Douglas PARTNERS

GROUNDED EXPERTISE

Geotechnical Monitoring Plan

Midtown Macquarie Park new Primary School

Ivanhoe Estate, Macquarie Park, NSW

Prepared for Taylor Construction Group Pty Ltd

Project 216254.04

19 December 2024

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Document History

Details

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Draft A	Mike O'Neill, Taylor Construction Group Pty Ltd
Revision 0	Mike O'Neill, Taylor Construction Group Pty Ltd
Revision 1	Mike O'Neill, Taylor Construction Group Pty Ltd

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.

Signature	Date
Author	19 December 2024
Reviewer	19 December 2024

FS604853

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Geotechnical Monitoring Plan
Midtown Macquarie Park new Primary School
Ivanhoe Estate, Macquarie Park, NSW

1. Introduction

This report prepared by Douglas Partners Pty Ltd (Douglas) outlines the geotechnical monitoring plan (GMP) for the Midtown Macquarie Park new Primary School at Ivanhoe Estate, Macquarie Park, NSW (the site). The work was commissioned by email, dated 22 November 2024 from Mike O'Neill of Taylor Construction Group Pty Ltd.

It is understood that the proposed development of the site includes the construction of a six-storey school building with a partial basement ground level, as well as construction of an on-grade car park area and landscaping. The site plan is shown on Drawing 1, Appendix B.

The proposed bulk excavation level (BEL) is RL 48.15 m AHD, which will require a maximum cut depth of about 4 m below ground level on the western portion of the site, which reduces to no cut and some areas of fill on the eastern portion of the site.

It is understood that the excavation on the western portion of the site will be supported by soldier piles with shotcrete infill panels. Temporary batters are proposed in areas with shallow cuts in the eastern portion of the site.

The GMP is based on the results of a geotechnical investigation undertaken by Douglas at the site in August 2022 (ref: 216254.00.R.001, Rev. 3, dated 30 June 2023). The investigation included four rock-cored boreholes to depths of between 6 m and 10 m, five test pits to depths of 1.5 m and the installation of four groundwater monitoring wells. An interpreted geotechnical cross-section, based on the investigation results, is shown on Drawing 2, Appendix B.

This GMP has been prepared to address Development Consent Condition B41(b) in **SSD-56124984**, as summarised in Table 1.

Table 1: Summary of Development Consent Conditions Address in this Report

Condition Number	Development Consent Condition	Relevant Section of Report
B41(b)	A Geotechnical Monitoring Sub-Plan (GMP) to be implemented during construction that:	Entire Report
	(i) is based on a geotechnical investigation of the site and subsurface conditions, including groundwater;	Entire Report
	(ii) details the location and type of monitoring systems to be utilised including those that will detect the deflection of all shoring structures, settlement and excavation induced ground vibrations to the relevant Australian Standard;	Sections 3, 4 & 5

Condition Number	Development Consent Condition		Relevant Section of Report
B41(b)	(iii)	details the recommended hold points and trigger levels of any monitoring systems, to allow for the inspection and certification of geotechnical and hydro-geological measures by the professional engineer; and	Sections 3, 4 & 5
	(iv)	details an action plan and contingency for the principal building contractor in the event these trigger levels are exceeded.	Sections 3, 4 & 5

The proposed basement footprint is located within the Ivanhoe Estate. The site is bounded by Mahogany Avenue to the south, grassed and paved areas to the east and west, and multi-storey residential apartment buildings to the north. The development to the north at 9 Peach Tree Road is understood to have a basement to an unknown depth and a multi-storey residential development has been completed to the west of the site (Ivanhoe Estate site 'C1') understood to have a basement to down to approximately RL 47 m AHD. Sites 'C2' and 'C3' to the south of the site are currently under construction with basements.

Note that this monitoring plan is a live document and may require updating as the works progress. Also note that Principal Contractor and Builder are used interchangeably and essentially mean the same entity. The term geotechnical engineer means a suitably experienced geotechnical engineer or engineering geologist.

2. Objectives

The objectives of the GMP are to provide a sequence for geotechnical and hydrogeological monitoring activities expected during excavation and construction, showing the responsible parties, as well as hold points to manage the geotechnical aspects of the construction processes.

The plan has been separated into the following three sections:

- **Geotechnical** – movement or settlement of temporary and permanent works and structures, excavation support, and adequacy of foundation materials;
- **Hydrogeological** – potential changes of the groundwater; and
- **Vibration** – vibration generated by excavation works.

The Principal Contractor for the proposed development is responsible for implementing the measures outlined in this plan. The contractor shall engage the services of suitably qualified and experienced professionals for the required monitoring activities.

3. Geotechnical Monitoring

3.1 General

The key geotechnical aspects which require monitoring on this project are as follows:

- stability of excavations;
- groundwater;
- stability of adjacent existing buildings; and
- adequacy of the foundation materials to provide support to footings.

The impact of the excavation of any adjacent structures is dependent on the stability of the proposed basement excavation. At this site, the nearest heavily loaded structures to the proposed excavation are the apartment buildings at 5 and 7 Peach Tree Road to the north, which are approximately 10 m from the proposed excavation footprint. Lightly loaded structures are located adjacent to the site, including the concrete footpath and pavement at Mahogany Avenue to the south, and paved driveways to the north at 5 and 7 Peach Tree Road.

For monitoring the stability of the excavation, survey monitoring by a registered surveyor and visual inspections by a suitably qualified and experienced geotechnical engineer will be carried out at regular intervals, as construction progresses. Following the inspections and/or review of the survey data, additional excavation support measures may be necessary.

The geotechnical engineer is to inspect the drilling of foundation piles and the excavated base of footings to confirm the bearing capacity of the rock.

3.2 Geotechnical Monitoring Procedure

The steps shown in Table 2 are recommended, with Hold Points identified where information should be provided to the structural or geotechnical engineers prior to continuing with the works.

Table 2: Summary of Geotechnical Monitoring Activities

Step	Description	Hold Point
G1. Prior to Commencement of Works		
G1.1	The Principal Contractor and any relevant subcontractors should familiarise themselves with the structural engineer's drawings, the geotechnical reports and this monitoring plan.	
G1.2	Installation of survey monitoring targets by a registered surveyor at 10 m centres at the top of the shoring walls or along the top of the perimeter of the excavation along each elevation. Baseline survey of monitoring targets before commencement of any bulk excavation works.	Hold Point
G2. During Excavation		
G2.1	Inspection of the drilling and installation of 20% (distributed evenly around site) of the shoring piles by a geotechnical engineer to check ground conditions are as per design assumptions and installation as per design.	Hold Point
G2.2	Builder to carry out daily visual inspections of the excavation crest and faces to check for any signs of ground movement/instability/loose material.	
G2.3	Survey of the monitoring targets by a registered surveyor as excavation progresses at 1.5 m depth intervals.	Hold Point
G3. After Excavation		
G3.1	Inspection of the base of the excavation at bulk level by the geotechnical engineer to assess the ground conditions prior to detailed excavation.	Hold Point

Step	Description	Hold Point
G3.2	Survey of the monitoring targets by a registered surveyor once excavation is at bulk excavation level, once basement slabs have been constructed, and one month following completion of the basement structure or after three consecutive measurements not less than a week apart showing no further movement, whichever is the later.	Hold Point
G3.3	Inspection of all foundation piles and footing excavations by a geotechnical engineer to confirm that the bearing capacity meets the requirements of the design.	Hold Point

3.3 Trigger Levels/Contingency Plans

The movement trigger levels for the shoring wall are based on an estimated wall deflection of up to 8 mm along the west elevation. The threshold levels adopted are provided in Table 3.

Table 3: Movement Trigger Levels for Shoring Wall

Threshold Level	% of Agreed Limit	Magnitude of Deflection	Required Action
Alert Level	Up to 80%	Up to 6 mm	No action. Excavation can continue
Action Level	81% to 100%	6 mm to 8 mm	Review monitoring data and increase monitoring frequency to an agreed level. Excavation can continue
Alarm Level	Over 100%	>8 mm	Excavation to stop and agreed contingency measures to be implemented

If the subsurface conditions encountered during the excavation are different to those indicated in the geotechnical report, both the geotechnical and structural engineers must be immediately informed. The geotechnical and structural engineers should then inspect the site and re-design the excavation support (i.e. shoring), foundations or another feature, as required.

Contingency measures for adverse movement at the excavation crest will depend on the nature and extent of the movement. Measures could include backfilling against the shoring wall face, installation of anchors, and installation of internal props/bracing.

4. Hydrogeological Monitoring

4.1 General

Reference should be made to the Dewatering Management Plan (Douglas Report 216254.04.R.001) for background on groundwater at the site, expected inflow and monitoring requirements.

Based on the available information, the pre-excavation level of the permanent groundwater table at the site reduces from approximately RL 49 m AHD up-slope to approximately RL 45 m AHD

downslope. Subsequent site observations and monitoring suggests that these levels may be impacted by more recent nearby basement dewatering, and it is possible that groundwater will not be encountered at the bulk excavation level of RL 48.15 m AHD. Table 4 shows the recommended monitoring steps, with Hold Points identified, where information should be provided to the structural or geotechnical engineer prior to continuing with the works.

Note that as part of the soldier pile and shotcrete support, vertical strip drains should be installed behind the shoring to collect all seepage that may occur and to direct the seepage to the subfloor drainage system, from where it can be removed using sump-and-pump or gravity drainage methods.

Table 4: Summary of Hydrogeological (Groundwater) Monitoring Activities

Step	Description	Hold Point	Ref
H1. Prior to Excavation			
H1.1	Inspection of shoring piles by a geotechnical engineer to observed groundwater inflows into the pile holes. If water levels observed in the pile holes suggests that groundwater will not be intersected by the excavation, then excavation work may proceed. Otherwise, refer to the monitoring and reporting requirements in the DMP.	Hold Point	DMP
H2. Excavation below RL 49 m AHD to Bulk and Detailed Level			
H2.1	Builder to carry out daily inspection of excavation area and notify the geotechnical engineer if water inflow is observed.		
H2.2	Inspection of the base of the excavation at bulk level by the geotechnical engineer to assess the hydrogeological conditions prior to detailed excavation. If water inflow is observed, then the monitoring and reporting requirements in the DMP will need to be implemented prior to continuing excavation/construction.	Hold Point	DMP
H3. Following Completion of Excavation and Commencement of Building Construction			
H3.1	Evaluation of information obtained from Steps H1 and H2 by the geotechnical engineer, to determine ongoing frequency of monitoring and reporting given in H1 and H2, if required.	Hold Point	DMP
H4. Prior to Handover/OCC			
H4.1	Re-evaluation by geotechnical engineer of predicted long-term groundwater inflows to basement, based on ongoing records during construction.	Hold Point	DMP
H4.2	Builder to prepare documentation confirming their compliance with the monitoring and reporting requirements required by this GMP.	Hold Point	
H4.3	Builder to confirm that the as-built groundwater management system includes suitable measures to allow for the long-term groundwater treatment, quality evaluation and volume discharge requirements of the permanent groundwater management system.	Hold Point	DMP

4.2 Trigger Levels/Contingency Plans

4.2.1 General

If groundwater is encountered in the excavation, trigger levels and contingency plans described in the following sections will need to be considered.

4.2.2 Water Quality

If the results of groundwater quality measurements indicate an impact on existing groundwater conditions, or on disposal requirements for the pumped water, a plan must be developed to mitigate any impacts on existing groundwater conditions, and to provide treatment to meet the appropriate groundwater disposal requirements.

4.2.3 Water Level Outside the Basement

Previous groundwater monitoring in the area indicates a natural groundwater fluctuation of approximately 1 m. Groundwater levels surrounding the site that fall by more than 1 m below initial levels (as measured shortly prior to dewatering and taking fluctuation into account, as well as surrounding drained basements or excavations) should trigger an assessment of the records of pumped groundwater volumes, records of pumped groundwater/seepage volumes and weather/climatic factors. A plan may need to be developed to reduce groundwater take if the drawdown is determined to be due to the excavation. This may include localised grouting/sealing such as polymer-based emulsion grout etc.).

4.2.4 Groundwater Inflow

If groundwater inflow is assessed as excessive relative to the predicted inflow (refer DMP Report 216254.04.R.001), reanalysis and reassessment may be needed and additional measures to reduce groundwater inflow may be necessary. This may include localised grouting/sealing such as polymer-based emulsion grout etc.), as above.

5. Vibration Monitoring

5.1 General

Based on the report on geotechnical investigation for the site (ref: 216254.00.R.001, Rev. 3, dated 30 June 2023), an allowable vibration limit of 5 mm/s Vector Sum Peak Particle Velocity (VSPPV) at the foundation level of nearby buildings is suggested. The proposed allowable vibration limit at the foundation level of adjacent buildings is also adequate to reduce the risk of structural damage to buildings and road assets on the adjacent properties, including buried services. However, vibration sensitivity of the services should be confirmed with the asset owners prior to excavation. The limit may need to be adjusted to reflect the asset requirements, response of neighbouring structures during excavation and vibration dosage once the neighbouring building is occupied.

The proposed limit takes into account both structural damage and human comfort criteria given in relevant Standards (e.g., ISOAS 2670, EPA guidelines, German DIN4150 Standard and Australian Standard AS 2187-2 (2006)).

A vibration trial may be required to size equipment at the commencement of excavation into rock. The trial may indicate that minimum offset distances are required for the preferred plant, or that alternative excavation methods are required.

5.2 Monitoring Procedures

For this site, due to the limited excavation proposed, it is suggested that vibration monitoring be limited to carrying out an initial trial of excavation equipment. If the trial indicates that the vibration limits could be exceeded, then the contractor is to install a permanent monitoring system which will allow 'self-management' of vibration.

If required, geophones should be installed on or near the base of the walls of the neighbouring buildings. The geophones should be firmly attached to the building's structure or footings and should be connected to a data monitor, which is capable of measuring vibrations to 0.5 mm/sec PPVi or less. The monitor shall be set up to record all vibrations which exceed 5 mm/sec. A warning light or sound signal shall be attached to the monitor, which is configured with an alarm threshold of 5 mm/sec PPVi to warn the excavation contractor of vibration exceedances. The system should also automatically send a text message to the site superintendent should an exceedance occur, for the superintendent to investigate.

Table 5 shows the steps recommended, with Hold Points identified, where information should be provided to the structural or geotechnical engineer prior to continuing with the works.

Table 5: Summary of Vibration Monitoring Activities

Step	Description	Hold Point
V1. Prior to Commencement of Bulk Excavation Works		
V1.1	When excavation encounters medium strength rock, undertake a vibration trial using the largest machine of each equipment category (e.g., rock breaker, bulldozer with ripping tyne, rock saw) to be used in order to determine the minimum buffer distances to neighbouring structures for each equipment type. Geotechnical engineer to advise on whether proposed equipment is likely to exceed allowable vibration levels and whether continuous monitoring is required.	Hold Point
V1.2	If the vibration trial indicates that vibration limits may be exceeded by the proposed works, then geophones and monitors are to be installed and configured to undertake continuous unattended monitoring of vibration. Install geophone at the base of the neighbouring structure closest to the excavation works. Connect geophone to data monitor and install a flashing light or sound warning signal and enable automatic text messaging to the site superintendent. Set warning light to trigger at 5 mm/s VSPPV.	Hold Point
V2. During Excavation		
V2.1	If continuous monitoring is required (see Step 1 above) – data from the monitor is to be uploaded weekly, with direct feedback to site personnel of the number of recorded events exceeding the Allowed Limit. Reports should include a tabulation of times and levels of any events exceeding a recording threshold of 5 mm/s VSPPV, for correlation with site activity records. The weekly vibration monitoring reports should be forwarded to the geotechnical engineer for review.	

Step	Description	Hold Point
V2.2	If the number of exceedances on any day is more than 10 then the respective excavation works shall stop, and the geotechnical engineer shall be notified. The geotechnical engineer will investigate the causes of the exceedances and provide advice on measures to avoid further vibration exceedances.	Hold Point

5.3 Trigger Levels/Contingency Plans

If the vibration trials indicate that continuous monitoring is required, then the monitor shall be configured such that either an SMS message is sent automatically to nominated mobile phones (including the monitoring entity and the site superintendent), or a flashing light or sound signal is triggered when the vibration at the base of the neighbouring structure exceed 5 mm/s VSPPV. If the SMS message is sent or the warning signal is triggered, then the machinery operator should reduce the force generated by his equipment or move further away from the neighbouring structure.

Occasional exceedances may be allowed, however, if a sustained exceedance occurs, an inspection by the structural and geotechnical engineers should be made of the potentially affected building and excavation should only resume if no vibration-induced damage can be seen.

If the warning light is being triggered frequently (e.g., >10 times/day), excavation works are to stop, the geotechnical engineer is to be notified, and a site visit carried out by the geotechnical engineer to investigate the cause of the exceedances. A change in excavation method may be recommended as a result of the inspection, or on the basis of recorded vibration data.

6. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for the proposed Midtown Macquarie Park new Primary School at Ivanhoe Estate, Macquarie Park, NSW in line with Douglas' proposal dated 28/08/23 and acceptance received from Mike O'Neill of Taylor Construction Group Pty Ltd dated 22 November 2024. The work was carried out under Douglas' Engagement Terms. This report is provided for the exclusive use of Taylor Construction Group Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas 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 Douglas' field testing has been completed.

Douglas' advice is based upon the conditions encountered during the previous geotechnical investigation at the site (ref: 216254.00.R.001, Rev. 3, dated 30 June 2023). The accuracy of the

advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical and groundwater components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

Appendix A

About this Report

About this Report

October 2024

Introduction

These notes have been provided to amplify Douglas' report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

Douglas' reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, Douglas will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, Douglas cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, Douglas will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, Douglas requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. Douglas would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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Appendix B

Drawings

Legend

- Approx. building footprint
- Approx. site boundary
- Test pit location
- Borehole with groundwater well
- Borehole location
- Proposed Driveway

Drawing adapted from aerial imagery from Metro Map. Site boundary traced from provided DWG architectural plans file

Test locations acquired using DGPS accurate to approximately 100 mm vertical/horizontal

0 15 30 45 m

Douglas Partners
Geotechnics / Environment / Groundwater

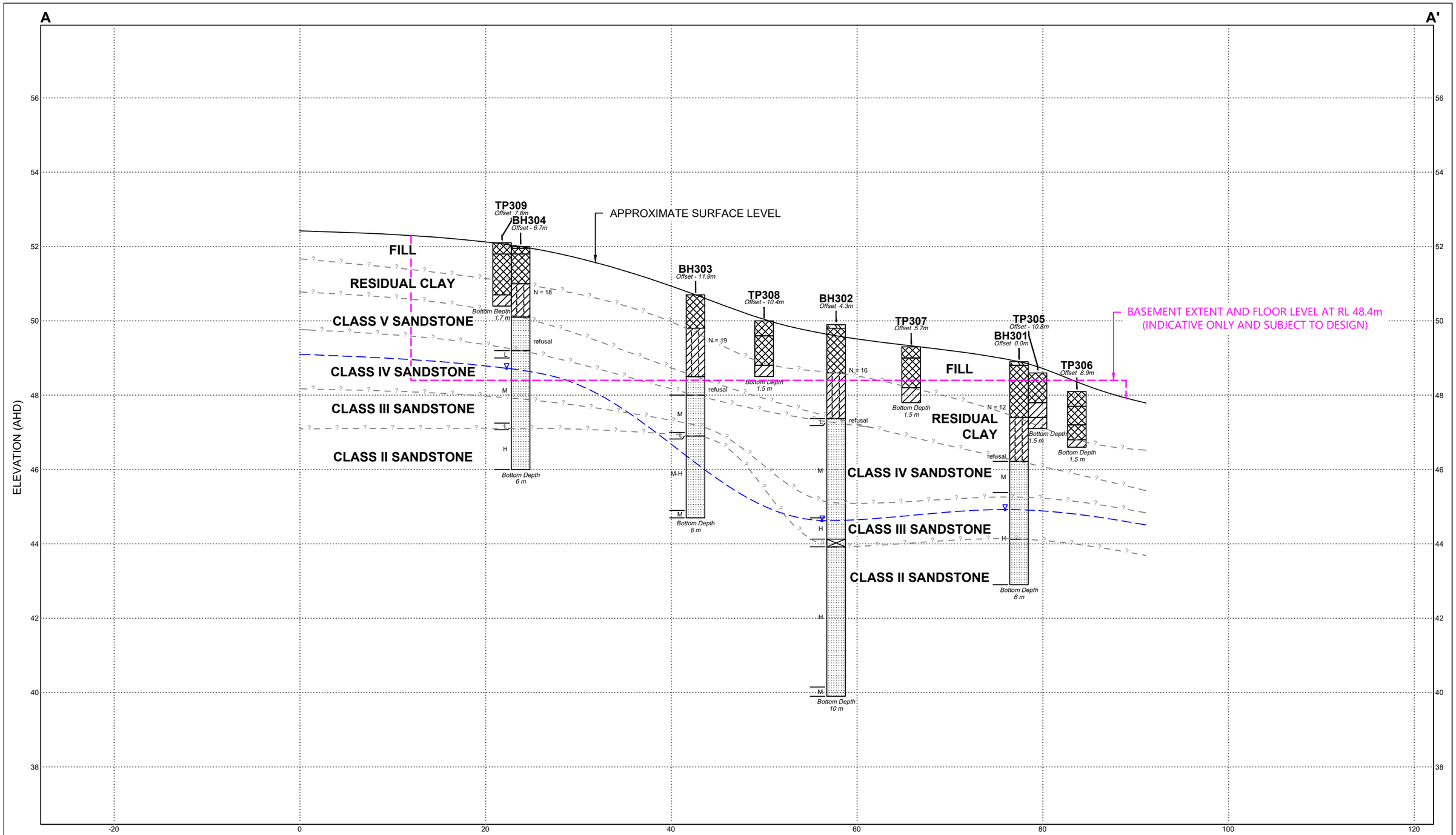
CLIENT: School Infrastructure NSW		
OFFICE: Sydney	DRAWN BY: CL	
SCALE: 1:600	DATE: 16.June.2023	

TITLE: **Test Location Plan**
Midtown Macquarie Park New Primary School
Macquarie Park, NSW

N

Project:	216254.00
DRAWING No:	1
REVISION:	0

DP.QGIS.A3LandScapeDrawingLayout.DftA



LEGEND

- Core Loss
- Clay
- Filling
- Roadbase
- Sandstone
- Sandy Clay
- Silty Clay

NOTES:

1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

ROCK STRENGTH

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

TESTS / OTHER

- N - Standard penetration test value
- — ? — - Interpreted geotechnical boundary
- ▽ - Water level
- — — — - Approximate Groundwater Table Level

0 8

Horizontal Scale (metres)
Vertical Exaggeration = 4.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: School Infrastructure NSW		TITLE: **Interpreted Geotchnical Cross-Section A-A'**	PROJECT No: 216254.00
OFFICE: Sydney	DRAWN BY: JV/MG	**Midtown Macquarie Park New Primary School**	DRAWING No: 2
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 23.08.2022	**Macquarie Park, NSW**	REVISION: 0