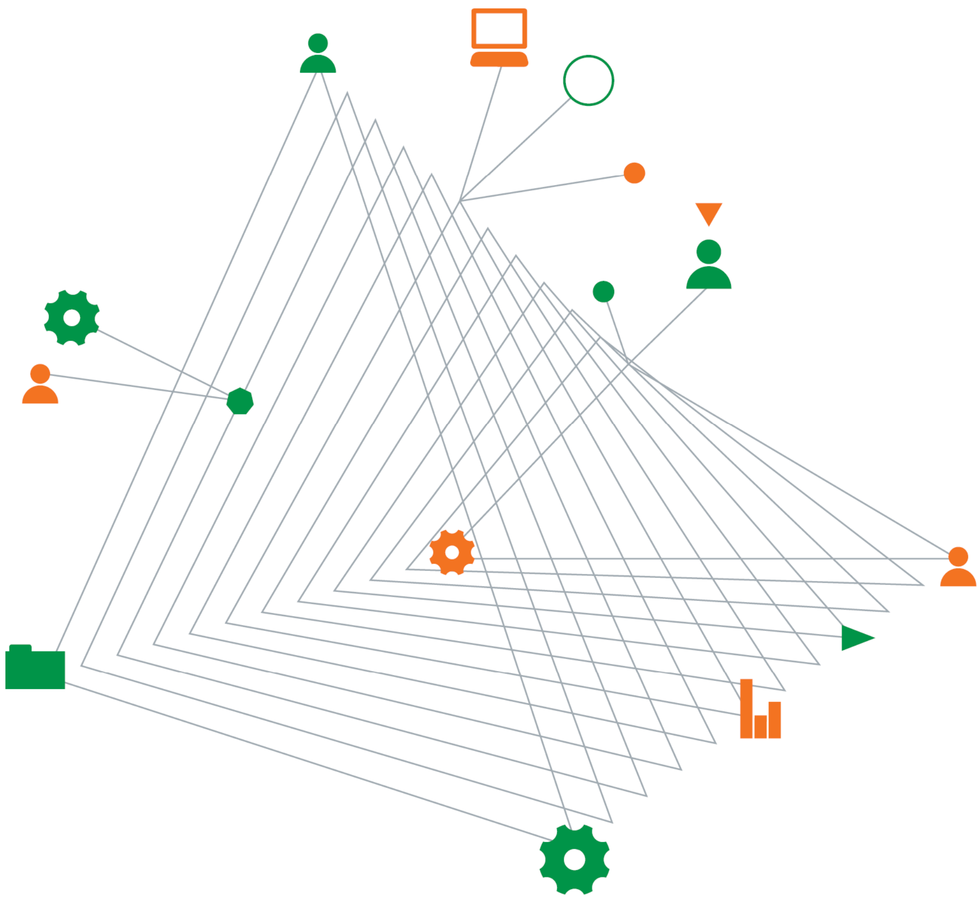
Bouygues Construction Australia Pty Ltd

Dooleys Lidcombe Catholic Club Redevelopment

Groundwater Assessment

24 June 2016



Experience
comes to life
when it is
powered by
expertise

Dooleys Lidcombe Catholic Club Redevelopment

Prepared for
Bouygues Construction Australia Pty Ltd

Prepared by
Coffey Geotechnics Pty Ltd
Level 19, Tower B, 799 Pacific Highway
Chatswood NSW 2067 Australia
t:+61 2 9406 1000   f: +61 2 9406 1002
ABN: 93 056 929 483

24 June 2016

Document authorisation

Our ref: GEOTLCOV25554AA-AK

For and on behalf of Coffey

Ben Rotter
Senior Groundwater Engineer

Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
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1. Introduction

This report presents a Groundwater Assessment for the proposed redevelopment of Dooley's Catholic Club located on Church Street, Lidcombe, NSW.

The assessment was commissioned by Bouygues Construction Australia Pty Ltd (Bouygues) and completed in general accordance with the proposal (reference GEOTLCOV25554AA-AF, dated 2 March 2016) prepared by Coffey Geotechnics Pty Ltd (Coffey).

2. Proposed development

The site is approximately 9,500 m^2 in footprint and is bounded to the south by Church Street, to the west by Olympic Drive, and to the east by existing Dooleys Lidcombe Catholic Club buildings.

The site extends to the north and encompasses the row of houses on the north side of Board Street. These houses and the section of Board Street they are on will be demolished as part of the development. The remainder of the development will replace the 230-bay car park on the corner of Olympic Drive and Church Street. Figure 1 outlines the area of the proposed development.

The proposed redevelopment comprises a two-level club facility, a 12-level hotel and a two-level basement. Image 1 shows an indicative representation of the proposed development.

The proposed lowest basement level (Basement Level 2) has a floor elevation of 10.5 m AHD across a footprint of approximately 9,950 m^2.

Drawings showing the proposed development (provided by Bouygues) are included in Appendix A.

Image 1: Indicative Stereographic Image of Proposed Development

3. Hydrogeological conditions

3.1. Stratigraphy

Coffey undertook geotechnical investigation at the site in November 2015 (Coffey, 2015).

Coffey assessed ground conditions at the site to generally comprise:

- Gravelly sand and clayey gravelly sand fill up to 0.7 m deep, overlying
- Residual soil from 1.4 m to 2.7 m thick. Residual soil was observed as clay and silty clay, overlying
- Interbedded siltstone and sandstone, increasing in strength with depth.

Three groundwater monitoring piezometers were constructed in boreholes during the investigation. These piezometers were screened within the bedrock.

Figure 1 shows the locations of the Coffey boreholes and piezometers.

Figures 2 and 3 present inferred ground conditions at the site in section.

3.2. Groundwater levels

Coffey measured groundwater levels in the piezometers at the site on 1 December 2015, approximately one week after borehole drilling was complete (and piezometers had been developed by purging). Groundwater levels were also recorded between 16 March 2016 and 20 April 2016 using an automatic logger, and manual measurements were taken on both of those dates.

Table 1 provides a summary of the groundwater levels observed.

Figure 4 presents the record of groundwater levels interpreted from automatic logging along with rainfall. Rainfall records in Figure 4 are from the Bureau of Meteorology (BOM) Station at the Sydney Olympic Park AWS Archery Centre (Station No. 66212), where the record continues into April.

Groundwater levels within the bedrock did not show significant response to rainfall during the monitoring record.

BOM Station No. 66212 does not have significant historical data. The station at Rookwood (Hawthorne Ave, Station No. 66164) has records since 1945, and these records have been used for longer term rainfall data.

At the Rookwood BOM station, the monthly rainfall in March 2016 was 48.5 mm, below the 70-year mean record for the month of March of 109.2 mm, and the 95th percentile total rainfall for the month of March of 253.9 mm.

Groundwater levels may therefore not respond significantly to rainfall events typical of average conditions. However, they may rise to more extreme events.

For this reason, a groundwater table elevation higher than 10.4 m AHD (the highest recorded level at site) may occur.

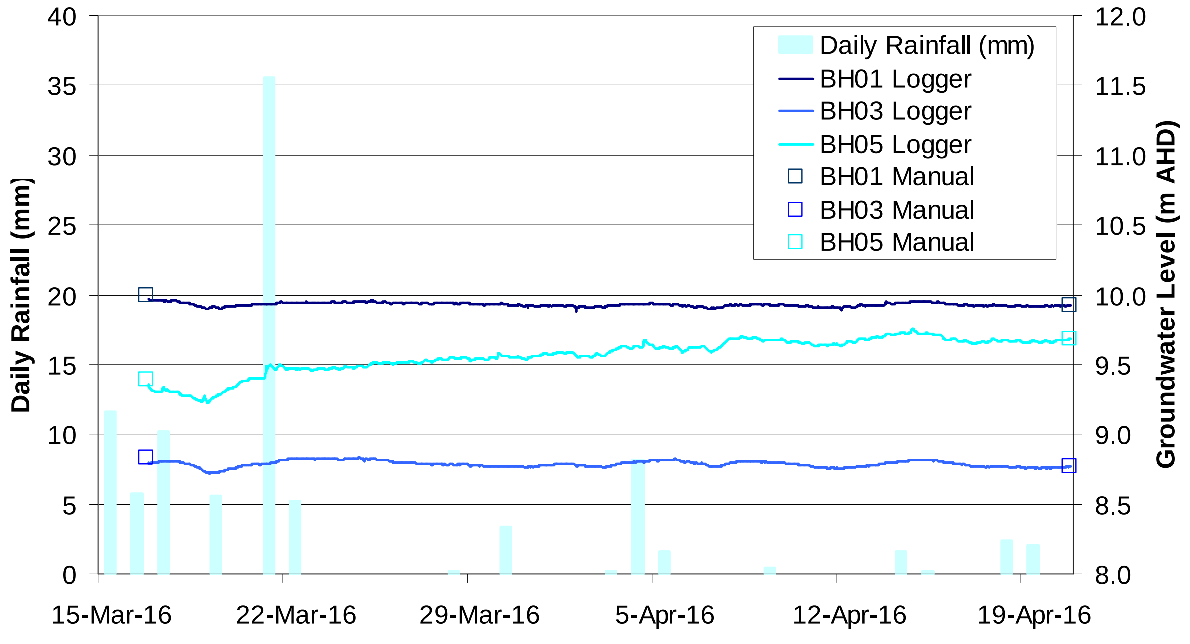


Figure 4: Interpreted Continuous Groundwater Levels

Table 1: Summary of Manually Observed Groundwater Levels

Piezometer	Ground Surface Elevation[a] (m AHD)	Depth to Groundwater Below Existing Ground Level (m)			Estimated Groundwater Elevation[a] (m AHD)		
		1 Dec 2015	16 Mar 2016	20 Apr 2016	1 Dec 2015	16 Mar 2016	20 Apr 2016
BH01	14.66	4.81	4.67	4.73	9.9	10.0	9.9
BH03	13.20	4.31	4.36	4.43	8.9	8.8	8.8
BH05	15.60	5.95	6.21	5.91	9.6	9.4	9.7

Notes: [a]Inferred from survey plan provided.

3.3. Aquifer properties

Rising head hydraulic conductivity tests were conducted in the piezometers BH01 and BH03 at the site on 1 December 2015. Results of the tests are provided in Appendix B.

The interpreted hydraulic conductivity values of bedrock engaged by the tests at BH01 and BH03 were 0.05 m/day and 0.06 m/day.

3.4. Groundwater quality

We understand the intention is to pump groundwater seepage which flows into the basement to the local stormwater network, with water ultimately assumed to emerge in Haslams Creek. Haslams Creek is a lined freshwater channel over its nearest reach to site, before becoming unlined.

To assess the suitability of groundwater collected during construction for discharge to stormwater, we have reviewed the results of groundwater sampling and analysis previously undertaken in December 2015 (Coffey, 2016).

Groundwater samples collected from the three piezometers on site were analysed for total recoverable hydrocarbons (TRH); polycyclic aromatic hydrocarbons (PAH); benzene, toluene, ethylbenzene, and xylenes (BTEX); and dissolved metals by a NATA accredited laboratory.

Table 2 presents groundwater quality parameters measured during the sampling, and compares them with the ANZECC (2000) water quality guideline trigger values for 95% protection of freshwater ecosystems.

Table 3 provides comparison of groundwater quality laboratory results against ANZECC (2000) trigger levels for protection of 95% of species in freshwater.

Groundwater pH lies within the acceptable range.

Concentrations of PAH and BTEX were below the ANZECC (2000) trigger levels.

Xylene was detected in BH01, though it was below the ANZECC (2000) trigger levels. TRH in the C6-C9 fraction was detected in BH01 at the LOR.

Nickel and zinc were detected above the ANZECC (2000) trigger levels at BH05.

Given the presence of these compounds at discrete locations, high concentrations are expected to be localised. Mixing of seepage water from across the site, and dilution within the stormwater system, is likely to reduce these concentrations. However, based on available data, nickel and zinc concentrations may remain above ANZECC (2000) trigger levels. We recommend that groundwater seepage to the construction excavation be analysed to confirm this.

Table 2: Groundwater Quality Parameters

Parameter	ANZECC (2000) Trigger Level for Freshwater	BH01	BH03	BH05
pH	6.5 to 8.0 (lowland rivers)	6.92	6.98	7.00
Electrical Conductivity (µS/cm)	Not provided	11,320	3,490	4,410
Redox Potential (mV)	Not provided	-12	36	220

Table 3: Groundwater Laboratory Results and Comparison with ANZECC (2000) Guideline Trigger Values

Chemical Group	Chemical Name	Units	Limit Of Reporting	ANZECC (2000) Trigger Level for 95% Protection of Freshwater Ecosystems	BH01	BH03	BH05
TRH	C6-C9	µg/L	20	NP	20	< 20	< 20
	C10-C14	µg/L	50	NP	< 50	< 50	< 50
	C15-C28	µg/L	100	NP	< 100	< 100	< 100
	C29-C36	µg/L	100	NP	< 100	< 100	< 100
BTEX	Benzene	µg/L	1	950*	< 1	< 1	< 1
	Ethylbenzene	µg/L	1	80*	< 1	< 1	< 1
	Toluene	µg/L	1	180*	< 1	< 1	< 1
	m&p-Xylenes	µg/L	2	75(m)* 200(p)*	4	< 2	< 2
	o-Xylene	µg/L	1	350*	2	< 1	< 1
PAH	Naphthalene	µg/L	1	16*	< 1	< 1	< 1
Dissolved Metals	Arsenic (III)^	µg/L	1	24	1	3	3
	Cadmium	µg/L	0.1	0.2	< 0.1	< 0.1	< 0.1
	Chromium (III)^	µg/L	1	NP 4.4 for Cr(VI)	< 1	< 1	< 1
	Copper	µg/L	1	1.4	< 1	< 1	< 1
	Lead	µg/L	1	3.4	< 1	< 1	< 1
	Mercury	µg/L	0.1	0.6	< 0.1	< 0.1	< 0.1
	Nickel	µg/L	1	11	3	3	**110**
	Zinc	µg/L	5	8	7	< 5	**12**

Notes: Exceedences are in **bold red** text.
NP means not provided by ANZECC (2000).
^The pH and Oxidation/Reduction Potential of water indicates that arsenic and chromium would generally be in a 3+ valence state. The 3+ valence state trigger criteria were therefore selected.
*ANZECC (2000) does not provide a high reliability trigger value, and the low/moderate reliability value has been adopted here and is to be used only as an indicative interim working level.

4. Assessment of groundwater inflows and drawdown

A drained basement is proposed for the development.

We have assessed likely groundwater inflows and associated drawdown to a drained basement.

Assuming a drained basement with a sub-floor drainage system that extends some 0.5 m below the finished floor level of 10.5 m AHD, the groundwater level will lie above the basement drainage level in some areas of the site and/or following periods of high rainfall.

Groundwater inflow to the basement, and the lateral extent of groundwater drawdown, was assessed by analytical methods based on theory presented by Edelman (1972) for radial drawdown from an extensive aquifer. This assessment provides a conservative estimate of drawdown under steady state flow conditions.

The assessment assumes:

- A groundwater level of 11 m AHD in the vicinity of the site. This is some 0.5 m above the highest recorded groundwater level at site, and considers potential rise in groundwater level due to significant rainfall events
- The total basement footprint is some approximately 9,950 m^2
- Groundwater within the excavation would be drawndown some 0.5 m below basement finished floor level to 10.0 m AHD
- The hydraulic conductivity of the bedrock is 0.06 m/day, based on rising head test results
- The base of the underlying rock aquifer contributing to groundwater flow to the excavation lies at 0 m AHD
- Infiltration of 2% (typical of urban settings) of mean annual rainfall of 993 mm (the 70-year mean for Bureau of Meteorology Station at Rookwood).
- Absence of water bearing features (such as fault zones) within the rock
- Surface water does not enter the basement.

Based on these assumptions, a conservative calculated estimate of (steady state) inflow to the proposed drained basement is up to approximately 4.6 m^3/day (1.7 ML/year). However, actual future seepage to the basement may typically be significantly less than this.

Groundwater drawdown is expected to be up 1 m immediately adjacent to the basement walls, reducing to negligible at a distance of up to 100 m from the basement walls.

5. Potential impacts to groundwater

5.1. Local groundwater flow regime

Groundwater is likely to be preferentially drawn to the proposed development. Groundwater flows within the rock aquifer may be modified by the development, with increased groundwater flowing towards the proposed basement. This drawdown influence is expected to be limited to within a 100 m radius of the basement.

5.2. Existing groundwater users

To assess the potential impact of the development on existing groundwater users, a search of Department of Primary Industries registered groundwater bores was conducted on 29 April 2016. The closest bore to the site (GW111940) is over 400 m away. Groundwater drawdown impacts on existing registered groundwater users are therefore not expected.

5.3. Ground settlement

Given that the groundwater table generally lies within the bedrock, and that the assessed drawdown is relatively minor (less than 1 m), ground settlement associated with a drained basement is expected to be negligible.

Additional ground settlement/movement may occur due to excavation, and these should be assessed as part of the shoring/basement design.

5.4. Impacts to groundwater quality

The proposed basement is expected to act as a groundwater sink. The development is therefore not expected to directly impact groundwater quality.

5.5. Impacts to groundwater dependent ecosystems

The Bureau of Meteorology's GDE Atlas (http://www.bom.gov.au/water/groundwater/gde/) does not identify any Groundwater Dependent Ecosystems (GDE) within 1 km of the site. Groundwater drawdown induced by the development is not assessed to extend to that distance. Therefore, GDE are not expected to be impacted by the development.

5.6. Release of groundwater seepage

It is anticipated that groundwater seepage to the basement will be collected and released to stormwater.

Groundwater quality data indicate the presence of xylene (TRH fraction C6-C9) at one location.

Nickel and zinc were detected above the ANZECC (2000) trigger levels at one location.

Given the presence of these compounds at discrete locations, high concentrations are expected to be localised. Mixing of seepage water from across the site, and dilution within the stormwater system, is likely to reduce these concentrations. However, based on available data, nickel and zinc concentrations may remain above ANZECC (2000) trigger levels. We recommend that groundwater seepage to the construction excavation be analysed to confirm this.

6. Policy and potential impacts

The *NSW Aquifer Interference Policy* (September 2012) considers assessment of impacts of aquifer interference activities on water resources and the concept of ensuring “no more than minimal harm” (referred to in the *Water Management Act 2000*).

The minimal impact considerations are dependent upon the impacted aquifer type (alluvial, coastal, fractured rock or other special cases) and whether the aquifer is classified as “highly productive” or “less productive groundwater” (based on groundwater yield and total dissolved solids concentration).

The proposed basement will draw groundwater from a fractured rock aquifer. Groundwater yields from sandstone/siltstone aquifers are typically below 5 L/s. Thus, the fractured rock aquifer would classify as a “less productive” aquifer.

The minimal impact considerations for aquifer interference activities in these aquifers are listed in Table 4 along with our assessment of the potential impact.

In accordance with the Department of Primary Industries NSW Office of Water *Aquifer Interference Policy*, the development is assessed to induce “minimal” impact upon groundwater resources.

Table 4: Aquifer Interference Policy Minimal Impact Consideration

Impact On	Impact Consideration	Assessed Impact
Water Table	1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. A maximum of a 2 m decline cumulatively at any water supply work. 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2 m decline cumulatively at any water supply work then make good provisions should apply.	The nearest groundwater dependent ecosystem and water supply work (DPI Water-registered bore) to the proposed basement is located beyond the assessed extent of groundwater drawdown influence imposed by the basement. Therefore, the development is not expected to impact on the water table within 40 m of GDE or water supply works.
Water Pressure	1. A cumulative pressure head decline of not more than a 2 m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement (1) above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	The nearest water supply work (DPI Water-registered bore) to the proposed basement is located beyond the assessed extent of groundwater drawdown influence imposed by the basement. Therefore, the development is not expected to impact on the pressure head at any water supply work.
Water Quality	1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. 2. If condition (1) is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in	The development is expected to act as a groundwater sink. The development is therefore not expected to significantly modify groundwater quality.

Impact On	Impact Consideration	Assessed Impact
	groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.	

7. Summary and recommendations

Our assessment findings and recommendations are as follows:

- The impact of the development upon groundwater resources is assessed to be categorised as “minimal”, in accordance with the NSW Aquifer Interference Policy (September 2012 issue)
- Groundwater seepage to the proposed basement is calculated to be up to 1.7 ML/year. However, actual seepage to the basement may typically be significantly less than this
- Groundwater drawdown is expected to be up to 1 m immediately adjacent to the basement walls, reducing to negligible within some 100 m of the walls
- Our assessment assumes the surface water and groundwater within fill is prevented from entering the basement drainage system. We recommend design measures to ensure surface water and groundwater within fill and residual soil is prevented from entering the basement drainage system
- The proposed basement is expected to induce increased groundwater flows toward its footprint, but this influence is expected to be limited to within some 100 m of the basement
- The proposed basement is not expected to impact upon existing groundwater users (DPI Water-registered groundwater bores) or groundwater dependent ecosystems
- The proposed basement is expected to act as a groundwater sink, and is not expected to significantly impact groundwater quality
- Ground settlement associated with a drained basement is expected to be negligible. Additional ground settlement/movement may occur due to excavation. We recommend this be assessed as part of the shoring/basement design
- Based on the available data, groundwater collected by the basement may require treatment for arsenic and nickel (and possibly hydrocarbons) prior to release to stormwater. We recommend that groundwater seepage to the construction excavation be analysed to confirm this
- It is anticipated that groundwater seepage to the basement will be collected and released to stormwater, with ultimate release to Haslams Creek, a freshwater channel. Groundwater quality data indicate the presence of xylene (TRH fraction C6-C9), and concentrations of nickel and zinc above the ANZECC (2000) trigger levels, at discrete locations. Given the presence of these compounds at discrete locations, high concentrations are expected to be localised. Mixing of seepage water from across the site, and dilution within the stormwater system, is likely to reduce these concentrations. However, based on available data, nickel and zinc concentrations may remain above ANZECC (2000) trigger levels. We recommend that groundwater seepage to the construction excavation be analysed to confirm this
- Groundwater monitoring is recommended during construction to confirm conditions are consistent with those considered in this assessment.

8. Limitations

This report is based on data collected at a limited number of piezometers at discrete locations. Subsurface conditions can change over relatively short distances. Groundwater monitoring conducted during construction dewatering should be used to verify the consistency of groundwater (levels, flow and quality) and ground conditions with those assumed/adopted in this assessment.

The attached document entitled “Important Information about Your Coffey Report” presents additional information on the uses and limitations of this report.

9. References

Coffey (2015), Geotechnical Investigation Report, Dooleys Lidcombe Catholic Club Redevelopment, report prepared for Bouygues Construction Australia Pty Ltd, 27 January 2016, reference GEOTLCOV25554AA-AC.

Coffey (2016), Detailed Site Investigation, Dooley’s Catholic Club and Hotel Development, Olympic Drive, Lidcombe NSW, report prepared for Bouygues Construction Australia Pty Ltd, 27 January 2016, reference GEOTLCOV25554AA-AB.

Polubarinova-Kochina, P.Ya. (1952), Theory of the Motion of Ground Water Gostekhizdat, Moscow, *in* Harr, M.E., Groundwater and Seepage, McGraw-Hill Book Company, New York, 1962.

coffey

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Important information about your **Coffey** Report

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

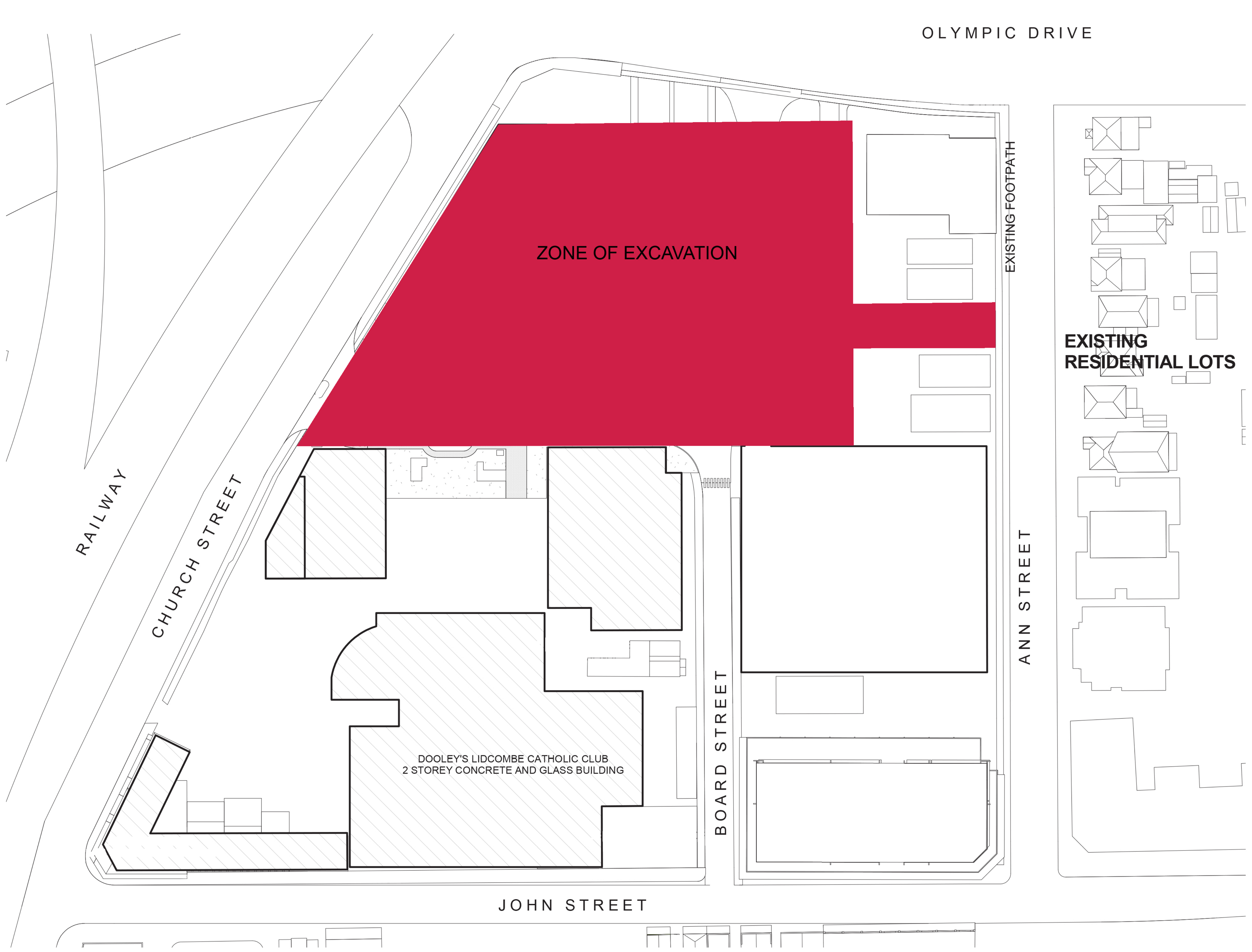
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

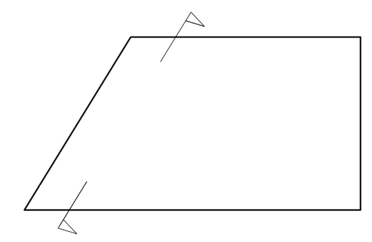
* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

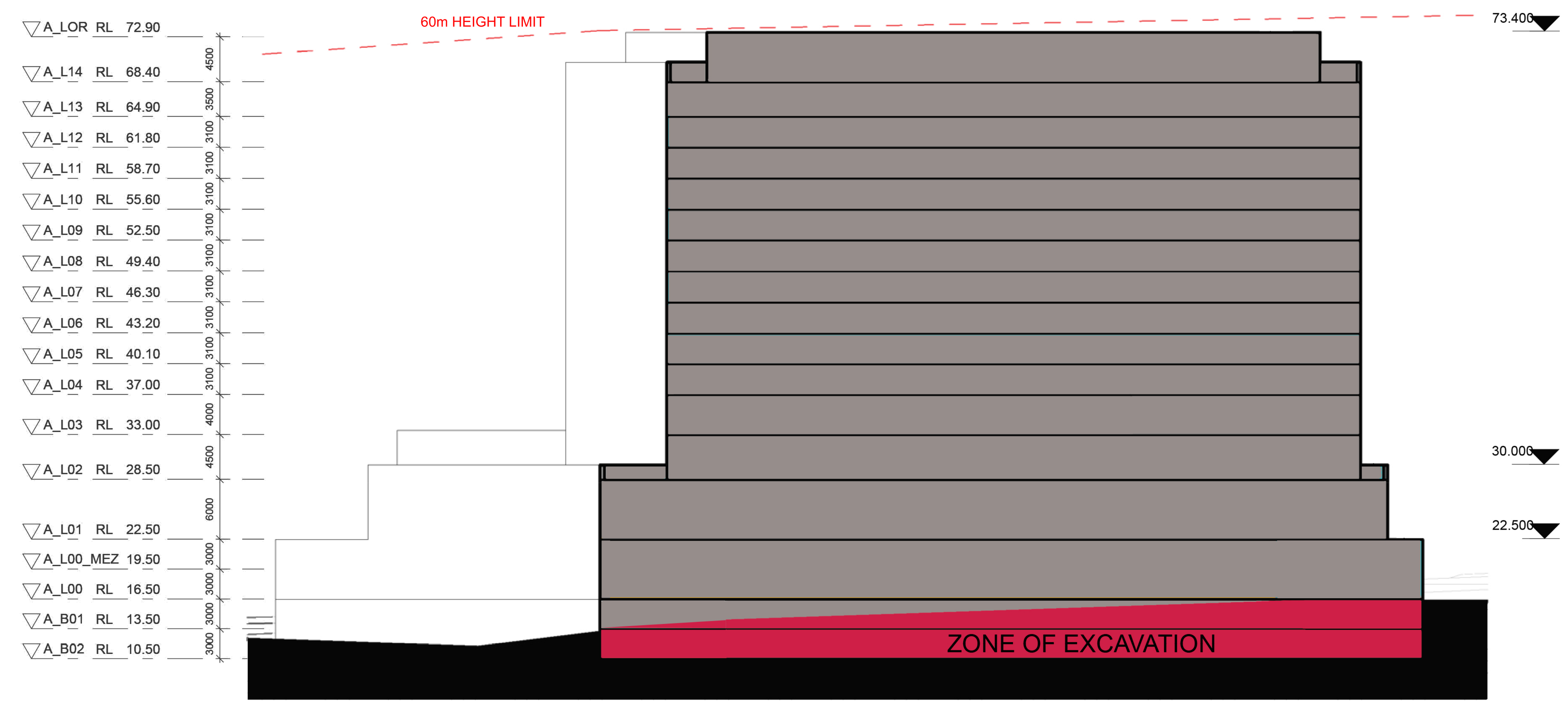
Appendix A - Proposed Basement and Excavation Drawings (provided by Bouygues)



1 EXCAVATION PLAN
1 : 1000

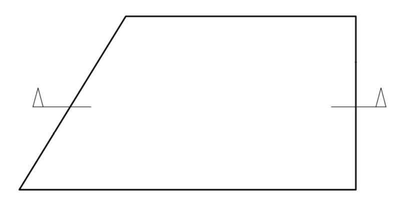
SECTION KEY

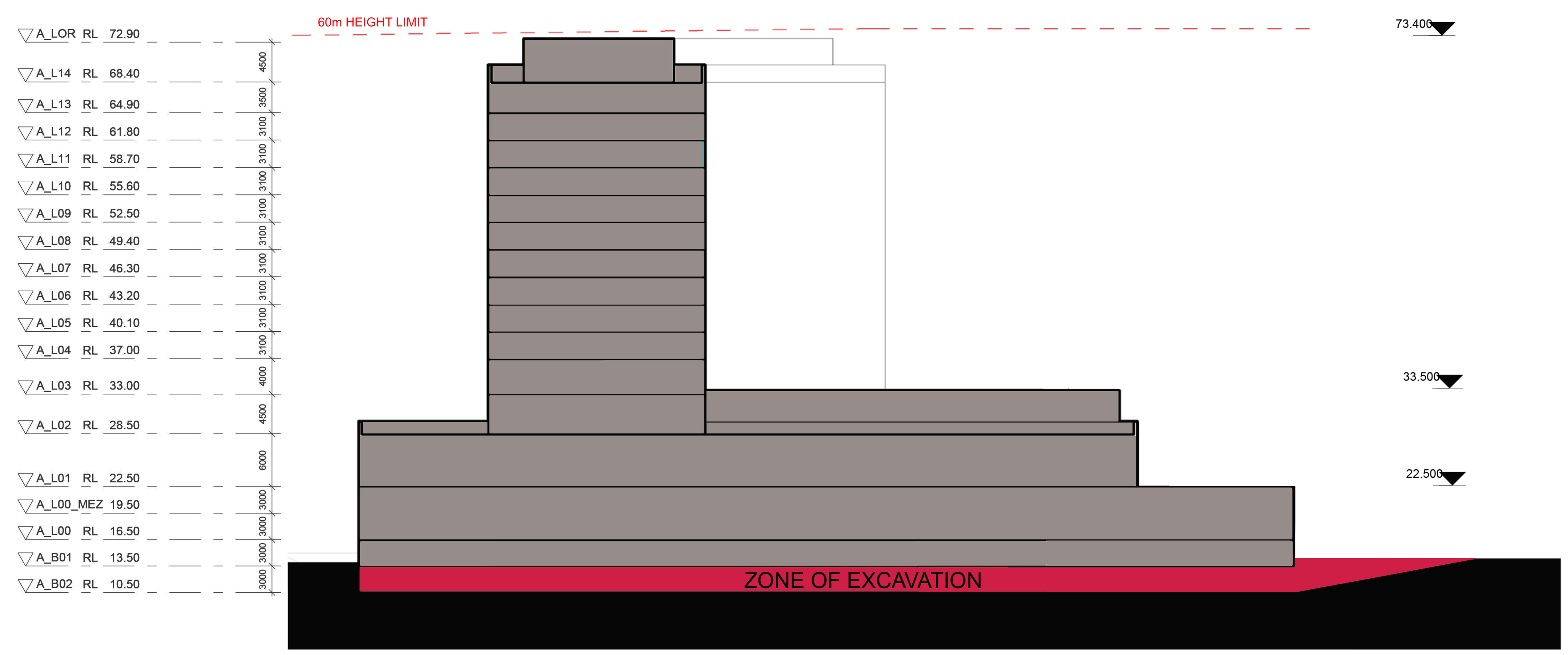




2 ENVELOPE SECTION - NORTH/ SOUTH
1 : 500

SECTION KEY





3 ENVELOPE SECTION - EAST/ WEST
1 : 500

Project: DOOLEYS LIDCOMBE CATHOLIC CLUB
JOHN STREET, LIDCOMBE, NSW 2141
Client: DOOLEYS CATHOLIC CLUB
16/06/16
Job No: 214019
Dwg No: DA-0014
BASEMENT EXCAVATION PLAN
AS INDICATED @ A1
0 5 10 20 30 50m
7/06/2016 3:01:49 PM

PTW Architects
Level 13, 9 Castlereagh St
Sydney NSW 2000 Australia
T +612 9232 5877
F +612 9221 4139
PTW Axil architects

LEGEND

PLANT/ SERVICES	378m²
CARPARK	5569m²
BACK OF HOUSE	1307m²
LOADING DOCK & WASTE	1880m²
COMPACTORS	
TURNING BAY	
HOTEL STORE	
CLUB STORE	
LOADING DOCK	

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Project: DOOLEYS LIDCOMBE CATHOLIC CLUB JOHN STREET, LIDCOMBE, NSW 2141	Client: Owner	16/06/16	Job No: 214019	Dwg No: DA-1008	CLUB/HOTEL - BASEMENT PLAN B2	1 : 200 @ A1

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NSW Nominated Architects

S Parsons Architect No.6098
D Jones Architect No.4778
A Parker Architect No.6578
A Rossi Architect No.5057

PTW Architects

Level 13, 9 Castlereagh St
Sydney NSW 2000 Australia

PTW
T +612 9232 5877
F +612 9221 4139

Axil architects

Appendix B - Rising Head Test Results

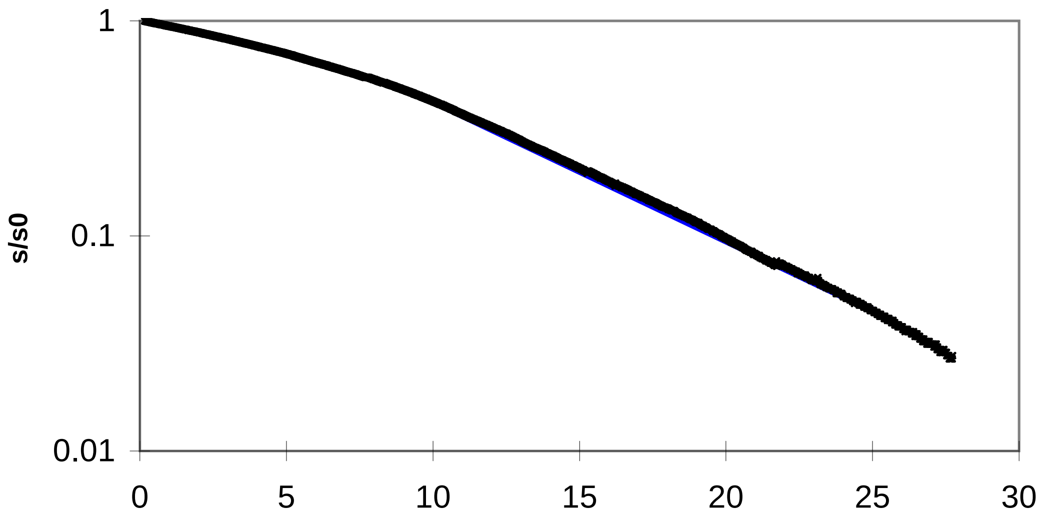
RISING OR FALLING HEAD TEST ANALYSIS

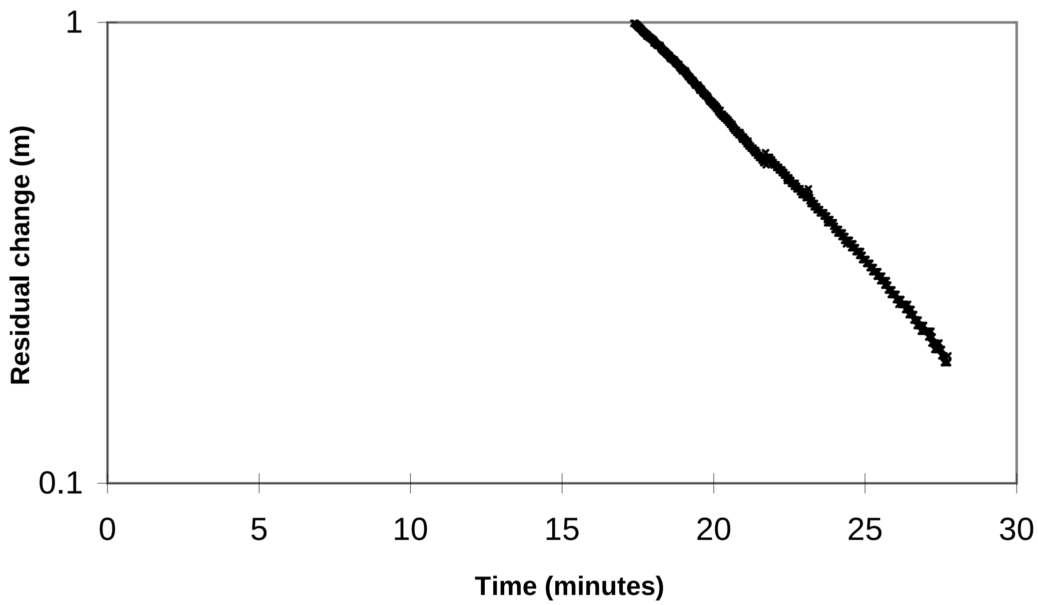
Bore Data	Units	Value
Initial groundwater level	m	4.796
Groundwater level at t=0	m	11.6
Casing radius (r)	m	0.025
Bore radius (R)	m	0.01
Screened interval length (L)	m	9.9
Match time start	min	10
Match time end	min	25
Characteristic Time (t_0)	**min**	**6.67**
Hydraulic Conductivity (K)	**m/day**	**0.0470**

Borehole: BH01

Method Developed by Hvorslev (1951)

$$K = \frac{r^2 \ln(L/R)}{2Lt_0}$$





Reference: Hvorslev, M.J. (1951), Time lag and soil permeability in ground water observations. U.S. Army Corps of Engineers Waterway Experimentation Station, Bulletin 36.

drawn	BR	client:	Bouygues Construction Australia
approved	PT	project:	Dooleys Lidcombe Club & Hotel Development
date	9 Dec 2015	title:	Rising Head Test at BH01
scale	AS SHOWN	project no:	GEOTLCOV25554AA — Figure A1
original size	A4		

coffey

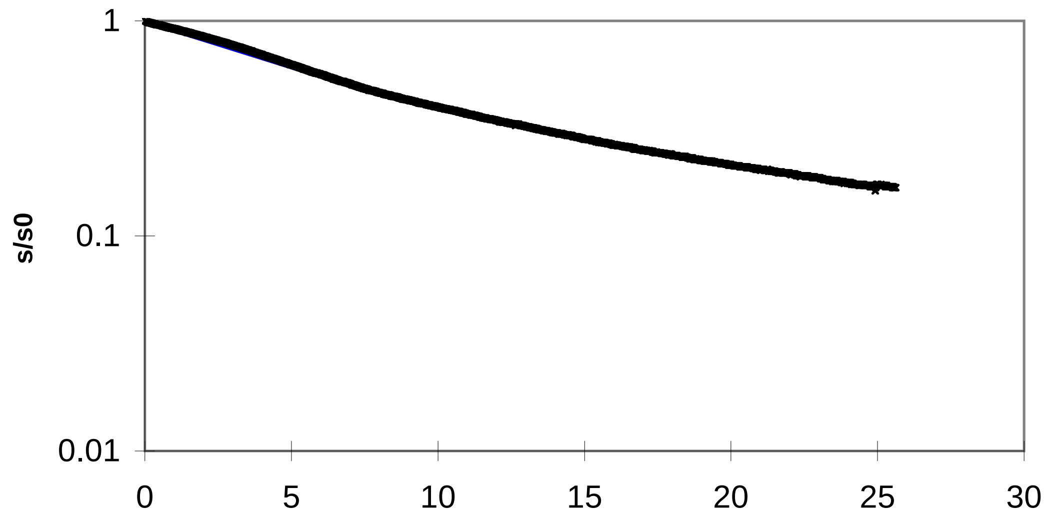
RISING OR FALLING HEAD TEST ANALYSIS

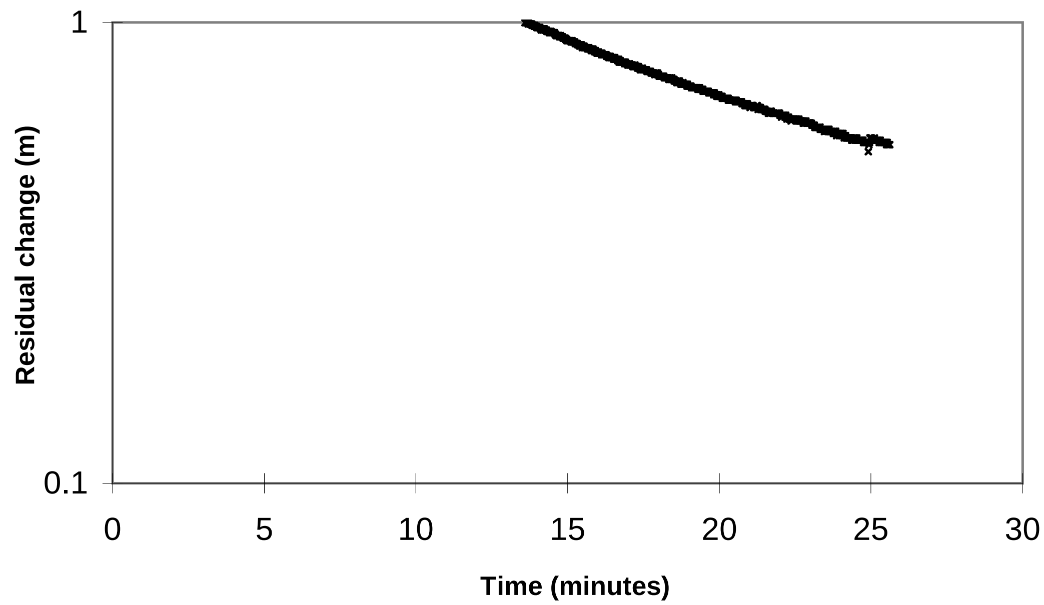
Bore Data	**Units**	**Value**
Initial groundwater level	m	4.273
Groundwater level at t=0	m	7.51
Casing radius (r)	m	0.025
Bore radius (R)	m	0.05
Screened interval length (L)	m	3.2
Match time start	min	1
Match time end	min	7
Characteristic Time (t_0)	**min**	**9.95**
Hydraulic Conductivity (K)	**m/day**	**0.0588**

Borehole: BH03

Method Developed by Hvorslev (1951)

$$K = \frac{r^2 \ln(L/R)}{2Lt_0}$$





Reference: Hvorslev, M.J. (1951), Time lag and soil permeability in ground water observations. U.S. Army Corps of Engineers Waterway Experimentation Station, Bulletin 36.

drawn	BR	client:	Bouygues Construction Australia
approved	PT	project:	Dooleys Lidcombe Club & Hotel Development
date	9 Dec 2015		
scale	AS SHOWN	title:	Rising Head Test at BH03
original size	A4	project no:	GEOTLCOV25554AA — Figure A1

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