Douglas Partners
Geotechnics / Environment / Groundwater

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Report on
Preliminary Geotechnical Assessment

SCEGGS Darlinghurst, Masterplan Redevelopment
215 Forbes St, Darlinghurst

Prepared for
SCEGGS Darlinghurst Limited

Project 86514.01
October 2018

Douglas Partners
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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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1. Introduction

This report presents the results of a preliminary geotechnical assessment undertaken for a Masterplan at Sydney Church of England Girls Grammar School (SCEGGS) at 215 Forbes St, Darlinghurst. The investigation was commissioned in an email dated 2 August 2018 by Robert Denton of Tanner Kibble Denton Architects on behalf of SCEGGS Darlinghurst Limited and was undertaken in accordance with Douglas Partners' proposal SYD180462 (Rev2) dated 26 July 2018.

The Masterplan generally comprises:

- Wilkinson House Redevelopment;
- The new multi-purpose building including driveway entries and associated landscaping; and
- New Administration Building and restoration of Barham Building.

The geotechnical assessment is a desktop study of available information gathered from previous geotechnical investigations carried out on the site by Douglas Partners Pty Ltd (DP) for various other developments. A site and a site walkover was conducted on 23 August 2018.

2. Previous Investigations

In June 1994, Douglas Partners (DP) carried out a geotechnical investigation for the sports building, which is located on the eastern side of the site about mid-distance along Forbes Street. This investigation comprised six bores drilled to depths of up to 8.5 m below the existing surface level to obtain detailed information on the soil and rock stratigraphy. The results of the investigation were provided in a Report No. 20080 for Tierney & Partners, Consulting Engineers for the sports building design.

The investigation indicated that sandstone bedrock was generally located less than 0.5 m below surface level. Furthermore, the sandstone was medium or high strength from near the surface and DP's assessment was that vertical excavations could be made in the sandstone but that rock bolts would be required to stabilise areas where steeply dipping joints intersect the excavation faces at unfavourable orientations. It was also determined that localised shotcreting of low and very low strength bands would be required to minimise weathering and deterioration of these beds.

The investigation also comprised mapping of the sandstone cliff-face on the site which was eventually excavated for the sports complex. This mapping identified a weak zone in the Hawkesbury Sandstone and contended that this weak zone could have been caused by a fault in the sandstone or by an igneous dyke intersecting the excavation at about right angles to the Forbes Street frontage. If the

weak zone was a dyke, it is possible that similar geological features could intersect the site of the current proposed building.

In April 2008, Douglas Partners (DP) carried out a geotechnical investigation for the Science and Technology Building, which is located off St Peter's Street. This investigation comprised five bores drilled to depths of up to 10 m below the existing surface level and three test pits to obtain detailed information on the soil and rock stratigraphy. The results of the investigation were provided in a Report No. 45427.

The results of the field work indicated a subsurface profile comprising about 1 m of filling overlying weathered sandstone and then medium strength sandstone from depths of 0.35 m to 1.0 m into rock. Below about 3 m depth, the sandstone was generally medium and high strength unbroken rock with few defects.

Other investigations carried out on the site generally encountered rock at depths less than 1 m.

3. Site Description and Geology

SCEGGS is located in an intensely developed residential and commercial area of Darlinghurst about 1 km from the Sydney Central Business District. Overall the site occupies an irregular shaped area measuring about 150 m x 60 m and is currently occupied by many school buildings which range in age from relatively recent to in excess of 100 years old. The school itself is located on the corner of Forbes Street and St Peters Street.

SCEGGS is located in undulating country with gentle slopes to the north towards Woolloomooloo Bay estimated to be about 5%. A feature of the site is a high sandstone cliff, ranging up to about 8 – 10 m high running in approximately north-south direction through the centre of the site. The eastern side is higher than the southern side. Previous work on the site has removed some of the sandstone.

The 1:100 000 Series Geological Sheet for Sydney indicates that the site is underlain by Hawkesbury Sandstone. This geological formation usually comprises medium to coarse grained quartz sandstone with minor shale lenses. Previous investigations on the site confirm the geological mapping with Hawkesbury Sandstone at shallow depths below the surface. Sandstone was also exposed in a cutting along Forbes Street prior to excavation for the existing sports hall.

4. Geotechnical Model

Douglas Partners has previously carried out geotechnical investigations on the site for the Sports Hall and the Science and Technology Buildings. Previous investigations indicate a general subsurface profile comprising up to about 1 m of filling overlying weathered sandstone which quickly graded into medium and high strength sandstone. The medium and high strength sandstone had some moderately weathered zones in the upper 2 m. Below depths of about 3 m, however, the sandstone was generally medium and high strength, fresh, unbroken rock with few defects.

In addition, a site visit was undertaken in August 2018 and the following observations were made:

- There is a sandstone cliff some 8-10 m high on the western side of Thomson Street and the southern side of the Old Gym Building;
- The sandstone cliff continues in a north-south direction between the Old Gym Building and the Science Block;
- The sandstone cliff is on the school boundary to the west of the Old Girls' Building and the neighbouring residences;
- Sandstone is exposed behind the eastern walls of the Sports Hall which is excavated into the ground;
- Sandstone is exposed at basement level of the Wilkinson Building;
- Sandstone is exposed in the underfloor areas of the Barham Building;
- Sandstone is exposed near the ground floor of St Peter's Playhouse.

Many of the school buildings on site have been excavated into the rock, which will have changed the original rock depths across the site.

A previous investigation comprised mapping of the sandstone cliff-face on the site which was eventually excavated for the Sports Hall. This mapping identified a weak zone in the Hawkesbury Sandstone and contended that this weak zone could have been caused by a fault in the sandstone or by an igneous dyke intersecting the excavation at about right angles to the Forbes Street frontage.

No free groundwater was observed during the previous investigation and water was not present where rock was exposed in the different buildings during a site visit on 23 August 2018. It is expected, however, that after periods of heavy rainfall some seepage will occur along the bedrock surface. The permanent water table within the intact bedrock is expected to be at many tens of metres below the current site level with groundwater flow along bedding planes and through vertical joints being low and readily manageable.

5. Proposed Development

The proposed Masterplan, as shown on the architectural drawing in Appendix B, generally comprises:

- Wilkinson House Redevelopment. Details of the proposed works are unknown. The existing building has a basement and is founded on sandstone;
- The new multi-purpose building including driveway entries and associated landscaping. In order to construct the new building, it appears that the Old Gym, Library Building and Science Building will be demolished. The existing drawing indicates that the new building crosses the cliff line; and
- New Administration Building and renovation of Barham Building. The eastern part of the Barham Building would have to be demolished to make way for the new Administration building. The northern section of the Barham Building, which is to be renovated is founded on rock.

Exact details of each development are yet to be confirmed.

A drawing showing the locations of the proposed works is given in Appendix B.

6. Comments

6.1 General

As details of the proposed works are unknown, preliminary comments are given to cover general conditions on site.

From a geotechnical perspective, there are generally good founding conditions of medium and high strength sandstone close to the surface.

The converse of the medium and high strength sandstone being a general good founding stratum is that cost and effort required to remove the sandstone, should basements or excavation be adopted, is more than normal.

6.2 Ground Conditions

The site is generally underlain by weathered material at shallow depth over generally medium or high strength bedrock. Whilst these conditions are favourable insofar as vertical excavations are generally feasible and relatively high bearing pressures can be adopted, on a small site such as this, excavation can be difficult and vibration issues become critical in carrying out the bulk excavation works.

6.3 Excavation

Any deep excavations below existing surface levels will probably be mostly in medium to high strength sandstone with some minor low or very low strength bands. Generally, it is considered that the excavation underlain by medium and high strength sandstone, would be difficult and under normal circumstances would need a heavy bulldozer, such as a D10 (or larger), and also the use of rock breakers to break some of the stronger layers and to trim the final excavation faces. However, due to the proximity of buildings, which are sensitive to vibrations, it may be necessary to utilise a rock saw around the perimeter of the excavation and to use small rock breakers to assist in the excavation so as to limit the vibration of adjacent structures.

It is advised that an excavation trial is carried out using the equipment proposed for the work before the main excavation work commences to establish whether the vibration limits given below can be achieved. If the trial proves satisfactory, then bulk excavation works could commence but if the vibration levels are too high it may be necessary to get the contractor to either adjust their excavation techniques or to utilise smaller equipment.

6.4 Vibrations

Excavation of the medium and high strength rock will cause some vibration but with care this can be maintained at levels which are below the critical levels for major building damage. The sandstone bedrock underlying the site is expected to extend into adjacent properties and is likely to transmit vibrations generated by the excavation process. Consequently, it will be necessary to adopt appropriate construction methodologies and equipment to limit the vibration at adjacent buildings to acceptable levels.

If hydraulic rock hammering is required it may result in vibrations being transmitted to the surrounding ground and any buildings or structures in the vicinity. It will generally be necessary to use smaller excavation plant or alternatively methods such as rock sawing, line drilling or a milling head when in close proximity to existing structures. It is DP's experience that particular care is warranted when using hydraulic rock hammers within 10 m of adjacent structures. To limit the risk of causing vibration induced damage to existing structures it is recommended that monitoring of the vibration be carried out during an initial excavation trial. If acceptable vibrations are recorded using the techniques and equipment proposed for bulk excavation then excavation could continue. If excessive vibrations occur it may be necessary to amend the excavation plan.

The propagation of vibrations at a site depends upon the plant used to carry out the excavation and the prevailing ground conditions together with the type of construction and foundation of the structures receiving the vibrations. The ground conditions such as rock strength and defects are unique to every particular site and therefore it is recommended that excavation trials be subject to vibration monitoring to establish the extent to which vibration are attenuated by the local geological conditions.

The Australian Explosives Code (AS2187.2-1993) recommends a peak particle velocity (PPV) of 10 mm per/sec for residential structures subject to blasting vibration. Ground vibrations arising from excavation plant, however, are continuous and not transient as would be blasting vibrations. Therefore, more stringent vibration limits should apply. On the basis of the above it is considered that the vibrations should be limited to a maximum PPV of 5 mm/sec at the building line of the existing adjacent structures.

It should also be noted that humans are very sensitive to vibration, even at levels which are considered inconsequential for buildings and utilities. It may therefore be beneficial to give ample notice to local residents that excavation is to commence. It would also be prudent to undertake a dilapidation survey on all adjacent buildings so that any pre-existing damage can be identified and therefore avoid claims that the excavation has caused deterioration in adjacent structures.

6.5 Excavation Support

Whilst it should be generally possible to excavate medium and high strength sandstone vertically it is considered likely that rock bolts or pins may be required to stabilise areas where steeply dipping joints intersect the excavation faces at unfavourable orientations. Localised shotcreting of low and very low strength bands may also be required to reduce weathering and deterioration of these bands.

To determine the requirement for rock bolts or pins it is recommended that inspections of the excavation faces be undertaken by an experienced geotechnical engineer or engineering geologist at regular intervals, say 1-1.5 m depth of excavation, during construction.

While the overburden soils and filling are likely to be relatively thin (i.e. generally less than 1 m) these materials should be battered back at a maximum slope of 2H:1V. Alternatively, they could be supported by a retaining structure.

6.6 Underpinning of Adjoining Structures

The site is generally underlain by a relatively shallow depth of filling and soil overlying medium strength bedrock. It is expected that the footings of the school buildings are likely to be supported on medium strength bedrock so there appears to be no need for underpinning of adjoining structures. It is, however, recommended that the footings of all buildings near the excavation face be inspected when excavation commences to ensure that the conditions observed on the site are representative of all conditions beneath the footings of existing buildings. If underpinning is required it will have to be done in short panels no greater than about 1 m lengths by excavating under the footings and providing temporary support until concrete blade walls can be installed from the underside of the footing down to competent bedrock.

6.7 Foundations

The founding material underlying most of the site will mostly comprise medium to high strength sandstone with the possibility of some minor low or very low strength bands. Pad or strip footings founded on this material are considered to be suitable footing types. For these conditions it is considered that the building footings could be designed on the basis of an ultimate bearing pressure of 20 MPa. Even with a very low geotechnical strength reduction factor it is still possible that excessive settlements could occur so it is suggested that a maximum preliminary allowable bearing pressure of 3.5 MPa be adopted without the need for any spoon testing in the foundation excavation or 6 MPa if spoon testing is undertaken in at least half of the footing excavations during construction.

A previous investigation identified weak zones in the rock face along Forbes Street, and it was contended that the weak zones may have been caused by an igneous dyke. If this was correct, then there is a possibility of other such weak zones on the site. It is therefore imperative that all foundations be affected to ensure that foundations conditions are not impacted by igneous intrusions. If some footings are affected, they may have to be redesigned by lowering the bearing pressure or bridging over the dyke.

6.8 Groundwater

It is expected that the groundwater would be located many metres below the existing site. It is, however, probable that some seepage will occur along the sandstone bedrock after periods of heavy rainfall. The quantity of flow should not be significant but provision will need to be made to collect any seepage flows and to dispose of this into the local stormwater drainage system.

6.9 Seismic Design

The site's class for earthquake loading as given in AS1170.4-2007 would be Class B_e – Rock on the basis that the foundations would be on rock at shallow depth and the rock near the surface is considered to have an unconfined compressive strength of less than 50 MPa.

Following detailed investigation for a specific location, it may be possible to change the site's class to Class A_e if the unconfined compressive strength of the rock is greater than 50 MPa.

6.10 Further Investigation

The above comments are based on previous geotechnical investigations on the site and current site observations of exposed rock. Additional geotechnical investigations will be required once final details of the new developments become known.

7. Limitations

Douglas Partners (DP) has prepared this report for this project at SCEGGS, Darlinghurst in accordance with DP's proposal dated 26 July 2018 and acceptance received from Tanner Kibble Denton Architects on behalf of SCEGGS Darlinghurst Limited dated 14 August 2018. The work was carried out under SCEGG Darlinghurst Limited amended Conditions of Engagement. This report is provided for the exclusive use of SCEGGS Darlinghurst Limited and their agents 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 DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report 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 previous testing and current observation 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.

DP's advice is based upon the conditions encountered during previous investigations and our current site observations. The accuracy of the advice provided by DP 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.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion 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 DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

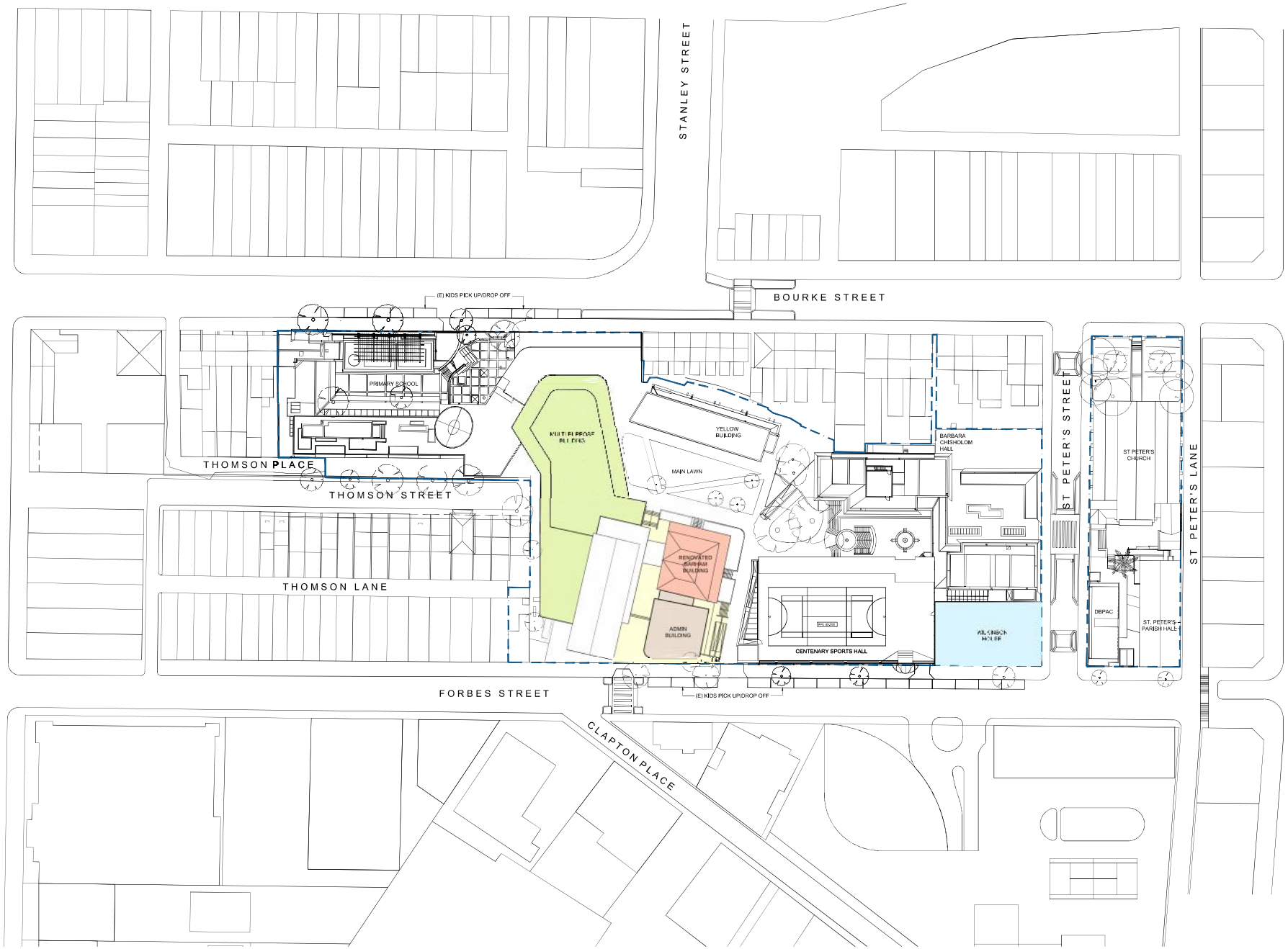
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate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

Site Inspection

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

Appendix B

Drawings



LEGENDS

- (N)MULTI-PURPOSE BUILDING
- (N)ADMINISTRATION BUILDING
- RESTORED BARHAM BUILDING
- REFURBISHED ENTRY
- (N)WILKINSON HOUSE REDEVELOPMENT
- SITE BOUNDARY

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NSW Nominated Architects:
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Alex Kibble Registration No. 6015

Do not scale drawings. Verify all dimensions on site. Notify architect of all discrepancies.

10 20 30 40 50

Project
SCEGGS DARLINGHURST MASTERPLAN

Drawing Title
PROPOSED SITE PLAN

Drawing No. AR.MP.1104

Revision P3

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