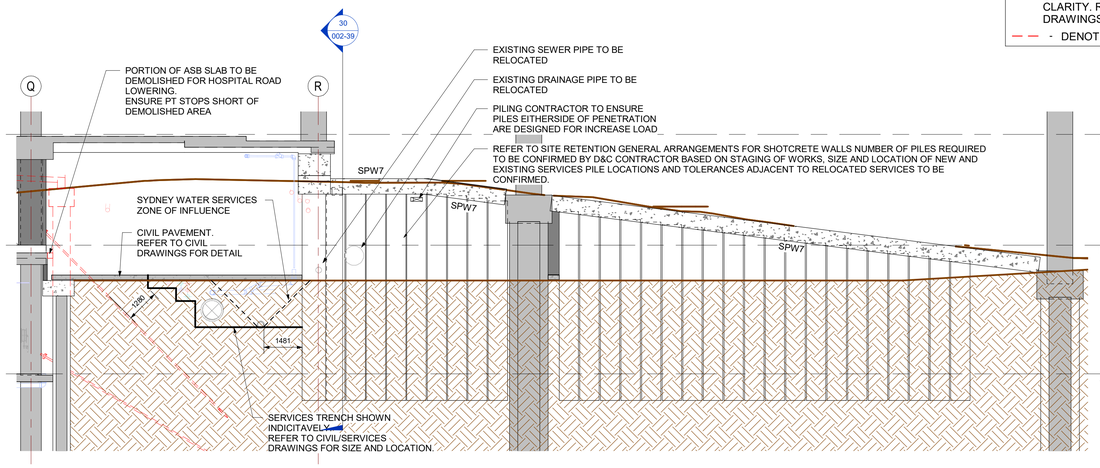


SITE RETENTION - HOSPITAL ROAD LOWERING - ELEVATION 10

SCALE 1 : 100

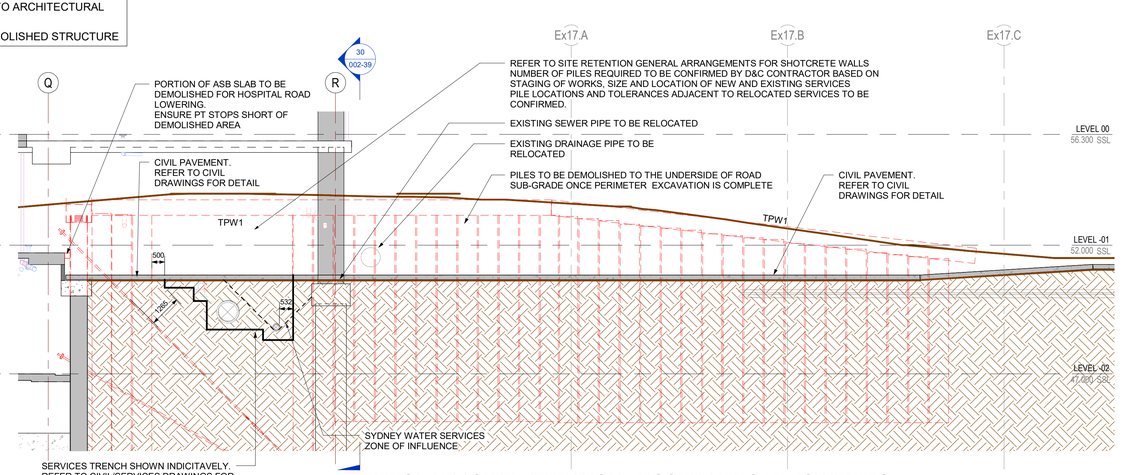
NOTES:
- SERVICES SHOWN INDICATIVELY ONLY. REFER TO SERVICES DRAWINGS FOR SIZES AND LOCATIONS.
- STORMWATER AND SEWERAGE SHOWN INDICATIVELY ONLY, REFER TO CIVIL DRAWINGS.
- BLOCKWALLS NOT SHOWN FOR CLARITY. REFER TO ARCHITECTURAL DRAWINGS.

— — - DENOTES DEMOLISHED STRUCTURE



SITE RETENTION - HOSPITAL ROAD LOWERING - ELEVATION 11

SCALE 1 : 100



TEMPORARY SITE RETENTION - HOSPITAL ROAD LOWERING - ELEVATION 12

SCALE 1 : 100

CONFIDENTIAL & COMMERCIAL-IN-CONFIDENCE

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NOTE

CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING

ISSUE	DATE	FOR
A	04.07.19	IASB SSDA ISSUE
B	08.07.19	IASB SSDA ISSUE
C	02.09.19	IASB SSDA ISSUE
D	18.10.19	IASB SSDA TENDER ISSUE
E	04.11.19	ISSUED FOR SYDNEY WATER
F	07.11.19	IASB SSDA TENDER ISSUE

PROJECT MANAGEMENT

PWC

ARCHITECTS

BVN / TERROIR

MECHANICAL ENGINEERING

LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING

WOOD & GRIEVE ENGINEERS

HYDRAULIC ENGINEERING

ACOR CONSULTANTS

CONSTRUCTION MANAGER

landlease

CLIENT

NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE

CLIENT NUMBER

130487

PROJECT

RANDWICK CAMPUS REDEVELOPMENT

BAKER ST
RANDWICK NSW 2031
AUSTRALIA

ENSTRUCT PROJECT NUMBER

5385

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

1 : 100@B1 DO NOT SCALE

STATUS

FOR TENDER

DRAWING

BUILDING 50
SITE RETENTION ELEVATIONS - SHEET 4

DRAWING NUMBER	ISSUE
RCR-ENS-STR-50-DRW-002-23	F