GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

GEOTECHNICAL INVESTIGATION

FOR

MING & LIN WANG

2 Monash Crescent, Clontarf, New South Wales

Report No: 25/1912

Project No: 33121/9986D-G

July 2025

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DRAWING NO. 25/1912 – SITE LOCATION

NOTES RELATING TO GEOTECHNICAL REPORTS

1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out by STS Geotechnics Pty Limited (STS) for the proposed construction of a new dwelling at 2 Monash Crescent, Clontarf, NSW.

The following documents were provided to assist in the preparation of this report:

- Survey Plan: 'Survey Showing Selected Levels & Boundary Identification & Detail over Lot 2 in DP 539424 , prepared by Hill & Hume Surveyors reference 65607001A issue A, dated 13.08.2024.
- Architectural Drawings:, prepared by Studio Nina Pty Ltd, Project No. 2402, Revision B dated 7.5.2025

Based on the drawings provided, the proposed dwelling comprises two to three levels including a basement. The survey plan also indicates the presence of sandstone outcrops onsite. Based on the architectural drawings, excavations up to about 6m deep in some areas are expected. Additional excavations may be required for footings or service trenches.

The geotechnical investigation report has been prepared to assess the subsurface conditions over the site and develop a preliminary conceptual geotechnical model of the ground conditions based on our local engineering experience and previous investigations within the vicinity of the site. This model assists in providing preliminary geotechnical advice and recommendations for the proposed development addressing the following:

The purpose of this investigation was to determine the following:

- Site conditions and regional geology
- Subsurface conditions,
- Site classification according to AS2870-2011 (soil reactivity),
- Preliminary Excavation conditions including vibration control during rock excavation,
- Preliminary Excavation support and retaining wall design parameters,
- Foundation design parameters including foundation options, and
- Acid Sulfate Soils Assessment and need for an Acid Sulfate Soils Management Plan.
- Recommendations for additional geotechnical investigations for detailed design and post-DA following site clearance.

2. NATURE OF THE INVESTIGATION

2.1. Fieldwork

Due to the access constraints the investigation was carried out by a detailed visual inspection from one of the senior engineers to determine the existing geological and geotechnical conditions with the vicinity of the site to identify geotechnical features. No intrusive fieldwork was carried out.

3. GEOLOGY AND SITE CONDITIONS

The Sydney geological series sheet at a scale of 1:100,000 shows the site is underlain by Triassic Age Hawkesbury Sandstone. Rocks within this formation typically comprise medium to coarse-grained quartz sandstone with very minor shale and laminite lenses. Hawkesbury sandstone in Sydney is characterised by sub horizontal bedding and subvertical joints.

The site ins irregular in shape and dips to the south/south-west about 30 degrees. The referenced survey plan shows an elevation of about RL 20 at the highest north east corner to RL 3.84 at the bottom of the street level at Monash Crescent.

Reference to Google Earth satellite images and contour maps of the surrounding areas, shows that sandstone outcrops are present at similar elevations to the site. The presence of this feature is consistent with the expected geology of this area and indicates that sandstone bedrock is close to the existing ground surface around the site.

Sandstone outcrops were observed and confirmed on site during the fieldwork and consistent with our experience in this geological setting.

Plate 1: Sandstone Bedrock/Outcrops observed across the site.

4. SUBSURFACE CONDITIONS

Based on our experience within this geological setting and review of our in-house database in Clontarf, it is our expectation that the subsurface conditions at this site will likely consist of Fill/Topsoil overlying weathered sandstone bedrock. The Sandstone is likely to initially very low to low strength and extremely to distinctly weathered. The strength (not always) generally increases, and weathering generally decreases with depth.

Groundwater is not expected to be encountered. The depth of seepage (if encountered) is likely to be along the soil/rock interface and through the defects within the Hawkesbury Sandstone.

5. GEOTECHNICAL DISCUSSION

5.1. Site Classification to AS2870-2011

The classification has been prepared in accordance with the guidelines set out in the "Residential Slabs and Footings" Code, AS2870 - 2011. (if applicable)

The site may be classified as *stable (A)* provided the entire structure bears within the sandstone bedrock.

Any shallow high level foundation design and construction consistent with this classification shall be adopted as specified in the above referenced standard and in accordance with the design details given below.

5.2. Excavation Conditions and Support

Prior to any excavation commencing, we recommend that reference be made to the Safe Work Australia Excavation Work Code of Practice, dated January 2020.

As noted above, bulk excavations of up to about 6 metres below existing ground will be required. Based on our experience in this geological setting and site observations, medium and/or high strength sandstone are likely to be encountered prior to reaching bulk excavation level or during the excavation of footings or service trenches.

Excavators alone, without assistance, may not be able to remove any significant amount of the weathered sandstone. Hydraulic breakers mounted on an excavator or jack hammers may be required to break up most of the rock before it can be removed using an excavator.

Care will be required to ensure that the structures on the subject site and buildings or other developments on adjacent properties are not damaged when excavating the rock. Excavation methods should be adopted which limit ground vibrations at the adjoining structures to not more than 5 mm/sec. Vibration monitoring may be required to verify that this is achieved.

Table 5.1 - Recommendations for Rock Breaking Equipment

Distance from adjoining structure (m)	**Maximum Peak Particle Velocity 5 mm/sec**	
	Equipment	Operating Limit (% of Maximum Capacity)
1.5 to 2.5	Hand operated jackhammer only	100
2.5 to 5.0	300 kg rock hammer	50
5.0 to 10.0	300 kg rock hammer or 600 kg rock hammer	100 50

The limits of 5 mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in Table 5.1.

To assist in reducing vibrations and over-break of the sandstone, we recommend that a conservative initial saw cutting of the bedrock may be adopted using rock saw attachments fitted to the excavator.

Rock sawing of the has several advantages as it often reduces the need for rock bolting as the cut faces generally remain more stable and require a lower level of rock support than hammer cuts, ground vibrations from rock saws are minimal and the saw cuts will provide a slight increase in buffer distance for use of rock hammers. However, the effectiveness of such approach must be confirmed by the results of vibration monitoring.

If rock sawing is carried out around excavation boundaries in not less than 1-metre-deep lifts, a 900 kg rock hammer could be used at up to 100% maximum operating capacity with an assessed peak particle velocity not exceeding 5 mm/sec, subject to observation and confirmation by a geotechnical engineer at the commencement of excavation.

It should be noted that vibrations that are below threshold levels for building damage may be experienced at adjoining developments.

It would be appropriate before commencing excavation to undertake a dilapidation survey of any adjacent structures that may potentially be damaged. This will provide a reasonable basis for assessing any future claims of damage.

Groundwater seepage monitoring should be carried out during bulk excavation works and prior to finalising the design of a pump out facility. Outlets into the stormwater system will require Council approval.

Furthermore, any existing buried services, which run below the site, will require diversion prior to the commencement of excavation or alternatively be temporarily supported during excavation, subject to permission or other instructions from the relevant service authorities. Enquiries should also be made for further information and details, such as invert levels, on the buried services

5.3. Excavation Monitoring

Consideration should be made to the impact of the proposed development upon neighbouring structures, roadways and services. Basement excavation retention systems should be designed so as to limit lateral deflections.

Contractors should also consider the following limits associated with carrying out excavation and construction activities:

- Limit lateral deflection of temporary or permanent retaining structures;
- Limit vertical settlements of ground surface at common property boundaries and services easement; and
- Limit Peak Particle Velocities (PPV) from vibrations, caused by construction equipment or excavation, experienced by any nearby structures and services.

Monitoring of deflections of retaining structures and surface settlements should be carried out by a registered surveyor at agreed points along the excavation boundaries and along existing

building foundations / services / pavements and other structures located within or near the zone of influence of the excavation. Owners of existing services adjacent to the site should be consulted to assess appropriate deflection limits for their infrastructures. Measurements should be taken in the following sequence:

- Before commencing installation of retaining structures where appropriate to determine the baseline readings. Two independent sets of measurements must be taken confirming measurement consistency;
- After installation of the retaining structures, but before commencement of excavation;
- After excavation to a depth of 1.5m, and every 1.5m interval thereafter.
- After backfilling behind retaining walls.
- One month after completion of the permanent retaining structure or after three consecutive measurements not less than a week apart showing no further movements, whichever is the latter.

5.4. Groundwater Considerations

Based on the observations, the ground level excavations are not expected to encounter the groundwater table. However, some minor perched water seepage may flow into the excavation from the soil rock interface. The inflow rates are likely to be minor and therefore a sump and a pump should be sufficient to control the anticipated seepage.

5.5. Safe Batter Slope

Subject to additional geotechnical investigations in a form of cored boreholes and inspections by a suitably experienced geotechnical engineer, it may be possible to have near vertical cuts in medium and high strength sandstone provided the following.

- The excavation face is absent of adversely oriented defects that may result in instability;
- Inspections be carried out by an experienced geotechnical engineer progressively during basement excavations to assess rock quality and absence of adversely oriented defects;
- Where adversely oriented defects are present which may form slip planes, wedges or unstable blocks, such areas be stabilized prior to further excavations.

It is of course important that the onsite excavations do not endanger the adjacent properties and where space for temporary batters is not available, a suitable retention system will be required for the support of the entire depth of excavation within the soils.

Excavations on the subject site should not extend below the zone of influence of any adjacent structure foundations, without first installing temporary support or discussing the works with a geotechnical engineer.

5.6. Retaining Wall Design Parameters

Until the excavation is commenced, and the actual conditions are exposed it is not practical to be more definitive. The sandstone bedrock may include some joints. If joints are continuous, they could form wedges which may need to be supported with bolts. If boulders extend beyond site boundaries, then they will need to be trimmed and supported. As noted above particular care will be required when excavating close to boundaries. This work should be carried out in small sections so that the subsurface conditions can be identified, and any appropriate shoring or support can be installed before too large an area is exposed.

It is recommended that an experienced engineering geologist or geotechnical engineer observes the excavation as it progresses. At that time, they will be able to recommend any support that is required for either temporary or permanent conditions and help to finalise the design of the final cut slopes and any retaining walls that may be required.

All loosened rocks should either be stabilised or removed from the sides of the excavation as it proceeds. If floaters are encountered care will be required as they can often be sizeable in this geological environment, appearing to be part of the “solid” rock profile.

As noted above, experience has demonstrated that near vertical cuts in the competent in-situ sandstone found in this area will normally remain stable for long lengths of time. An allowance should be made at this time for the installation of some passive grouted dowels in conjunction with shotcrete, and possibly a limited number of rock bolts. Also, if shaley seams are encountered they will need to be protected from long term undercutting using shotcrete and pins or infill concrete cut into the face. Even with the above support there is always the chance that some small blocks which are not identified during excavation will become dislodged later with time.

An alternative to leaving the rock face exposed is to design perimeter walls to support the excavation in the long-term using the parameters shown below.

The space between the rock face and the back of the walls could be filled with free draining hard igneous rock with an appropriate large agriculture drain installed at the toe. This may help to relieve the potential for damp penetrating the external walls.

When considering the design of the supports for the overlying soils (if required), it will be necessary to allow for the loading from structures in adjoining properties, any ground surface slope, and the water table present.

The following parameters are suggested for the design of the retaining wall system where there is a level ground surface:

Soils:

Earth Pressure Coefficient (K_a)	=	0.4
Total (Bulk) Density	=	18 kN/m^3

Sandstone:

Earth Pressure Coefficient	=	0.1 or 10 kPa (whichever is lesser)
Passive Earth Pressure Coefficient (K_p)	=	4.5 (sandstone only)
Total (Bulk) Density	=	23 kN/m^3

5.7. Foundation Design

it is recommended that all footings for the proposed building be founded within the sandstone bedrock of similar strength or better to provide uniform support and reduce the potential of differential settlements.

Piles and footings founded at bulk excavation level in weathered sandstone may be proportioned using an allowable end bearing pressure of 1000 kPa. For piled foundations, an allowable adhesion value of 100 kPa may be adopted for the portion of the shaft within the weathered sandstone.

In order for us to provide higher foundation design values, rock coring will be required preferably following demolition drilled to minimum 2.0m below final bulk excavation levels to determine the quality of bedrock and optimise foundation design.

To ensure the bearing values given can be achieved, care should be taken to ensure the base of the excavations is free of all loose material prior to concreting. To this end, it is recommended that all excavations be concreted as soon as possible, preferably immediately after excavating, cleaning, inspecting and approval.

During foundation construction, should the subsurface conditions vary to those inferred in this report, a suitably experienced geotechnical engineer should review the design and recommendations given above to determine if any alterations are required.

6. ACID SULFATE SOIL ASSESSMENT

6.1. Introduction

ASS is the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. Natural processes formed most acid sulfate

sediments when certain conditions existed in the Holocene geological period (the last 10,000 years). Formation conditions require the presence of iron-rich sediments, sulfate (usually from seawater), removal of reaction products such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful supply of organic matter. It should be noted that these conditions exist in mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes.

The relatively specific conditions under which acid sulfate soils are formed usually limit their occurrence to low lying parts of coastal floodplains, rivers and creeks. This includes areas with saline or brackish water such as deltas, coastal flats, backswamps and seasonal or permanent freshwater swamps that were formerly brackish. Due to flooding and stormwater erosion, these sulfidic sediments may continue to be re-distributed through the sands and sediments of the estuarine floodplain region. Sulfidic sediment may be found at any depth in suitable coastal sediments – usually beneath the water table.

Any lowering in the water table that covers and protects potential ASS will result in their aeration and the exposure of iron sulfide sediments to oxygen. The lowering in the water table can occur naturally due to seasonal fluctuations and drought or any human intervention, when carrying out any excavations during site development. Potential ASS can also be the exposed to air during physical disturbance with the material at the disturbance face, as well as the extracted material, both potentially being oxidised. The oxidation of iron sulfide sediments in potential ASS results in ASS soils.

Successful management of areas with ASS is possible but must consider the specific nature of the site and the environmental consequences of development. While it is preferable that sites exhibiting acid sulfate characteristics are not disturbed, management techniques have been devised to minimise and manage impacts in certain circumstances.

When works involving the disturbance of soil or the change of groundwater levels are proposed in coastal areas, a preliminary assessment should be undertaken to determine whether acid sulfate soils are present and if the proposed works are likely to disturb these soils.

6.2. Presence of ASS

Reference to the the ASS Risk Map Soil Risk Mapping (eSPADEv2.2) indicates the property is within an area where there are no known occurrences of ASS. It should be noted that maps are a guide only.

The following geomorphic or site criteria are normally used to determine if acid sulfate soils are likely to be present:

- sediments of recent geological age (Holocene)
- soil horizons less than 5 in AHD

- marine or estuarine sediments and tidal lakes
- in coastal wetlands or back swamp areas

6.3. Assessment

The proposed development has a surface elevation of approximately RL >8 m AHD (based on survey plan provided) with a shallow depth to rock. This not consistent with the geomorphic criteria necessary for the presence of ASS. No groundwater was observed during the fieldwork. Therefore, site development is extremely unlikely to result in the lowering of the groundwater where nearby ASS may be present. Therefore, the proposed works will not result in exposure of ASS allowing oxidation to take place and resulting in the development of acidic conditions. Based on our onsite observations, it is our opinion that the proposed construction will not intercept any ASS in the area nor cause lowering of any groundwater.

Our assessment is the proposed construction will not require the preparation of an Acid Sulfate Soil Management Plan.

7. FINAL COMMENTS

It is our preliminary assessment that the site is considered suitable provided (1) excavation methodologies are carried out, (2) all slopes are retained by engineered retaining walls or excavation faces are inspected by an experienced geotechnical engineer and (3) all footings are designed as per the recommendations outlined in this report subjected to a detailed geotechnical investigation.

We recommend the following additional geotechnical work be undertaken as follows;

- Review of the assessment and recommendations presented in this report following availability of further details of the proposed works, and updating as required as a separate engagement;
- Vibration Monitoring;
- Additional Geotechnical Investigation in the form of cored boreholes to confirm the subsurface conditions, including the depth and quality of the sandstone bedrock across the site. This is to ensure that the design reflects the actual subsurface conditions on the site. In this regard, cored boreholes will most likely be required. A minimum of two (2), preferably four (4) boreholes are recommended for this site.
- Aggressivity testing for buried concrete and steel structures;
- If directed by Sydney Water or any asset owner, carry out numerical impact assessment or specialist engineering assessment, further geotechnical monitoring installs and/or subsequent monitoring;
- Geotechnical inspection of unsupported excavations in the sandstone bedrock;

- Geotechnical Inspections of the exposed bearing surfaces for footings by an experienced geotechnical professional to verify the founding material and ensure the allowable pressure given has been achieved; and
- Ongoing monitoring of groundwater inflows into the bulk excavation;

We recommend that a meeting be held after initial structural design has been completed to confirm that our recommendations have been correctly interpreted. We also recommend a meeting at the commencement of construction to discuss the primary geotechnical issues and inspection requirements.

During construction, should the subsurface conditions vary from those inferred above, we would be contacted to determine if any changes should be made to our recommendations.

Yours faithfully,

Mrigesh Tamang
MIE Aust, CPEng, NER, APEC Engineer, IntPE(Aust)
Senior Geotechnical Engineer/ Manager
STS Geotechnics Pty Limited

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Borehole and Penetrometer Locations

Client:	Ming and Lin Wang	**Project No.**	33121/9986D-G	**Date:**	July 2025
Site Address:	2 Monash Crescent, Clontarf	**Drawing No.**	25/1912	**Scale:**	Unknown
Work:	Geotechnical Investigation	**Revision No.**	0		

Important Information

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INTRODUCTION

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report. When copies of reports are made, they should be reproduced in full.

GEOTECHNICAL REPORTS

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by STS Geotechnics Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, STS Geotechnics Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

UNFORSEEN CONDITIONS

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, STS Geotechnics Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

SUBSURFACE CONDITIONS

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

SUPPLY OF GETEOECHNICAL INFORMATION OR TENDERING PURPOSES

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.