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Integrated Practical Solutions

Acid Sulfate Soil Management Plan

Proposed School Upgrades
Narrabeen Education Precinct
Namona Street, Narrabeen

Prepared for
NSW Department of Education

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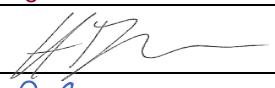
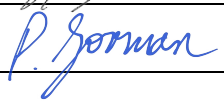
Author		17 August 2022
Reviewer		17 August 2022

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1. Introduction

Douglas Partners Pty Ltd (DP) was engaged by Johnstaff Projects Pty Ltd on behalf of the NSW Department of Education to complete this Acid Sulfate Soil Management Plan (ASSMP) in relation to the proposed school upgrades work at Narrabeen Education Precinct, Namona Street, Narrabeen (the site). The report was prepared in general accordance with DP's proposal 86973.04.P.003.Rev1 dated 23 June 2022.

Narrabeen Education Precinct comprises Narrabeen North Public School (NNPS) and Narrabeen Sports High School (NSHS). The area subject to this ASSMP is defined by the investigation areas (herein referred to as the proposed work areas) associated with the detailed site investigation (DSI) previously conducted by DP (2022)[1], and is shown on Drawings 1 to 3, Appendix A.

Previous investigations have identified acid sulfate soils (ASS) within the site (and hence the proposed works areas) as reported in DP (2020)[2] and DP (2022). These investigations identified that potential acid sulfate soil (PASS) are unlikely to be at NNPS at depths less than 2.5 m below ground level (bgl) although are likely to be present in the deeper natural soils at NNPS, whilst PASS is expected to be encountered at depths of approximately 1.5 m bgl or greater on NSHS. Given that the proposed works require disturbance of soils below these depths (e.g., piling for new buildings) an ASSMP was recommended (i.e., this ASSMP).

This ASSMP has been prepared with reference to the Acid Sulfate Soils Management Advisory Committee (ASSMAC), *Acid Sulfate Soils Manual,* 1998 and other guidance (refer to Section 4) and describes the proposed development, potential off-site impacts, responsibilities, and operational requirements. This ASSMP also outlines for consideration additional investigations to further inform treatment requirements (e.g., presence / absence of ASS, liming rate, etc.).

It is noted that this ASSMP only applies to where subsurface works will encounter, or potentially encounter ASS (including PASS). Given detailed design of the works is still to be completed, final determination of these areas and works is still to be finalised. Where unsure if the final works will encounter ASS requiring management, advice is to be sought from an appropriately experienced environmental consultant.

This ASSMP must be read in conjunction with the notes provided in Appendix B and other explanatory information and should be kept in its entirety without separation of individual pages or sections.

[1] DP, '*Report on Detailed Site Investigation (Contamination), School Upgrades – Proposed Works, Narrabeen Education Precinct, Namona Street, Narrabeen'*, DP ref: 86973.04.R.002.Rev0 dated 15 August 2022 (DP, 2022).
[2] DP, *'Report on Preliminary Site (Contamination) Investigation with Limited Sampling, Narrabeen Education Precinct, Namona Street, North Narrabeen',* dated April 2020, DP reference: 86973.01.R.001.Rev0 (DP, 2020).

2. Site Identification and Proposed Works

The proposed work area is defined by the investigation area subject to DP (2022) within NNPS and NSHS, Namona Street, Narrabeen (refer to Drawings 1 to 3, Appendix A). ASS mapping indicates that the proposed work area is located within an area of high probability of ASS occurrence below 1-3 m depth.

Narrabeen North Public School

The proposed works at NNPS comprise:

- Demolition of Building H, Building J and the amphitheatre;
- Removal of some trees;
- Removal of some existing demountable classrooms;
- Upgrade works to Building B (double bini-shell) for use as library including heritage conservation and restoration works;
- Refurbishment of Building K and the ground floor of Building V;
- Construction of two new buildings, namely:
  - A two storey building used for general learning spaces; and
  - A two storey building containing administration facilities, multi-purpose hall and out-of-school-hours care facilities on the ground floor with associated covered outdoor leaning area and staff facilities and amenities on the first floor. A covered outdoor leaning area (COLA) will be extending to the east will form part of these works.
- Upgrades to hard and soft landscaping including new pedestrian entry ramps.

Narrabeen Sports High School

The proposed works at NSHS comprise:

- Removal of two trees;
- Refurbishment and upgrades to Buildings A, C and K including conversion of Building K into new learning spaces;
- Construction of a two storey addition / extension to Building A containing new stage for the gymnasium and male and female change rooms on the ground floor and general learning spaces on the first floor; and
- Upgrades to hard and soft landscaping.

Foundation types for the three new two storey buildings are still to be determined as part of the final design documentation. The structural engineer has indicated that whilst pile design is to be determined by a specialist piling contractor, indicative pile depths may be in the order of 5 m bgl, with strip footings for these and smaller buildings of around 0.5 m depth.

It is noted that excavation depths for services, etc. or final earthworks levels were not available at the time of reporting and hence it was not possible to determine whether these works would likely encounter ASS. Notwithstanding, given the indicative pile depths it is anticipated that ASS will be encountered on NSHS whilst NNPS will require further investigation below 2.5 m to determine if works will encounter ASS as part of the final works (further information on this based on previous investigations is discussed in Section 3, with previous results included in Appendix C).

3. Summary of ASS at the Site

3.1 Background on ASS

ASS are naturally occurring sediments that contain iron sulphides, primarily pyrite, commonly deposited in estuarine environments. The occurrence of ASS is associated with areas or regions that have previously been or are currently estuarine environments. Due to changes in sea level or geomorphologic changes to coastal systems, these sediments are often overlain by terrestrial sediments.

When ASS are exposed to air (e.g., due to bulk excavation, piling or dewatering), the oxygen reacts with iron sulphides in the sediment, producing sulphuric acid. This acid can be produced in large quantities and is highly mobile in water. The sulphuric acid can drain into waterways causing severe short and long term socio-economic and environmental impacts, including damage to man-made structures and natural ecosystems.

ASS can also affect human health, including eye irritation and dermatitis from short term exposure of sensitive individuals. Long term exposure to untreated ASS and mobilised heavy metals can have more severe effects on some individuals.

ASS can either be classified as ‘actual acid sulphate soils’ (AASS) which are soils that have already reacted with oxygen to produce acid, or PASS. PASS are soils containing iron sulphide that have not been exposed to oxygen (e.g., soils below the water table). PASS therefore, have not produced sulphuric acid, but have the potential to do so if exposure to oxygen occurs. For the purposes of this report the term PASS is only used for soils which meet the requirements of EPA *Waste Classification Guidelines* (2014) Part 4 as summarised in Appendix D.

ASS field and laboratory based Action Criteria for determining if material is classified as PASS / AASS is provided in Section D2, Appendix D.

3.2 ASS Results for the Proposed Work Areas, DP (2020) and DP (2022)

DP conducted a PSI and DSI at the site, including a preliminary waste classification assessment and ASS assessment. The results of the DSI are presented in DP (2022) which incorporates a summary of the PSI (DP, 2020) results.

As part of the DSI works, samples were collected from six of the test locations within the investigation area at NNPS and one of the test locations within the investigation area at NSHS for ASS screening purposes. Moreover, selected samples were analysed for ASS as part of the PSI (DP, 2020), of which three locations (two at NNPS and one at NSHS) fell within the DSI investigation areas and were incorporated into the assessment. Samples recovered as part of the DSI were taken from a maximum depth of 2.6 m and samples taken as part of the PSI were taken from a maximum depth of 8 m.

The initial screening results indicated a potential for ASS to be present in the screened soil samples and chromium reducible sulfur (SCr) analysis was subsequently undertaken on six soil samples that were selected to delineate an interface between ASS and non-ASS. The analytical results showed that ASS was generally recorded in samples deeper than 1.5 m at NSHS, and ASS was not encountered within the upper 2.5 m at NNPS.

The analytical results relating to ASS from the proposed works areas sourced from DP (2022) are presented in Appendix C along with the test pit and borehole logs from DP (2020) and DP (2022).

Groundwater was observed at NNPS in TP1001A and TP1008 at 1.4 m and 2.1 m bgl respectively. Groundwater was observed at most locations within NSHS at depths of between 0.7 m and 1.8 m bgl. It is noted that precipitation events occurred prior to and during the course of the fieldwork. Moreover, groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

The results of the investigations suggested that:

- PASS is unlikely to be encountered at depths of less than 2.5 m at NNPS but is likely to be present beyond the depth. In this regard, it is likely that PASS is present in the deeper layers of natural soils, particularly the indurated sand; and
- PASS are likely to be encountered at NSHS at depths of approximately 1.5 m or greater. Moreover, the potential for PASS at NSHS appears to reduce in the deeper soil profiles (i.e., around 4- 8 m bgl).

Based on the analytical results, DP (2022) provided the following recommendations:

- Additional ASS assessment may be required for the new NNPS buildings depending on the final depth and nature of works; and
- An ASSMP (i.e., this report) should be developed to detail the requirements for further testing, management and disposal of the ASS excavated from the site.

Based on a pile depth in the order of 5 m (i.e., below 2.5 m bgl) the additional investigations for NNPS will be required (refer to Section 6).

It is noted that additional samples were collected across the site as part of the aforementioned previous investigations which indicated similar results to those from the investigation/proposed works areas.

3.3 Waste Classification Results for the Proposed Work Areas (DP, 2022)

On the basis of the observations at the time of sampling, the reported analytical results and results from DP (2020), DP (2022) reported that the soils at the sample locations within the proposed work areas, as shown on Drawings 1 to 3, Appendix A, are preliminary classified as follows:

- NNPS:
  - The central, western and northern sections of the proposed works area (i.e., the area west of BH07 and BH09) are preliminary classified as general solid waste (non-putrescible) special waste (asbestos);
  - Fill around BH1016/0-0.2 is preliminary classified as general solid waste (non-putrescible) scheduled waste;
  - Fill in the eastern section of the proposed work area (i.e., the area east of BH09 and excluding BH1016) is preliminarily classified as general solid waste (non-putrescible); and
  - The natural soils within the upper 2.5 m across the proposed work area are preliminarily classified as general solid waste (non-putrescible). The deeper natural soils may also be classifiable as ASS, although further assessment of this would be required once the final scope / depth of the works are established (refer to Section 6).
- NSHS:
  - Fill and natural soils above 1.5 m bgl within the investigation area[3] are preliminarily classified as general solid waste (non-putrescible); and
  - The natural soils below 1.5 m bgl within the investigation area are preliminarily classified as general solid waste (non-putrescible) ASS.

Reference should be made to DP (2022) and EPA (2014) for further information on waste classification requirements. Given the presence of asbestos in some areas identified in DP (2022), consideration should be given to the excavation, segregation and handling of ASS and asbestos impacted soils. It is noted that handling of asbestos impacted ASS can potentially have significant costs and/or additional stockpile management considerations relative to handling these materials separately.

4. Guidelines

This ASSMP is devised on the basis of the following guidelines endorsed by EPA and with reference to other national guidelines where considered appropriate:

- Acid Sulphate Soils Management Advisory Committee (ASSMAC) *Acid Sulphate Soils Management Guidelines* (1998) (Stone, Ahern, & Blunden, 1998);
- NSW Environment Protection Authority (EPA) *Waste Classification Guidelines* (2014) (NSW EPA, 2014);

[3] This is limited to the proposed addition/extension to Building A (i.e., the proposed works area) and excludes all previously proposed upgrade works at the site given they are no longer proposed. Fill in some of these other areas of the school would be preliminary classified as general solid waste (non-putrescible) special waste (asbestos).

- NSW Roads and Traffic Authority (RTA) *Technical Guideline: Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze* (NSW RTA, 2005); and
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G 2018, *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Identification and Laboratory Methods Manual*, Department of Agriculture and Water Resources, Canberra, ACT. CC BY 4.0 (Sullivan et al 2018).

5. Management Options and Proposed Management Strategies

5.1 Application of ASS Management

The ASS investigation reported in DP (2022) indicated that ASS are likely to be present in the soils across the site although at varying depths at NNPS compared to NSHS. This includes ASS in shallow soils at NSHS. This ASSMP therefore applies to all soils beyond 2.5 m bgl at NNPS and 1 m bgl at NSHS, to be disturbed as part of the proposed works, unless otherwise confirmed by additional sampling and laboratory analysis (where appropriate) not to be ASS. Soils shallower than these depths are not subject to the ASSMP unless field indicators of potential ASS are found during the course of excavations.

5.2 Management Options

ASSMAC (1998) provides the following potential management options:

- Non-excavation or minimal earthworks;
- On-site treatment, followed by off-site disposal;
- On-site treatment, followed by on-site re-use;
- Off-site treatment and disposal;
- On-site reburial without treatment (PASS only);
- Off-site reburial without treatment (PASS only); and
- Separation of ASS fines.

Based on the proposed works and correspondence with Johnstaff Projects Pty Ltd, DP understands that a preferred approach has not yet been finalised. For this reason, ASS management options have been provided both for off-site disposal and on-site retention to provide flexibility following the submission of this report. It is noted that contamination, geotechnical and/or other considerations may be required should an on-site retention/reuse approach be considered.

For all management strategies dust should be kept to a minimum, and long sleeves, pants and gloves should be worn by workers in direct contact with untreated ASS.

6. Further Assessment at NNPS

Given the potential to encounter ASS at depths below 2.5 m on NNPS (and generally increases in probability with depth) and that pile foundations may be in the order of 5 m (to be confirmed), additional ASS investigations are recommended to be undertaken to assess the need for ASS management of these disturbed soils.

The additional investigation is best undertaken post finalisation of design features which confirm the depths of soils disturbance below 2.5 m bgl (e.g., pile depth, excavation of deeper service trenches if required, etc.). Based on DP's understanding of the proposed works, it is anticipated that works below 2.5 m bgl will be within or adjacent to the proposed building footprints.

On this basis additional works are to comprise:

- Investigations to at least 0.5 m below the final depth of soil disturbance (i.e., pile depth, service trench excavation);
- A minimum of four boreholes are to be drilled in the footprint of the proposed buildings. Additional locations may be required (e.g. ,along service trench alignment(s) outside the building footprints) if determined to be required by the environmental consultant:
- Collection of samples at regular intervals (i.e., approximately 0.5-1 m intervals);
- Screening of samples for indication on the potential presence of ASS;
- Laboratory analysis (e.g., SCr) of selected samples based on the screening results and to provide delineation through the subsurface profile (both vertically and laterally); and
- Assessment report which determines the presence / absence of ASS within the range to be disturbed by the works and if ASS management of disturbed soils is required.

It is noted that if additional investigations are not undertaken, the soils below 2.5 m bgl are to be assumed to be ASS and managed in accordance with this ASSMP. Given the potential to be implementing additional management requirements when not required, DP does not recommend this approach.

7. ASS Management

The management requirements for this plan are detailed in this section and the following sections. On site neutralisation, management, monitoring and verification of ASS should be undertaken as required using the methodology given below.

7.1 On-Site Treatment

7.1.1 Treatment Process for Soils

The general process for the treatment of ASS is as follows:

- Prepare a treatment pad as described in Section 7.1.3. Manage ASS during stockpiling and treatment to minimise dust and leachate generation (e.g., by covering, or lightly conditioning with water). If wet weather prevails, stop works and cover the stockpiled material with plastic sheeting to reduce the formation of leachate;
- Excavate, transport and stockpile ASS material to the treatment area in sealed trucks (or other plant as appropriate);
- Spread the ASS material onto the guard layer in layers of up to 0.3 m thick, leaving a 1 m flat area between the toe of the spread soil and the containment bund or drain. When spreading the first soil layer, care should be taken not to churn up the lime guard layer;
- If using a skip bin, spread the ASS into the bin in layers of up to 0.3 m thick, taking care not to churn up the lime guard layer;
- Let the ASS dry to facilitate lime mixing (if too wet, then adequate mixing of lime cannot be achieved). This may be assisted by stockpiling prior to spreading over the treatment area(s);
- Apply ag lime to the stockpiled soil (refer to Section 7.1.2 and Appendix E for treatment rate information) over each spread layer and harrow / mix thoroughly prior to spreading the next layer. Use of a rotary plough equipment (e.g., auger bucket) should be considered to assist with achieving a consistent mix of lime in the soil. Take care not to excavate into the lining of the treatment pad;
- Assess the success of the treatment using verification testing in accordance with Section 8. Samples should be collected with the assistance of plant to ensure sampling characterises the full depth of material in the treated layer. The verification testing has two components: field screening and laboratory analysis. Laboratory analysis is to be undertaken after the field screening results have passed;
- If field screening results indicate that additional neutralisation is required, add additional lime and mix;
- Once field screening results have passed, an additional layer(s) of ASS can be added and treated as long as a methodology exists for treating any underlying layer that fails the laboratory testing;
- When verification testing indicates that lime neutralisation is complete, then the stockpiled soil may be removed from the treatment pad, or left on the pad for additional soil to be treated on (as required);
- Continue the spreading / liming / mixing cycle until excavation and stockpiling of ASS is finished. This can be done one layer at a time, or with multiple ASS layers placed on top of each other;

- When verification testing indicates that lime neutralisation is complete, then the soil may be removed from the treatment area and disposed off-site to a suitable facility or reused on site subject to its suitability from both a contamination and geotechnical perspective; and
- Management of water as per Section 9.

7.1.2 Liming Rate

Based on the results of DP (2020) and DP (2022), the liming rates calculated by the laboratory ranged between <0.75 and 8.3 kg$CaCO_3$/t when ANC is excluded and also between <0.75 and 8.3 kg$CaCO_3$/t when ANC is included. These rates provide a general indication of the required liming rates given the variation in the soil. Further testing of the material once stockpiled can confirm the required liming rate. Alternatively, depending on the quantity of soil, a worst-case liming rate based on the current laboratory results may be adopted as an initial approach (with confirmation on the suitability of the liming rate applied required by validation testing).

Reference should be made to Appendix E for the equations for calculation liming rates.

7.1.3 Neutralisation Pads and Treatment of Soils

On-site treatment can be undertaken on a prepared treatment pad, with a leachate collection system. These need to be of sufficient size and capacity to allow treatment of the required volumes of soil in the required time frames, with an allowance for some “batches” of treated soil not meeting the required neutralisation criteria and requiring additional treatment.

The key features of the treatment area and design considerations are summarised below and shown in Figure 1 below:

- **Treatment pad area** - The treatment pad should be of an appropriate area for the volume of soil to be treated/stored, and should be prepared on relatively level or gently sloping ground to minimise the risk of potential instability issues, with a fall to the local drainage sump;
- **Pad location** - The pad should be located as far as practical from any potential ecological receptors (such as drainage lines, creeks) or the stormwater system;
- **Lining** - An approved compacted clay layer (at least two layers to a combined compacted thickness of 0.5 m) or an approved geosynthetic liner (such as HDPE sheeting) should be used to line the pad. If the hardstand concrete (or suitably sealed asphalt surface) is utilised as a treatment pad, then no lining would be required subject to initial inspection confirming it is in good condition;
- **Guard Layer** - A guard layer of fine agricultural lime (‘ag lime’) is to be applied over the pad to neutralise downward seepage at a rate of 20% of the liming rate per 1 m^2 and for every 1 m height of the stockpile. The guard layer should be re-applied following removal of treated soils and prior to addition of untreated ASS.

  NOTE: If the stockpiled soils on the treatment pad are expected to be greater than 3 m in height, it is recommended that the guard layer be applied as a base guard layer, with interim guard layers through the height of the stockpile; and

- **Bunded** - The treatment pad should be bunded to contain and collect potential leachate runoff within the treatment pad area and to prevent surface water from entering the treatment pad. The inner bund slopes should be lined to prevent leachate seeping into the ground surface, and sized to prevent overflow of untreated leachate onto the site.

Figure 1 below, shows a cross section of a typical treatment pad, should a pad be used.

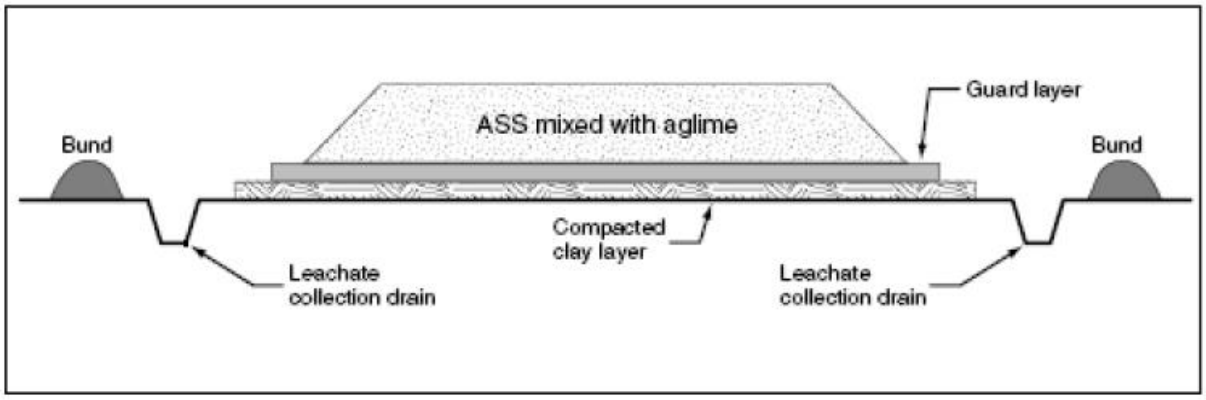


Figure 1: Schematic cross-section of a treatment pad, including clay layer (or hardstand concrete layer), guard layer, leachate collection system and containment with bunding.

Whilst it is standard practice to construct treatment areas for ASS, consideration may be given to the temporary storage and/or treatment of ASS during early or late works to take place in small manageable batches, as follows:

- Place manageable volumes in a sealed container such as a lined metal skip bin;
- HDPE sheet liner to line the bin;
- Application of a 0.3 m thick ag lime guard layer dispersed over the bottom of the bin liner; and
- Plastic covering over the material pile to cover from wind and rain.

It is anticipated that due to the scale of the proposed works, this treatment system would only be suitable for minor works typically associated with early or late works or possibly for the NSHS Building A extension works (depending on the expected volume of spoil to be generated).

7.2 Neutralisation Materials for Soils

Agricultural lime, commonly known as ag lime, is the preferred neutralisation material for the management of ASS, as this material is usually the cheapest and most readily available product for acid neutralisation. Furthermore, ag lime is slightly alkaline (pH of 8.5 to 9), non-corrosive, of low solubility and does not present handling problems. Ag lime comprises calcium carbonate ($CaCO_3$), typically made from limestone that has been finely ground and sieved to a fine powder.

Ag lime with the following properties is the preferred neutralising agent:

- Fine ground (particle size of at least <0.5 mm, and preferably <0.3 mm);
- At least 95% (but preferably 98% or more) calcium carbonate by weight;
- Neutralising value of at least 95%, but preferably equal to or greater than 98%;
- Produce alkalinity in the pH 7 to pH 9 range;
- Low solubility; and
- Dry.

Ag lime requires no special handling, however, it would be advisable to cover any ag lime stockpiles with plastic sheeting (e.g., tarpaulin) both to minimise wind erosion and wetting, as the material is more difficult to spread when wet.

Ag lime with a neutralising value (NV) of 95% to 98% is recommended. There could be economic justification for using a less pure grade of ag lime, however, this would require a higher application rate. Potential cost savings from using less pure material may be offset by the corresponding increase in required volumes, the transport and disposal costs.

Coarse grained calcite is not recommended, as one of the products of the neutralisation reaction is gypsum ($CaSO_4.2H_2O$) which has a relatively low solubility and tends to coat the reacting calcite grain, forming a partial barrier against further reaction.

Gypsum may also give off hydrogen sulphide in reaction with acidic conditions and can itself result in the generation of sulphuric acid.

Dolomitic ag lime, or magnesium blend ag lime, should not be used as these materials impose environmental risks from overdosing with the potential to damage estuarine ecosystems.

Due to its low solubility in water, ag lime is not suitable for the neutralisation of leachate, which requires a product with a very quick reaction and high solubility. The most suitable neutralising agent for leachate and retained drainage water is slaked lime or quicklime (calcium hydroxide). This is made by treating burnt lime (calcium oxide) with water (slaking) and comes as a fine white powder. It has a typical NV of about 135. Due to its very strong alkalinity (pH or about 12.5 to 13), slaked lime or quicklime should not be allowed to come into contact with the skin or be inhaled.

An alternative neutralising material can be used subject to prior approval by a suitably qualified scientist or engineer.

7.3 Off-Site Disposal of Soils

If treated or untreated material is to be disposed of offsite, assessment and material tracking will be undertaken in accordance with the requirements of the *Protection of the Environment Operations Act 1997* (POEO Act). Transport and disposal will be undertaken in accordance with *the Protection of the Environment Operations (Waste) Regulation 2014* (POEO Waste Regulation) and the EPA (2014).

All contractors transporting waste from site must be licenced to transport the classification of waste and must only dispose of the waste at a facility that is licenced to accept the waste classification.

7.4 On-Site Retention of Soils

Subject to conditions and verification testing outlined in section 7.1.1, treated soils may be retained and reused on site from an ASS perspective. Consideration should, however, be given to the suitability of these soils for on-site reuse from contamination, geotechnical and / or other perspectives. For example, soils which have not been segregated from asbestos impacted soils would also need to be managed in accordance with the remediation action plan or asbestos finds protocol for NNPS and NSHS respectively. [4]

7.5 Alternate Strategy or Contingency Plan

Where on-site treatment of ASS is not possible, off-site disposal under alternative management options are described in Appendices D and F.

8. Verification Testing of Treated Materials

The verification testing frequency of treated ASS is presented in Table 1 below. Appendix D outlines the adopted criteria to verify the success of the neutralisation treatment.

Table 1: Verification Testing Frequency

Test	Frequency
Field test: pHF and pHFox screening Laboratory analysis: SPOCAS / SCr Method (preferred)	Field test: • 3 samples per material type of treated soil; and • 5 samples per 100 m^3 of treated soil; and • 3 samples per treatment batch. Laboratory analysis: • 1 sample per material type of treated soil; and • 1 sample per 75 m^3 of treated soil; and • 2 samples per treatment batch.

The soil contained within the bunded treatment area should not be removed until the target values presented in Appendix D have been achieved.

[4] As recommended in DP (2022), these plans and protocols were still to be drafted at the time of writing.

It should be noted that laboratory tests will require a minimum of four days turnaround, possibly longer, and hence sufficient time should be allowed in the treatment programme for such verification testing. Only appropriately skilled staff should collect and test verification samples. In addition to normal regular supervision of the soil management process, it is suggested that formal inspections be undertaken.

9. Water and Groundwater Management

Water is the main mechanism by which acid and metals from oxidised ASS are mobilised and transported. Careful management of water is therefore paramount to effective management of potential adverse impacts from ASS. Management is required to provide control of treated waters for discharge, and provides some margin for unattended weekend or holiday periods as well as heavy rain periods.

It is currently unclear if groundwater will be encountered during excavation works (more likely on NSHS) although it is likely to be encountered during piling. It is understood dewatering is not proposed as part of these works. The presence of ASS on-site potentially impact upon the groundwater and surface water, requiring treatment.

All water which has come into contact with ASS requires assessment prior to off-site disposal. The screening criteria and water monitoring frequencies required for stormwater disposal are to be confirmed by Council.

In addition, the pH of all ponded drainage water around the confines of the treatment bunds should be measured daily and results assessed against the criteria provided in Appendix D.

The below sections provide general strategies for management, assessment and disposal of water leaching from stockpiled ASS, or required to be managed to facilitate the proposed works.

Further advice is to be sought from the environmental consultant information for managing water impacted by ASS as and when required.

9.1 Leachate and Surface Water Collection

All water that has been in contact with ASS / assumed ASS, and is not part of the general creek flow, must be managed, assessed, treated and appropriately disposed off-site.

9.2 Water Storage and Treatment

Water from ASS leachate will be stored in a tank or lined drains / detention basin.

As a minimum, the combined storage should be designed to store enough water to contain leachate and extracted water from a 1 in 10 year (1 hour) storm event.

9.3 Water Assessment for Disposal

Minimum recommended monitoring and testing of water to be managed is provided in Table 2, below.

Table 2: Suggested Water Monitoring Frequencies and Target Levels for Water Disposal to Stormwater

Test	Frequency / Location	Target Level
pH	Water detention basin / tank (and treatment plant if applicable): • During storage / treatment as required to allow timely treatment; • Less than 24 hours prior to any planned discharge; • Daily during discharge period; and • For unplanned discharges (i.e., due to rain), within 5 days of the cessation of the rainfall event.	• pH 6.5 to 8.5
Total Suspended Solids (TSS)		• ≤50 mg/L or equivalent turbidity measure (in NTU) where a statistical correlation between the TSS and turbidity has been determined
Oil and Grease		• None observable

Iron (total and soluble)	Water detention basin / tank (and treatment plant if applicable):
	• Visual Assessment:
	  • Daily during discharge.
	• Laboratory Analysis:
	  • Immediately prior to disposal; and
	  • Weekly checks during discharge period; and
	  • As required based on visual observations.
		• No obvious sign of iron staining / settlement
		• ≤0.3 mg/L filterable iron

Metals (aluminium, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, zinc)	Water detention basin / tank (and treatment plant if applicable):
	• Laboratory Analysis
	  • One round of testing before first disposal of impacted water; and
	  • If first round of testing exceeds target levels, then further testing prior to disposal is required.
	  • As required based on visual observations.
		• ANZG (2018) Trigger Levels for 95% Level of Protection for marine water ecosystems if no conditions are available.

Note: Target levels indicative only. To be confirmed by stormwater asset manager (e.g., Council).

It should be noted that depending on the final construction approach, if only limited water is proposed to be generated, consideration may be given to disposing water via other means to minimise the need for on-site treatment (e.g., tankering to waste facility).

9.4 Treatment

The potential impacts of ASS on water generally comprise a decrease in pH, possible elevated TSS / turbidity, iron and other metals.

Treatment of water is commonly required for pH and TSS. Aeration and removal of TSS also generally decreases metal concentrations in the water.

If a suitable treatment method for man-made contaminants in the water to be disposed of (e.g., oil and grease or metals) cannot be implemented, an alternate disposal method may be required (e.g., to trucking off-site to a liquid waste disposal facility or disposal to sewer in accordance with a specific Trade Waste Agreement which would need to be obtained from Sydney Water).

If impacts to surface water within the creek are being experienced, consideration should be given to applying a light covering / dusting of the exposed soils with lime and supplemented with a regularly monitoring of the pH until levels return to baseline readings. Care should be undertaken not to overdose with lime, and hence a progressive application and monitoring approach should be implemented. Use of sediment controls and programming of works when creek water levels are lower should also assist with reducing the generation of suspended solids in the surface waters and the associated potential increase in mobility of contaminants.

9.5 Water Discharge

Water requiring off-site discharge should be disposed in accordance with the POEO Act, relevant guidelines, consents and licences. Consent for discharge should be obtained from the relevant authorities, where appropriate. The approval body for discharge into the stormwater system is Council. Once site water has been effectively treated and assessed to meet the discharge criteria, it can be discharged in accordance with the requirements of the development consent of the relevant consent authority.

10. General Site Monitoring

General site monitoring requirements pertinent to the ASS which should be implemented by responsible parties are provided in Table 3 below.

Table 3: General Monitoring Requirements

Task	Frequency	Standard	Reporting / Record Keeping	Responsibility
Site inspection	Daily	Visual (e.g., staining) / olfactory (e.g., sulfuric odours) signs of ASS	File note	Site supervisor
Monitoring of disturbed excavation areas that are in ASS	Daily	Visual until backfilled or for two days following completion of works.	File note	Site supervisor

Task	Frequency	Standard	Reporting / Record Keeping	Responsibility
Monitoring of ASS treatment area/s	Daily during treatment	Visual pH testing until results show ASS or leachate has been neutralised (refer Section 8 and Appendix D for criteria and testing requirements)	File note and results of pH testing to be recorded in field sheets	Site supervisor
Dewatering excavation in ASS (if undertaken, not currently proposed)	Prior to planned discharge	Treated and tested to demonstrate compliance with requirements prior to discharge.	Field sheets and site records	Site supervisor / environmental consultant

11. Emergency Incident Response Plan

Site work activities which may cause potential environmental threats are summarised in Table 4 below together with recommendations for “Emergency Response Procedures”.

Table 4: Emergency Response Procedures

Works	Potential Environmental Threat	Emergency Response
Excavations / Soils Disturbance	Impacts to groundwater / surface water due to release of elevated acid (via PASS oxidisation) from excavations on nearby environment.	• Inform site foreman and project manager / environmental officer; • Determine pH of groundwater / surface water in Mullet Creek (likely receptor); • Implement sediment controls down-gradient of impacted areas (as appropriate); • Applying light dosing of lime to exposed soils (refer to Sections 7.1, 7.2 and 9.4); • If appropriate (following consultation with the environmental consultant) drain pit to tanks for water quality treatment (including pH buffering) and assessment prior to discharge;

Works	Potential Environmental Threat	Emergency Response
Treatment / Neutralisation	Soil washes or slips outside of bunded treatment area	• Inform site foreman and project manager / environmental officer; • Estimate volume of material breeching bund; • Conduct pH analysis of adjacent water collection points (e.g., open trenches, stormwater pits, etc.) and correct pH if potentially impacted (if feasible); • Remove breeched soil into a bunded treatment area; and • Over-excavate impacted area to 0.2 m depth (where suitable), apply and mix lime at rate as for guard layers (refer to Sections 7.1 and 7.2).
	Breach in containment bund	• Inform site foreman and project manager / environmental officer; • Close breach in bund; and • Conduct pH analysis of adjacent water collection points (e.g., open trenches, stormwater pits, etc.) and correct pH if potentially impacted (if feasible).

For all site works where incidents which pose an environmental threat, an incident report must be completed in order that:

- The cause of the incident may be determined;
- Determine how the incident occurred;
- Additional control measures may be implemented; and
- Work procedures may be modified to reduce the likelihood of the incident re-occurring.

12. Reporting and Record Keeping

It is good practise for the contractor to maintain a record of treatment of ASS. Such record should include the following details:

- Date;
- Location / area;
- Time of excavation;
- Neutralisation process undertaken;
- Lime rate utilised;
- Results of monitoring;
- Assessment, treatment and management of groundwater;
- Disposal permits or authority;

- Disposal location(s) and times; and
- Tonnages and disposal / transfer dockets (if applicable).

A record should also be maintained confirming contingency measures and additional treatment if undertaken. A final report should be issued to the NSW Department of Education upon completion of the works presenting the monitoring regime and results and confirming that adverse environmental impact has not occurred during the works.

13. Conclusions

This ASSMP provides management methods and procedures to minimise the environmental impacts resulting from the disturbance of ASS during the creek maintenance works. It also provides recommendations for neutralisation and treatment methods for the ASS, verification testing requirements, groundwater management strategies and emergency response procedures.

On completion of the detailed design and development of construction approach, this plan should be reviewed and updated if required.

14. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Narrabeen Education Precinct, Namona Street, Narrabeen in accordance with DP's proposal dated 23 June 2022 and acceptance received from Johnstaff Projects Pty Ltd on behalf of NSW Department of Education. The work was carried out as a variation to the Standard Form Agreement SINSW02795/21 dated 7 April 2022 agreed between DP and NSW Department of Education. This report is provided for the exclusive use of NSW Department of Education 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 from previous investigations are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. 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.

The assessment of atypical safety hazards arising from this advice is restricted to the environmental 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.

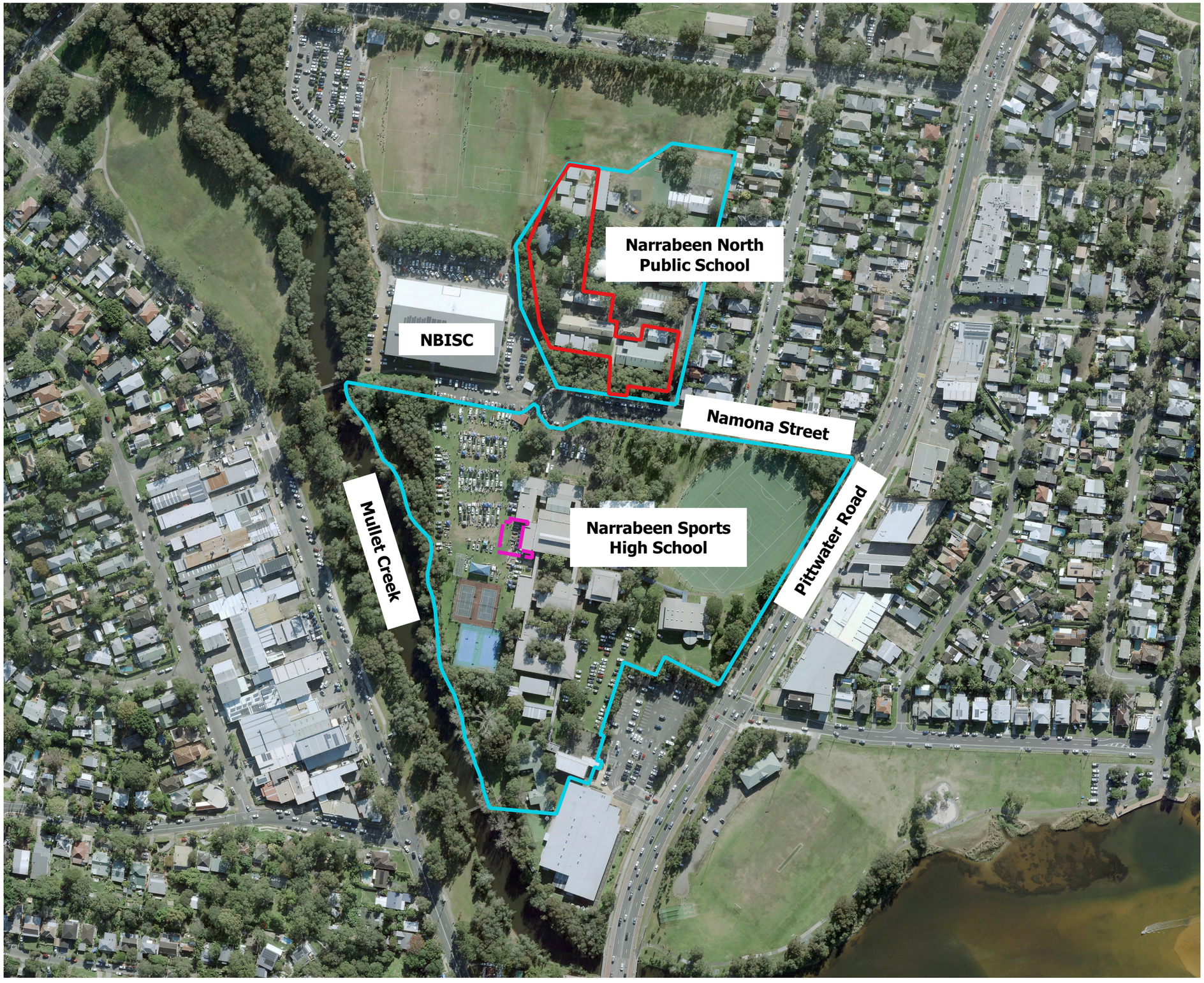
This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation,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

Douglas Partners Pty Ltd

Appendix A

Drawings



LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Boundaries shown are approximate only

Legend
- Site Boundaries
- NNPS Proposed Work Area
- NSHS Proposed Work Area

0 50 100 150 200 m

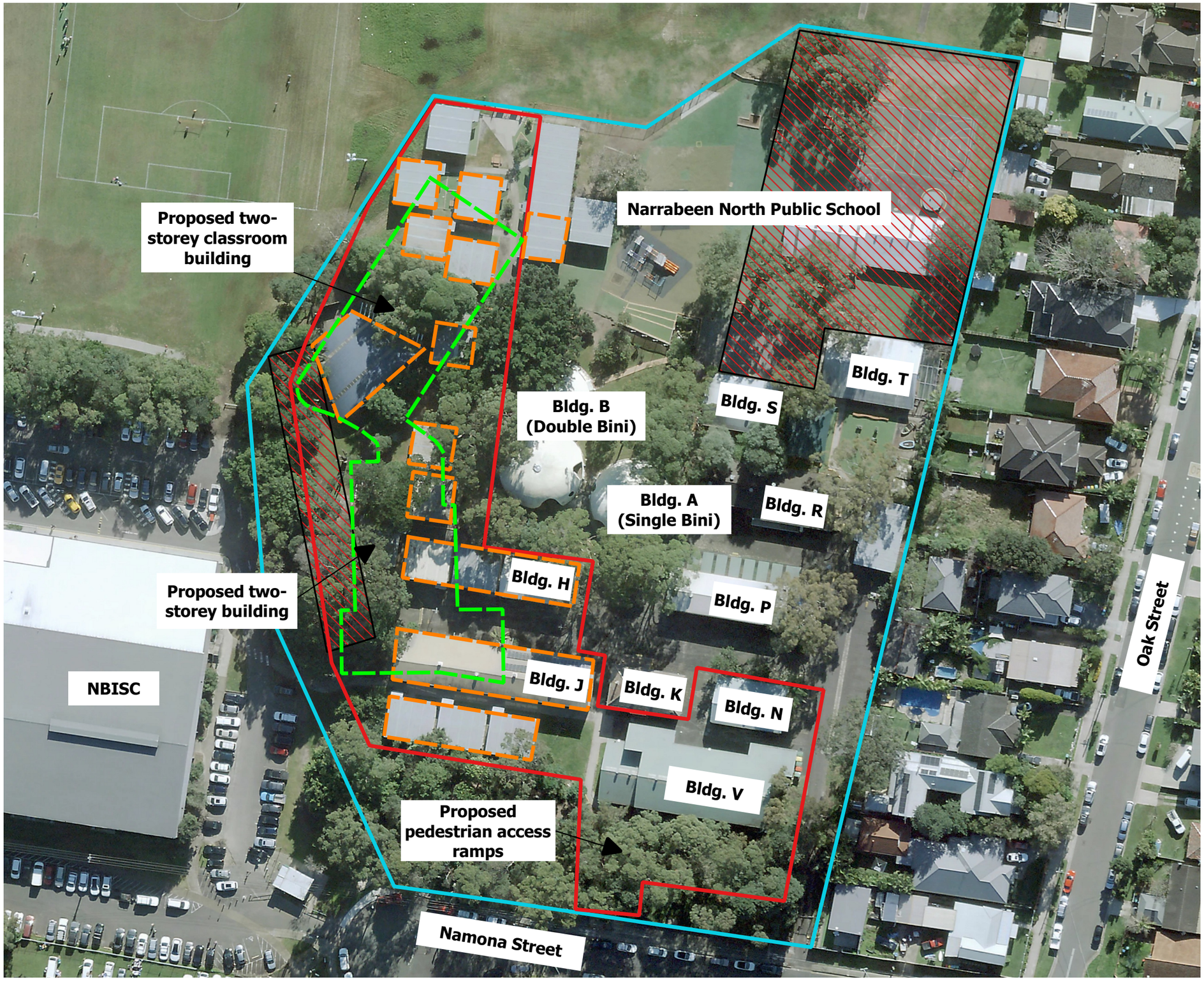
Douglas Partners
Geotechnics / Environment / Groundwater

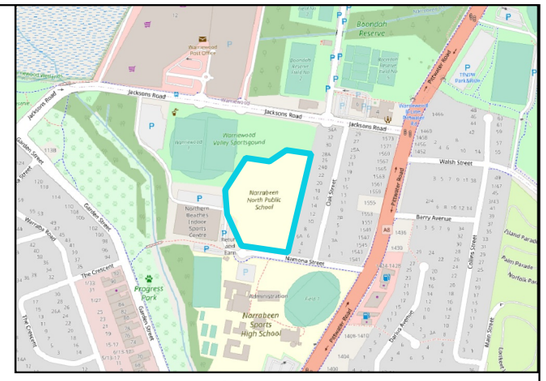
CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:3000 @ A3	DATE:	10.08.2022

TITLE: **Site Overview**
Narrabeen Education Precinct
Namona Street, North Narrabeen

N

PROJECT No:	86973.04
DRAWING No:	1
REVISION:	0





LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Boundaries shown are approximate only
4. NNPS AMP Asbestos Zones were sourced from Figure 1 of the AMP and are approximate only

Legend
- Narrabeen North Public School
- Proposed Work Area
- NNPS AMP Asbestos Zones
- Buildings Proposed for Demolition
- Proposed Buildings

0 20 40 60 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:850 @ A3	DATE:	11.08.2022

TITLE: **Site Location Plan - Narrabeen North Public School**
Narrabeen Education Precinct
Namona Street, North Narrabeen

N

PROJECT No:	86973.04
DRAWING No:	2
REVISION:	0

LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Boundaries shown are approximate only

Legend
- Narrabeen Sports High School
- Proposed Work Area

0 20 40 60 80 m

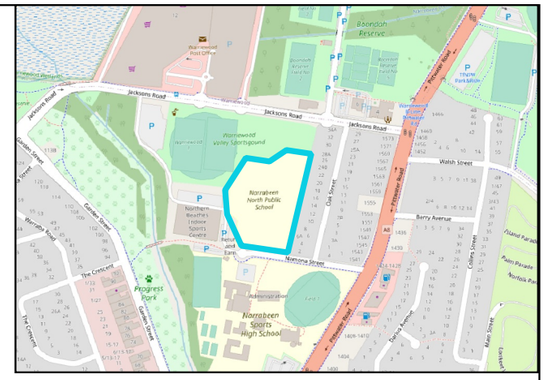
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:1500 @ A3	DATE:	10.08.2022

TITLE: **Site Location Plan - Narrabeen Sports High School**
Narrabeen Education Precinct
Namona Street, North Narrabeen

N

PROJECT No:	86973.04
DRAWING No:	3
REVISION:	0



LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Test locations and boundaries shown are approximate only
4. NNPS AMP Asbestos Zones were sourced from Figure 1 of the AMP and are approximate only
5. CPTs were also undertaken at some borehole locations
6. ASS samples taken from BH04, BH09, TP1001A, BH1004, TP1005, TP1008, BH1009 and TP1018

Legend

- Narrabeen North Public School
- Proposed Work Area
- NNPS AMP Asbestos Zones
- Buildings Proposed for Demolition
- Proposed Buildings

Test Locations (DP, 2022)

- Borehole
- Test Pit
- Surface Sample
- Fragment of Potential Asbestos Containing Material (PACM)

Previous Test Locations (DP, 2020)

- Groundwater Monitoring Well
- Borehole
- CPT Only

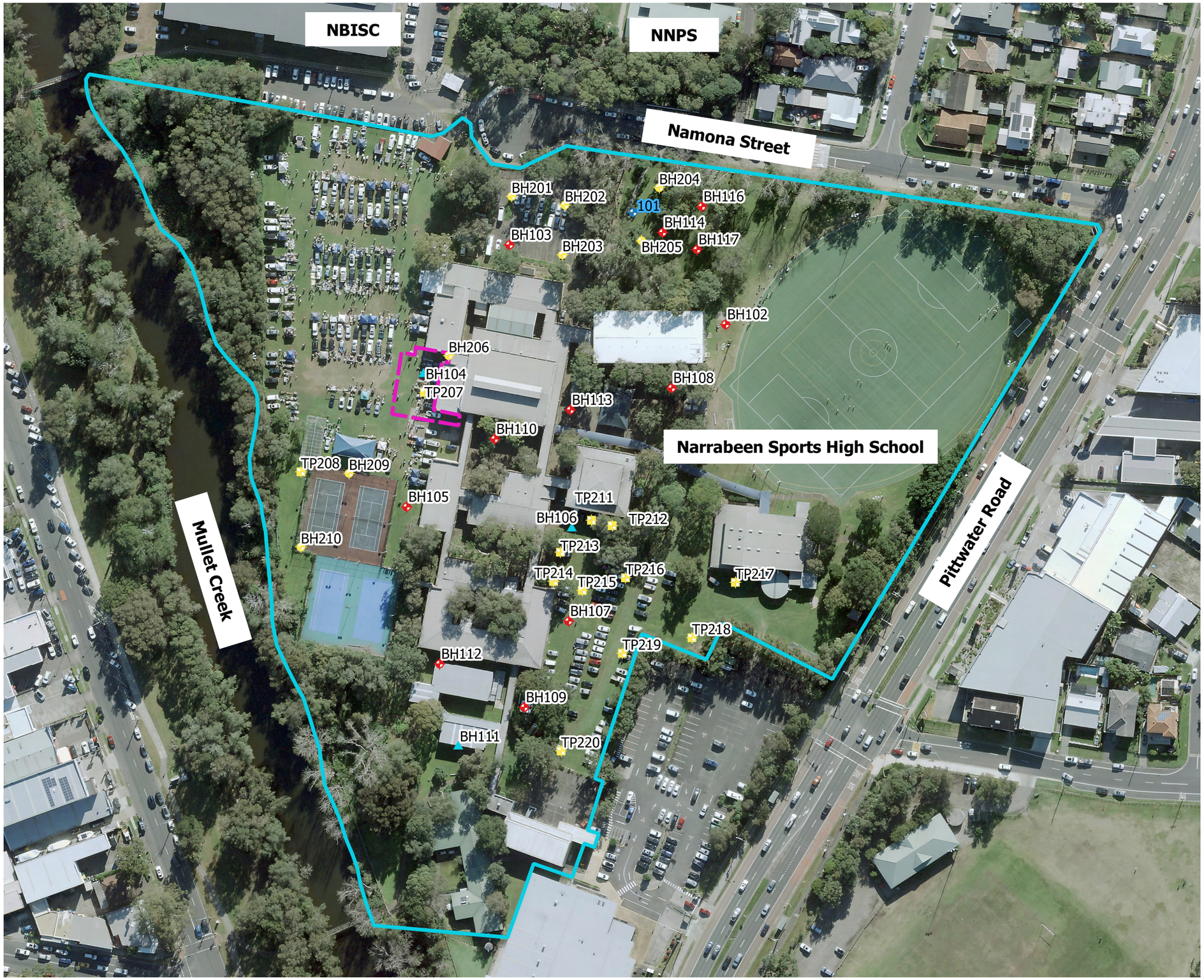
0 20 40 60 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:850 @ A3	DATE:	16.08.2022

TITLE: **Test Locations - Narrabeen North Public School**
Narrabeen Education Precinct
Namona Street, North Narrabeen

PROJECT No:	86973.04
DRAWING No:	4
REVISION:	0



LOCALITY MAP

Notes:
1. Basemap from metromap.com
2. Locality map from OSM Standard
3. Test locations and boundaries shown are approximate only
4. CPTs were also undertaken at some borehole locations
5. ASS samples taken from BH103, BH104, BH109, BH111, BH201, BH205, TP207, TP208, TP213, TP216, TP217, TP218 and TP219

Legend

- Narrabeen Sports High School
- Proposed Work Area

Test Locations (DP, 2022)

- Borehole
- Test Pit

Previous Test Locations (DP, 2020)

- Groundwater Monitoring Well
- Borehole
- CPT Only

0 20 40 60 80 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	NSW Department of Education		
OFFICE:	Sydney	DRAWN BY:	HD
SCALE:	1:1500 @ A3	DATE:	16.08.2022

TITLE: **Test Locations - Narrabeen Sports High School**
Narrabeen Education Precinct
Namona Street, North Narrabeen

N

PROJECT No:	86973.04
DRAWING No:	5
REVISION:	0

Appendix B

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 C

DP (2022) Summary of ASS Results and Logs

Douglas Partners
Geotechnics · Environment · Groundwater

Table H1C: Summary of Soil Laboratory Results - Acid Sulphate Soils - NNPS

Borehole / Test Pit ID	Depth (m)	Soil Description	Screening Tests[1]				Chromium Reducible Sulfur					
			pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	TAA[4] (%S)	S_{NAS}[6] (%S)	ANC[7] (%S)	Scr %S[8]	Net Acidity (%S)[9]
Assessment Criteria*			<4	<3	-	>1	-	-	-	-	>0.03	
Current Investigation												
TP1001A	0.8-0.9	Fill	7.5	4.9	Low reaction	**2.6**	-	-	-	-	-	-
TP1001A	1.3-1.4	SAND	6.7	5.4	Low reaction	**1.3**	-	-	-	-	-	-
TP1001A	1.8-1.9	SAND	6.3	4.8	Low reaction	**1.5**	5.3	0.02	-	-	0.005	0.020
TP1001A	2.2-2.3	SAND	6.2	4.7	Low reaction	**1.5**	5.3	<0.01	-	-	0.008	0.015
BH1004	0.8-0.9	SAND	8.0	5.8	Low reaction	**2.2**	-	-	-	-	-	-
BH1004	1.3-1.4	SAND	5.4	6.3	Low reaction	-0.9	-	-	-	-	-	-
BH1004	1.8-1.9	SAND	5.6	4.4	Low reaction	**1.2**	-	-	-	-	-	-
BH1004	2.3-2.4	SAND	5.8	4.7	Low reaction	**1.1**	-	-	-	-	-	-
TP1005	0.5-0.6	SAND	4.6	4.6	Low reaction	0	-	-	-	-	-	-
TP1005	1-1.1	SAND	4.7	4.1	Low reaction	0.6	-	-	-	-	-	-
TP1005	1.5-1.6	SAND	4.8	4.3	Low reaction	0.5	-	-	-	-	-	-
TP1005	2-2.1	SAND	4.9	4.5	Low reaction	0.4	-	-	-	-	-	-
TP1008	0.5-0.6	SAND	4.9	3.6	Low reaction	**1.3**	-	-	-	-	-	-
TP1008	1-1.1	SAND	5.1	4.5	Medium reaction	0.6	-	-	-	-	-	-
TP1008	1.5-1.6	SAND	5.1	3.4	Medium reaction	**1.7**	-	-	-	-	-	-
TP1008	2-2.1	SAND	5.8	4.5	Medium reaction	**1.3**	-	-	-	-	-	-
TP1008	2.5-2.6	SAND	5.8	3.9	Medium reaction	**1.9**	-	-	-	-	-	-
BH1009	0.7-0.8	SAND	5.1	5.2	Low reaction	-0.1	-	-	-	-	-	-
BH1009	1.2-1.3	SAND	5.4	5.4	Low reaction	0	-	-	-	-	-	-
BH1009	1.8-1.9	SAND	5.3	5.4	Low reaction	-0.1	6.0	<0.01	-	-	0.006	0.0060
TP1018	0.5-0.6	SAND	5.6	4.3	Low reaction	**1.3**	-	-	-	-	-	-
TP1018	1-1.1	SAND	5.6	5.0	Low reaction	0.6	-	-	-	-	-	-
TP1018	1.5-1.6	SAND	5.3	3.9	Low reaction	**1.4**	-	-	-	-	-	-
TP1018	2-2.1	SAND	5.6	4.0	Low reaction	**1.6**	5.0	0.01	-	-	0.005	0.020
DP (2020)												
BH4	0.1-0.3	Fill	7.7	7.1	High reaction	0.6	-	-	-	-	-	-
BH4	0.9-1.0	SAND	8.1	6.1	Medium reaction	**2**	-	-	-	-	-	-
BH4	1.5-1.6	SAND	8.2	6.1	Medium reaction	**2.1**	6.5	<0.01	-	<0.05	0.02	0.02
BH4	2.4-2.5	SILTY SAND	6.3	5.3	Medium reaction	1	-	-	-	-	-	-
BH4	3.5-4.0	SILTY SAND	5.4	**3.1**	High reaction	**2.3**	-	-	-	-	-	-
BH4	4.5-5.0	SILTY SAND	6.2	**3.2**	High reaction	**3**	-	-	-	-	-	-
BH4	5.5-6.0	SILTY SAND	5.4	**2.7**	High reaction	**2.7**	-	-	-	-	-	-
BH4	6.5-7.0	SILTY SAND	5.5	**3**	High reaction	**2.5**	-	-	-	-	-	-
BH4	7.5-8.0	SILTY SAND	5.3	**2.9**	High reaction	**2.4**	5	0.01	-	<0.05	0.03	**0.044**
BH9	0.4-0.5	Fill	4	**2.9**	Low reaction	**1.1**	3.3	0.08	<0.005	<0.05	<0.005	**0.081**
BH9	0.9-1.0	SAND	4.4	4.3	Low reaction	0.1	-	-	-	-	-	-
BH9	1.4-1.5	SAND	4.6	3.9	Low reaction	0.7	-	-	-	-	-	-
BH9	1.9-2.0	SAND	4.7	3.9	Low reaction	0.8	5.5	<0.01	-	<0.05	<0.005	<0.005
BH9	2.4-2.5	SAND	4.2	3.8	Low reaction	0.4	-	-	-	-	-	-
BH9	2.9-3.0	SAND	4.5	5.1	Low reaction	-0.6	-	-	-	-	-	-
BH9	3.4-3.5	Silty SAND	5	3.8	Medium reaction	**1.2**	-	-	-	-	-	-
BH9	3.5-4.0	Silty SAND	5.4	**3.2**	High reaction	**2.2**	-	-	-	-	-	-
BH9	4.5-5.0	Silty SAND	5.5	**3.2**	High reaction	**2.3**	-	-	-	-	-	-
BH9	5.5-6.0	Silty SAND	5.4	**2.9**	High reaction	**2.5**	-	-	-	-	-	-
BH9	6.5-7.0	Silty SAND	5.5	**2.9**	High reaction	**2.6**	-	-	-	-	-	-
BH9	7.5-8.0	Silty SAND	5.2	**3.1**	High reaction	**2.1**	4.7	0.02	-	<0.05	0.01	0.03

Notes:

1. Screening Tests undertaken by ELS
2. Low – indicates no or slight effervescence in hydrogen peroxide
   Medium – indicates moderate effervescence in hydrogen peroxide
   High – indicates vigorous effervescence in hydrogen peroxide
   Extreme/Volcanic - indicates very vigorous effervescence in hydrogen peroxide
3. Δ pH = pHF - pHFOX
4. TAA – titratable actual acidity
5. TPA – titratable peroxide acidity;
6. NAS – net acid soluable sulfur (reported for pHkCl < 4.5)
7. ANCe – excess acid neutralising capacity (reported for pHkCl > 6.5).
8. Scr - Chromium Reducible Sulphur
9. Net Acidity = TAA + Scr + Snas. (It should be noted that ANC is excluded as per WA Guidelines)

* ASSMAC (1998) action criteria for coarse (sand) materials

-	Not Tested
	Exceedance of field screening criteria
0.03	Exceedance of criteria.

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Table H2C: Summary of Soil Laboratory Results - Acid Sulphate Soils - NSHS

Borehole / Test Pit ID	Depth (m)	Soil Description	Screening Tests[1]								Chromium Reducible Sulfur	
			pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	TAA[4] (%S)	S_{NAS}[6] (%S)	ANC[7] (%S)	Scr %S[8]	Net Acidity (%S)[9]
Assessment Criteria*			<4	<3	-	>1	-	-	-	-	>0.03	
Currrent Investigation												
TP207	0.4-0.5	Fill	8.0	6.1	Medium reaction	**1.9**	-	-	-	-	-	-
TP207	0.9-1	Fill	8.4	6.2	Medium reaction	**2.2**	-	-	-	-	-	-
TP207	1.4-1.5	SAND	8.4	6.2	Medium reaction	**2.2**	9.8	<0.01	-	0.16	0.009	<0.005
TP207	1.9-2	SAND	7.1	**1.2**	Volcanic reaction	**5.9**	4.7	0.02	-	-	**0.15**	**0.18**
TP207	2.4-2.5	SAND	6.8	**2.5**	Volcanic reaction	**4.3**	-	-	-	-	-	-
DP (2020)												
BH104	0-0.1	Fill	7.6	5.7	High reaction	**1.9**	-	-	-	-	-	-
BH104	0.4-0.5	Fill	8.1	6.5	High reaction	**1.6**	-	-	-	-	-	-
BH104	0.95-1.0	Fill	8.5	8.3	Extreme reaction	0.2	-	-	-	-	-	-
BH104	1.4-1.5	Silty SAND	8.4	6.1	Medium reaction	**2.3**	-	-	-	-	-	-
BH104	1.9-2.0	Silty SAND	8.4	6.3	Low reaction	**2.1**	-	-	-	-	-	-
BH104	2.4-2.5	Silty SAND	8	5.9	Medium reaction	**2.1**	6.8	<0.01	-	0.08	<0.005	<0.005
BH104	3.5-4.0	SAND	7.6	6.5	High reaction	**1.1**	-	-	-	-	-	-
BH104	4.5-5.0	SAND	7.8	6.9	High reaction	0.9	-	-	-	-	-	-
BH104	5.5-6.0	SAND	7.9	6.9	High reaction	1	-	-	-	-	-	-
BH104	6.5-7.0	SAND	7.3	6.7	High reaction	0.6	-	-	-	-	-	-
BH104	7.5-8.0	SAND	6.9	5.5	High reaction	**1.4**	6.9	<0.01	-	<0.05	<0.005	<0.005

Notes:

1. Screening Tests undertaken by ELS
2. Low – indicates no or slight effervescence in hydrogen peroxide
   Medium – indicates moderate effervescence in hydrogen peroxide
   High – indicates vigorous effervescence in hydrogen peroxide
   Extreme/Volcanic - indicates very vigorous effervescence in hydrogen peroxide
3. Δ pH = pHF - pHFOX
4. TAA – titratable actual acidity
5. TPA – titratable peroxide acidity;
6. NAS – net acid soluable sulfur (reported for pHkCl < 4.5)
7. ANCe – excess acid neutralising capacity (reported for pHkCl > 6.5).
8. Scr - Chromium Reducible Sulphur
9. Net Acidity = TAA + Scr + Snas. (It should be noted that ANC is excluded as per WA Guidelines)

* ASSMAC (1998) action criteria for coarse (sand) materials

-	Not Tested
	Exceedance of field screening criteria
0.03	Exceedance of criteria.

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342193.1
NORTHING: 6269969.1

PIT No: TP1001
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
4	0.0	FILL/Silty SAND: fine to medium, grey-brown, trace charcoal and asphalt fragments, moist		E	0.0		PID < 1 ppm		
	0.2				0.2				
	0.3	Pit discontinued at 0.3m Possible service encountered							
3	1								1
2	2								2
1	3								3
0	4								4

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.1 AHD
EASTING: 342188.6
NORTHING: 6269974

PIT No: TP1001A
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
					0.0		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, brown, with organics, trace rootlets, moist		E*					
	0.2				0.2		PID < 1 ppm		
		FILL/SAND: fine to medium, grey-brown, trace clay, brick, tile, plastic, concrete and asbestos containing material, moist		E	0.3				
					0.8		PID < 1 ppm		
	0.9			E	0.9				
		SAND SP: fine to medium, pale grey, with nodules of indurated brown sand, silt and clay (coffee rock), moist, alluvial and estuarine							
		Below 1.1 m: brown, with silt, trace clay			1.3		PID < 1 ppm		
				E	1.4				
					1.8		PID < 1 ppm		
				E	1.9				
		Below 2.1 m: wet						▼	
				E	2.2				
	2.3	Pit discontinued at 2.3m			2.3				
		Test pit collapse							

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 2.1 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD10/20220419 taken from 0-0.2 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342206.6
NORTHING: 6269964.3
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4.6	0.01	MULCH							
		FILL/Silty SAND: fine to medium, dark grey-brown, trace rootlets and charcoal, moist		E	0.1 0.2		PID < 1 ppm		
	0.4	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.5 0.6		PID < 1 ppm		
		Below 0.7 m: pale grey							
	1			E	1.0 1.1		PID < 1 ppm		1
		Below 1.3 m: brown, with silt, trace clay							
	1.5	Bore discontinued at 1.5m Target depth reached							
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342186.9
NORTHING: 6269942.3

PIT No: TP1003
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
					0.0				
		FILL/Silty SAND: fine to medium, grey-brown, trace charcoal, moist		E			PID < 1 ppm		
	0.2	FILL/Silty SAND: fine to medium, grey-brown, moist			0.2				
				E	0.3		PID < 1 ppm		
					0.4				
	0.5	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine							
				E	0.7		PID < 1 ppm		
					0.8				
		Below 0.9 m: with nodules of indurated brown sand, silt and clay (coffee rock)							
				E*	1.1		PID < 1 ppm		
					1.2				
	1.4	Pit discontinued at 1.4m Target depth reached							

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD1/20220413 taken from 1.1-1.2 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342207.9
NORTHING: 6269937.9
DIP/AZIMUTH: 90°/--

BORE No: BH1004
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.1	FILL/Gravelly SAND: fine to coarse, brown, angular to subangular igneous gravel, with silt, moist		E	0.2		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, brown, trace rootlets, moist			0.3				
4	0.7	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine		E	0.8		PID < 1 ppm		
	1	Below 1.0 m: pale yellow-grey			0.9				1
		Below 1.2 m: with nodules of indurated brown sand, silt and clay (coffee rock)		E	1.3		PID < 1 ppm		
3					1.4				
	2			E	1.8				2
					1.9				
				E	2.3				
					2.4				
	2.5	Bore discontinued at 2.5m Target depth reached							
2									
	3								3
1									
	4								4
0									

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 2.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342175.1
NORTHING: 6269928

PIT No: TP1005
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
									5 10 15 20
		FILL/Silty SAND: fine to medium, grey-brown, trace rootlets, moist		E	0.0		PID < 1 ppm		
	0.2	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine			0.2				
				E	0.5		PID < 1 ppm		
					0.6				
	1			E	1.0		PID < 1 ppm		1
					1.1				
				E	1.5				
					1.6				
	2			E	2.0				2
	2.1	Pit discontinued at 2.1m Test pit collapse			2.1				
	3								3
	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.8 AHD
EASTING: 342196.8
NORTHING: 6269922.8
DIP/AZIMUTH: 90°/--

BORE No: BH1006
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	MULCH							
		FILL/Silty SAND: fine to medium, dark grey-brown, moist		E	0.1 0.2		PID < 1 ppm		
	0.4	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.6 0.7		PID < 1 ppm		
				E*	1.1 1.2		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached							

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD2/20220413 taken from 1.1-1.2 m.

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342176.3
NORTHING: 6269912.9

PIT No: TP1007
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
									5 10 15 20
		FILL/Silty SAND: fine to medium, dark brown, with roots and rootlets, trace plastic fragments and asbestos containing material, moist		E	0.0		PID < 1 ppm		
					0.2				
	0.3	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
		Below 0.5 m: pale grey, reducing silt		E	0.5		PID < 1 ppm		
					0.6				
	1			E	1.0		PID < 1 ppm		1
					1.1				
	1.5	Pit discontinued at 1.5m Target depth reached							
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.0 AHD
EASTING: 342178
NORTHING: 6269895.4

PIT No: TP1008
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILL/Silty SAND: fine to medium, dark brown, with roots and rootlets, trace asbestos containing material, moist		E	0.0		PID < 1 ppm		
	0.3	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			0.2				
				E	0.5		PID < 1 ppm		
					0.6				
	1	Below 0.9 m: with nodules of indurated brown sand, silt and clay (coffee rock)		E	1.0		PID < 1 ppm		
					1.1			▼	
		Below 1.4 m: wet		E	1.5				
					1.6				
	2			E	2.0				
					2.1				
				E	2.5				
	2.6	Pit discontinued at 2.6m Test pit collapse			2.6				
	3								
	4								

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.4 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342203.6
NORTHING: 6269898.5
DIP/AZIMUTH: 90°/--

BORE No: BH1009
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.025	ASPHALTIC CONCRETE							
	0.1	FILL/Gravelly SAND: fine to coarse, grey-brown, with silt, angular to subangular igneous gravel, moist		E*	0.2 0.3		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, dark grey, trace fine igneous gravel, moist							
	0.5	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.7 0.8		PID < 1 ppm		
	1	Below 1.0 m: reducing silt		E	1.2 1.3		PID < 1 ppm		
				E	1.8 1.9				
	2	2.0 Bore discontinued at 2.0m Target depth reached							
	3								
	4								

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 2.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD3/20220414 taken from 0.2-0.3 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.4 AHD
EASTING: 342217.2
NORTHING: 6269905.9
DIP/AZIMUTH: 90°/--

BORE No: BH1010
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.1	FILL/Gravelly SAND: fine to coarse, grey-brown, with silt, angular to subangular igneous gravel, moist		E	0.2 0.3		PID < 1 ppm		
		FILL/Silty SAND: fine to medium, dark grey, trace fine igneous gravel, moist							
	0.6	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E*	0.7 0.8		PID < 1 ppm		
	1	Below 1.0 m: reducing silt							1
				E	1.2 1.3		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached							
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD4/20220414 taken from 0.7-0.8 m.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.5 AHD
EASTING: 342192.8
NORTHING: 6269875.6
DIP/AZIMUTH: 90°/--

BORE No: BH1011
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID < 1 ppm		
	0.4	SAND SP: fine to medium, grey, moist, trace silt, alluvial and estuarine		E	0.6 0.7		PID < 1 ppm		
	1.0	Bore discontinued at 1.0m Target depth reached							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342210.4
NORTHING: 6269871.3
DIP/AZIMUTH: 90°/--

BORE No: BH1012
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID < 1 ppm		
	0.5	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.6 0.7		PID < 1 ppm		
	1.0	Bore discontinued at 1.0m Target depth reached							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.1 AHD
EASTING: 342250.9
NORTHING: 6269886.1
DIP/AZIMUTH: 90°/--

BORE No: BH1013
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.2	FILL/Gravelly SAND: fine to coarse, grey-brown, fine to medium angular to subangular igneous gravel, with silt and asphalt, trace brick, moist		E	0.1 0.2		PID < 1 ppm		
		SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.3 0.4		PID < 1 ppm		
		Below 0.4 m: reducing silt							
	1.0	Bore discontinued at 1.0m Target depth reached		E	0.9 1.0		PID < 1 ppm		

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342264.8
NORTHING: 6269877.8
DIP/AZIMUTH: 90°/--

BORE No: BH1014
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05		PID < 1 ppm		
	0.15	FILL/Gravelly SAND: fine to coarse, grey-brown, with silt and asphalt, angular to subangular igneous gravel, moist			0.15				
		SAND SP: fine to medium, grey, with silt, moist, alluvial and estuarine		E	0.4		PID < 1 ppm		
		Below 0.5 m: trace silt			0.5				
				E*	0.9		PID < 1 ppm		
3	1.0	Bore discontinued at 1.0m Target depth reached			1.0				
2	2								
1	3								
0	4								

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD5/20220414 taken from 0.9-1.0 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.4 AHD
EASTING: 342235
NORTHING: 6269851.8
DIP/AZIMUTH: 90°/--

BORE No: BH1015
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, trace roots, rootlets and terracotta fragments, moist		E*	0.0 0.2		PID < 1 ppm		
	0.4	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.6 0.7		PID < 1 ppm		
				E	1.1 1.2		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached							

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD6/20220414 taken from 0-0.2 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342237.1
NORTHING: 6269842.4
DIP/AZIMUTH: 90°/--

BORE No: BH1016
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, with roots and rootlets, trace mulch, moist		E	0.0 0.2		PID < 1 ppm		
	0.5	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E*	0.5 0.6		PID < 1 ppm		
	1			E	1.0 1.1		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached							
	2								
	3								
	4								

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD7/20220414 taken from 0.5-0.6 m.

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342245.1
NORTHING: 6269856.7

PIT No: TP1017
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, brown, trace clay, rootlets and terracotta fragment, moist		E	0.0		PID < 1 ppm		
	0.2	FILL/Silty SAND: fine to medium, dark grey-brown, trace rootlets, moist			0.2				
				E	0.4		PID < 1 ppm		
	0.6	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			0.5				
				E	0.9		PID < 1 ppm		
					1.0				
				E*	1.4		PID < 1 ppm		
	1.5	Pit discontinued at 1.5m Target depth reached			1.5				

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD8/20220414 taken from 1.4-1.5 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342256.8
NORTHING: 6269842.9

PIT No: TP1018
PROJECT No: 86973.04
DATE: 14/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
									5 10 15 20
		FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E*	0.0		PID < 1 ppm		
					0.2				
	0.3	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
				E	0.5		PID < 1 ppm		
					0.6				
		Below 0.8 m: pale grey							
3	1			E	1.0		PID < 1 ppm		1
					1.1				
		Below 1.2 m: trace nodules of indurated brown sand, silt and clay (coffee rock)							
				E	1.5				
					1.6				
2	2			E	2.0				2
	2.1	Pit discontinued at 2.1m			2.1				
		Test pit collapse							
1	3								3
0	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates obtained via DGPS. Approximate levels inferred from provided survey. *Blind replicate BD9/20220414 taken from 0-0.2 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342172.1
NORTHING: 6269921.1

PIT No: TP1019
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, brown, with organics, trace rootlets, glass, brick, terracotta, concrete and plastic fragments, moist		E	0.0		PID < 1 ppm		
	0.2	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			0.2				
				E	0.3		PID < 1 ppm		
		Below 0.6 m: pale grey			0.4				
				E	0.9		PID < 1 ppm		
	1.0	Pit discontinued at 1.0m Target depth reached			1.0				

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Approximate levels inferred from provided survey.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342180.1
NORTHING: 6269905.5

PIT No: TP1020
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, brown, with organics, trace rootlets, moist		E	0.0		PID < 1 ppm		
	0.2	FILL/SAND: fine to medium, with silt, grey-brown, trace gravel, rootlets and slag, moist			0.2				
				E	0.4		PID < 1 ppm		
					0.5				
	0.7	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
				E	0.9		PID < 1 ppm		
	1				1.0				1
				E*	1.4		PID < 1 ppm		
	1.5	Pit discontinued at 1.5m Target depth reached			1.5				
	2								2
	3								3
	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Approximate levels inferred from provided survey. *Blind replicate BD11/20220419 taken from 1.4-1.5 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342237.3
NORTHING: 6269938.1
DIP/AZIMUTH: 90°/--

BORE No: BH1021
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, dark brown, with rootlets, moist		E	0.1 0.2		PID < 1 ppm		
	0.25	Bore discontinued at 0.25m Refusal on gravel and geofabric							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 0.25 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 5.1 AHD
EASTING: 342242.5
NORTHING: 6269937
DIP/AZIMUTH: 90°/--

BORE No: BH1022
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
5		FILL/Silty SAND: fine to medium, dark brown, with rootlets, moist			0.1				
		Below 0.1 m: trace rootlets		E	0.2		PID < 1 ppm		
					0.6				
				E			PID < 1 ppm		
	0.7				0.7				
4		Bore discontinued at 0.7m							
		Refusal on gravel and geofabric							
	1								1
3									
	2								2
2									
	3								3
1									
	4								4

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 0.7 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.6 AHD
EASTING: 342240.5
NORTHING: 6269914.9
DIP/AZIMUTH: 90°/--

BORE No: BH1023
PROJECT No: 86973.04
DATE: 13/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	MULCH							
		FILL/Silty SAND: fine to medium, brown, trace rootlets and fine gravel, moist		E	0.1 0.2		PID < 1 ppm		
		Below 0.3 m: dark brown		E	0.4 0.5		PID < 1 ppm		
	0.7	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	0.9 1.0		PID < 1 ppm		
				E	1.4		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (150 mm) to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.4 AHD
EASTING: 342188.4
NORTHING: 6269990.3
DIP/AZIMUTH: 90°/--

BORE No: BH1024
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILL/Silty CLAY: medium to high plasticity, brown mottled red, trace ironstone, rootlets and fine igneous gravel, w~PL		E	0.0		PID = 2 ppm		
	0.2				0.2				
	0.3	Silty SAND SM: fine to medium, dark grey-brown, moist, alluvial and estuarine			0.3				
	0.4			E*	0.4		PID = 2 ppm		
	0.6				0.6				
	0.9	Below 0.9 m: wet		E	0.9		PID = 1 ppm	▼	
	1.1	Bore discontinued at 1.1m Target depth reached			1.1				

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.1 m.

WATER OBSERVATIONS: Groundwater observed at 0.9 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD22/20220714 taken from 0.4-0.6 m.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.0 AHD
EASTING: 342198.4
NORTHING: 6269993
DIP/AZIMUTH: 90°/--

BORE No: BH1025
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
3	0.0	FILL/SAND: fine to medium, grey, trace clay, fine to coarse gravel, brick and concrete fragments, moist, reworked natural		E	0.0 - 0.2		PID = 2 ppm		
				E	0.5 - 0.7		PID = 1 ppm		
2	0.8	FILL/Sandy CLAY: medium to high plasticity, yellow mottled red, trace silt and ironstone, w~PL		E	0.9 - 1.1		PID = 1 ppm	▼	1
	1.1	Silty SAND SM: fine to medium, dark grey-brown, trace rootlets, wet, alluvial and estuarine		E	1.2 - 1.4		PID = 1 ppm		
	1.7	Bore discontinued at 1.7m Target depth reached							
1	2								2
0	3								3
-1	4								4

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.7 m.

WATER OBSERVATIONS: Groundwater observed at 1.1 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.5 AHD
EASTING: 342210.9
NORTHING: 6269985.5
DIP/AZIMUTH: 90°/--

BORE No: BH1026
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/SAND: fine to medium, grey, trace clay, silt, brick, tile and plastic fragments, moist, possibly reworked natural		E*	0.0		PID = 1 ppm		
					0.2				
		Below 0.9 m: brown, with silt and clay, trace clay nodules		E	0.9		PID = 2 ppm		
	1.1	SAND SP: fine to medium, dark grey-brown, moist, alluvial and estuarine			1.1				
				E	1.2		PID = 1 ppm		
					1.4				
	1.5	Bore discontinued at 1.5m Target depth reached							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.5 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Approximate coordinates obtained via DGPS. Approximate levels inferred by comparison with nearby boreholes. *Blind replicate BD23/20220714 taken from 0-0.2 m.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342199.8
NORTHING: 6270003.5
DIP/AZIMUTH: 90°/--

BORE No: BH1027
PROJECT No: 86973.04
DATE: 14/07/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4		FILL/Silty SAND: fine to medium, brown, trace fine igneous gravel, rootlets and asbestos containing material, moist		E	0.0 0.2		PID = 2 ppm		
	0.6	SAND SP: fine to medium, grey, moist, alluvial and estuarine		E	0.6 0.8		PID = 3 ppm		
3	1	Below 1.2 m: indurated brown sand, silt and clay (coffee rock)		E	1.2 1.4		PID = 3 ppm		1
	1.6	Bore discontinued at 1.6m Target depth reached							
2	2								2
1	3								3
0	4								4

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.6 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 1.9 AHD
EASTING: 342187.2
NORTHING: 6269801.6
DIP/AZIMUTH: 90°/--

BORE No: BH201
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND: fine to medium, brown, trace rootlets and glass, moist		E*	0.0		PID < 1 ppm		
		Below 0.2 m: trace fine to medium sandstone gravel			0.2				
				E	0.4		PID < 1 ppm		
	0.5	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			0.5				
				E	0.9		PID < 1 ppm		
	1				1.0			▼	1
		Below 1.1 m: wet							
				E	1.4		PID < 1 ppm		
					1.5				
		Below 1.6 m: dark brown, sulfuric odour							
				E	1.9				
	2				2.0				2
				E	2.4				
	2.5	Bore discontinued at 2.5m Target depth reached			2.5				
	3								3
	4								4

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 2.5 m.

WATER OBSERVATIONS: Groundwater observed at 1.1 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD12/20220419 taken from 0-0.2 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.0 AHD
EASTING: 342207.6
NORTHING: 6269798.3
DIP/AZIMUTH: 90°/--

BORE No: BH202
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.09	CONCRETE SLAB		E	0.1 0.2		PID < 1 ppm		
	0.4	FILL/Sandy CLAY: medium to high plasticity, orange mottled yellow, trace fine to medium ironstone and clinker, w~PL		E	0.4 0.5		PID < 1 ppm	▼	
		SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine Below 0.7 m: wet		E*	0.9		PID < 1 ppm		
	1.0	Bore discontinued at 1.0m Target depth reached			1.0				

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.0 m.

WATER OBSERVATIONS: Groundwater observed at 0.7 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD13/20220419 taken from 0.9-1.0 m.

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 1.9 AHD
EASTING: 342206.6
NORTHING: 6269779.2
DIP/AZIMUTH: 90°/--

BORE No: BH203
PROJECT No: 86973.04
DATE: 19/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.11	CONCRETE SLAB							
		FILL/Sandy CLAY: medium to high plasticity, orange mottled yellow, trace ironstone and clinker, w~PL		E	0.2 0.3		PID < 1 ppm		
	0.5	FILL/SAND: fine to medium, brown, trace shells, moist		E	0.6		PID < 1 ppm		
	0.7	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			0.7				
	1	Below 1.0 m: wet, sulfuric odour		E	0.9 1.0		PID < 1 ppm	▼	1
				E	1.4		PID < 1 ppm		
	1.5	Bore discontinued at 1.5m Target depth reached			1.5				

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: Groundwater observed at 1.0 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.8 AHD
EASTING: 342243.8
NORTHING: 6269805
DIP/AZIMUTH: 90°/--

BORE No: BH204
PROJECT No: 86973.04
DATE: 20/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0–0.1		PID < 1 ppm		
		FILL/SAND: fine to medium, brown, trace shells, sandstone gravel and cobbles, slag and terracotta, moist		E	0.3–0.4		PID < 1 ppm		
				E	0.8–0.9		PID < 1 ppm		
	1.2	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	1.3–1.4		PID < 1 ppm		
				E	1.8–1.9		PID < 1 ppm		
	2.0	Bore discontinued at 2.0m Target depth reached							

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 2.0 m.

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 3.3 AHD
EASTING: 342237
NORTHING: 6269784.6
DIP/AZIMUTH: 90°/--

BORE No: BH205
PROJECT No: 86973.04
DATE: 20/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID < 1 ppm		
		FILL/SAND: fine to medium, brown, trace shells and sandstone gravel, moist		E	0.3 0.4		PID < 1 ppm		
				E	0.8 0.9		PID < 1 ppm	▼	
		Below 1.0 m: wet		E	1.3 1.4		PID < 1 ppm		
	1.5	SAND SP: fine to medium, dark grey, trace silt, wet, alluvial and estuarine, sulfuric odour		E	1.8 1.9		PID < 1 ppm		
				E	2.3				
	2.4	Bore discontinued at 2.4m Target depth reached			2.4				

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Solid flight auger (300 mm) to 2.4 m.

WATER OBSERVATIONS: Groundwater observed at 1.0 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.8 AHD
EASTING: 342163
NORTHING: 6269740.5
DIP/AZIMUTH: 90°/--

BORE No: BH206
PROJECT No: 86973.04
DATE: 20/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.13	CONCRETE SLAB							
		FILL/SAND: fine to medium, brown, trace silt, shells and gravel, moist		E*	0.2 0.3		PID < 1 ppm		
				E	0.7 0.8		PID < 1 ppm		
	1.1	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine Below 1.4 m: wet		E	1.2 1.3		PID < 1 ppm	▼	
	1.5	Bore discontinued at 1.5m Target depth reached							

RIG: 5 Tonne Excavator **DRILLER:** A&A Hire Service **LOGGED:** HD **CASING:** -

TYPE OF BORING: Dia-core (300 mm) to 0.13 m, solid flight auger (300 mm) to 1.5 m.

WATER OBSERVATIONS: Groundwater observed at 1.4 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD14/20220420 taken from 0.2-0.3 m.

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342153.7
NORTHING: 6269726.5

PIT No: TP207
PROJECT No: 86973.04
DATE: 20/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E*	0.0		PID < 1 ppm		
2	0.2	FILL/SAND: fine to medium, brown, trace brick and plastic fragments, moist			0.2				
				E	0.4		PID < 1 ppm		
					0.5				
				E	0.9		PID < 1 ppm		
1					1.0				1
1	1.2	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine						▼	
		Below 1.3 m: wet		E	1.4		PID < 1 ppm		
					1.5				
		Below 1.7 m: dark grey, sulfuric odour		E	1.9		PID < 1 ppm		
0	2				2.0				2
				E	2.4				
	2.5	Pit discontinued at 2.5m Test pit collapse			2.5				
-1	3								3
-2	4								4

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.3 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD15/20220420 taken from 0-0.2 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 1.8 AHD
EASTING: 342106.3
NORTHING: 6269696

PIT No: TP208
PROJECT No: 86973.04
DATE: 20/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0		PID < 1 ppm		
	0.2	FILL/SAND: fine to medium, brown, trace silt and shells, moist			0.2				
				E	0.4		PID < 1 ppm		
					0.5				
				E	0.9		PID < 1 ppm		
	1.1				1.0				
		SAND SP: fine to medium, dark grey, trace silt, moist, alluvial and estuarine, sulfuric odour		E	1.4		PID < 1 ppm		
					1.5			▼	
		Below 1.8 m: wet		E	1.9				
	2.0	Pit discontinued at 2.0m Test pit collapse			2.0				

RIG: 5 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.8 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.0 AHD
EASTING: 342124.7
NORTHING: 6269695.4
DIP/AZIMUTH: 90°/--

BORE No: BH209
PROJECT No: 86973.04
DATE: 20/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
2	0.04	ASPHALTIC CONCRETE		E	0.05		PID < 1 ppm		
	0.15	FILL/Gravelly SAND: fine to coarse, dark grey, fine to medium gravel, with silt, moist, slight organic odour			0.15				
		FILL/SAND: fine to medium, brown, trace shells, moist		E*	0.7 0.8		PID < 1 ppm		
1	1								1
		Below 1.3 m: wet		E	1.4		PID < 1 ppm	▼	
	1.5	Bore discontinued at 1.5m Borehole collapse			1.5				
0	2								2
-1	3								3
-2	4								4

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.5 m.

WATER OBSERVATIONS: Groundwater observed at 1.3 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD16/20220420 taken from 0.7-0.8 m.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 1.8 AHD
EASTING: 342106.3
NORTHING: 6269667.2
DIP/AZIMUTH: 90°/--

BORE No: BH210
PROJECT No: 86973.04
DATE: 20/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE							
	0.2	FILL/Gravelly SAND: fine to coarse, dark grey, fine to medium gravel, with silt, moist, slight organic odour		E	0.1 0.2		PID < 1 ppm		
		FILL/SAND: fine to medium, brown, trace shells, moist		E	0.5 0.6		PID < 1 ppm		
	0.9	SAND SP: fine to medium, pale grey, trace silt, moist, alluvial and estuarine		E	1.0 1.1		PID < 1 ppm	▼	
		Below 1.3 m: wet							
	1.4	Bore discontinued at 1.4m Target depth reached							

RIG: Hand Tools **DRILLER:** HD **LOGGED:** HD **CASING:** -

TYPE OF BORING: Hand auger to 1.4 m.

WATER OBSERVATIONS: Groundwater observed at 1.3 m.

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and levels obtained via DGPS.

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342217.7
NORTHING: 6269677.4

PIT No: TP211
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E*	0.0		PID < 1 ppm		
	0.2	FILL/SAND: fine to medium, brown, with silt, trace fine to medium gravel and plastic fragments, moist			0.2				
				E	0.4		PID < 1 ppm		
					0.5				
	0.6	FILL/SAND: fine to medium, pale brown, moist							
				E	0.9		PID < 1 ppm		
	1.0	Below 0.9 m: with nodules of medium plasticity sandy clay, trace fine to medium sandstone gravel			1.0				
		SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine						▼	
		Below 1.2 m: wet		E	1.4		PID < 1 ppm		
					1.5				
				E	1.9		PID < 1 ppm		
	2.0	Pit discontinued at 2.0m Target depth reached			2.0				

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.2 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD17/20220421 taken from 0-0.2 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 1.9 AHD
EASTING: 342225.7
NORTHING: 6269675.3

PIT No: TP212
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, concrete and sandstone cobbles, moist		E	0.0		PID < 1 ppm		
					0.2				
	0.4	FILL/SAND: fine to medium, brown, moist							
				E	0.5		PID < 1 ppm		
		Below 0.7 m: with nodules of medium plasticity sandy clay, trace ironstone cobbles and sandstone gravel			0.6				
				E	0.9		PID < 1 ppm		
	1.0	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			1.0			▼	
		Below 1.2 m: wet		E	1.4		PID < 1 ppm		
	1.5	Pit discontinued at 1.5m Target depth reached			1.5				

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.2 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342205.8
NORTHING: 6269665.2

PIT No: TP213
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets and fine to medium igneous gravel, moist		E	0.0		PID < 1 ppm		
					0.2				
	0.3	FILL/SAND: fine to medium, pale brown, moist		E*	0.4		PID < 1 ppm		
					0.5				
		Below 0.6 m: trace nodules of medium plasticity silty clay							
				E	0.9		PID < 1 ppm		
	1				1.0				1
	1.2	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine, slight sulfuric odour							
		Below 1.4 m: wet		E	1.4		PID < 1 ppm	▼	
					1.5				
				E	1.9		PID < 1 ppm		
	2 2.0	Pit discontinued at 2.0m Test pit collapse			2.0				2
	3								3
	4								4

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.4 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD18/20220421 taken from 0.4-0.5 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342203.2
NORTHING: 6269654

PIT No: TP214
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0			E	0.0		PID < 1 ppm		
	0.1	FILL/Silty SAND: fine to medium, dark brown, trace rootlets and fine to medium igneous gravel, moist			0.1				
		FILL/SAND: fine to medium, brown, trace shells and brick fragments, moist							
		Below 0.4 m: pale brown		E	0.4		PID < 1 ppm		
					0.5				
				E	0.9		PID < 1 ppm		
	1				1.0				1
	1.1	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine							
				E*	1.4		PID < 1 ppm		
	1.5	Pit discontinued at 1.5m Test pit collapse			1.5				
	2								2
	3								3
	4								4

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD19/20220421 taken from 1.4-1.5 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.0 AHD
EASTING: 342214.2
NORTHING: 6269650.5

PIT No: TP215
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
2	0.1	FILL/Silty SAND: fine to medium, dark brown, trace rootlets and igneous gravel, moist		E*	0.0 0.1		PID < 1 ppm		5 10 15 20
		FILL/SAND: fine to medium, pale brown, trace shells, moist		E	0.4 0.5		PID < 1 ppm		
1	0.9 1	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine		E	1.0 1.1		PID < 1 ppm		1
	1.2	Pit discontinued at 1.2m Test pit collapse							
0	2								2
-1	3								3
-2	4								4

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD20/20220421 taken from 0-0.1 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 1.9 AHD
EASTING: 342230.8
NORTHING: 6269655.4

PIT No: TP216
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
					0.0		PID < 1 ppm		5 10 15 20
		FILL/Silty SAND: fine to medium, dark brown, trace rootlets and igneous gravel, moist		E					
	0.2	FILL/SAND: fine to medium, pale brown, trace shells and concrete cobbles, moist			0.2				
				E	0.5		PID < 1 ppm		
					0.6			▼	
	0.9	SAND SP: fine to medium, dark grey, with silt, wet, alluvial and estuarine, sulfuric odour		E	1.0		PID < 1 ppm		
					1.1				
	1.2	Pit discontinued at 1.2m Test pit collapse							

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 0.9 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342273
NORTHING: 6269653.6

PIT No: TP217
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace clay, rootlets, igneous gravel, glass and brick fragments, moist		E*	0.0		PID < 1 ppm		
	0.2	FILL/SAND: fine to medium, pale brown, trace shells, concrete and sandstone gravel and cobbles, moist			0.2				
				E	0.4		PID < 1 ppm		
					0.5				
				E	0.9		PID < 1 ppm	▼	
	1.0	Below 1.0 m: wet			1.0				
	1.2	SAND SP: fine to medium, grey, trace silt, wet, alluvial and estuarine		E	1.4		PID < 1 ppm		
	1.5	Pit discontinued at 1.5m Test pit collapse			1.5				

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.0 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS. *Blind replicate BD21/20220421 taken from 0-0.2 m.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.3 AHD
EASTING: 342256.3
NORTHING: 6269632.4

PIT No: TP218
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0		PID < 1 ppm		
					0.2				
	0.4	FILL/SAND: fine to medium, brown, moist							
				E	0.6				
					0.7				
	1.1	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine			1.2				
		Below 1.3 m: wet		E	1.3			▼	
					1.8		PID < 1 ppm		
				E					
	1.9	Pit discontinued at 1.9m			1.9				
		Test pit collapse							

5 10 15 20

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.3 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342229.6
NORTHING: 6269626.4

PIT No: TP219
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0		PID < 1 ppm		
					0.2				
	0.3	FILL/SAND: fine to medium, pale brown, trace shells and fine to medium ironstone gravel, moist							
				E	0.5		PID < 1 ppm		
					0.6				
	1.0	SAND SP: fine to medium, grey, trace silt, moist, alluvial and estuarine, sulfuric odour Below 1.1 m: wet						▼	
				E	1.2		PID < 1 ppm		
					1.3				
				E	1.7		PID < 1 ppm		
	1.8	Pit discontinued at 1.8m Test pit collapse			1.8				

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Groundwater observed at 1.1 m.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: NSW Department of Education
PROJECT: Proposed School Upgrade
LOCATION: Namona Street, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342206.1
NORTHING: 6269588.9

PIT No: TP220
PROJECT No: 86973.04
DATE: 21/4/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILL/Silty SAND: fine to medium, dark brown, trace rootlets and asphalt fragments, moist		E	0.0		PID < 1 ppm		
	0.2	FILL/SAND: fine to medium, brown, trace shells, asphalt and brick fragments and concrete gravel, cobbles and boulders, moist			0.2				
				E	0.5		PID < 1 ppm		
	0.9	Pit discontinued at 0.9m Refusal on concrete boulders			0.6				

RIG: 2 Tonne Excavator with 300 mm wide bucket

LOGGED: HD

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Location coordinates are in MGA Zone 56. Coordinates and levels obtained via DGPS.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342285.8
NORTHING: 6269998.5
DIP/AZIMUTH: 90°/--

BORE No: BH01
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE		E	0.05		PID<1ppm		
	0.15	FILL/Gravelly SAND SP: fine to coarse, brown, igneous, trace silt, moist		E*	0.15 0.4 0.5		PID<1ppm		
	0.6	FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist							
	1	SAND SP: fine to medium, pale grey, moist, alluvial and estuarine		E	0.9 1.0		PID<1ppm		
	1.5	Silty SAND SM: fine to coarse, dark brown, indurated, moist, alluvial and estuarine		E	1.4 1.5		PID<1ppm		
	2 2.0	Bore discontinued at 2.0m - Target Depth Reached		E	1.9 2.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200123 taken at 0.4-0.5m

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.5 AHD
EASTING: 342229.9
NORTHING: 6269957.2
DIP/AZIMUTH: 90°/--

BORE No: BH03
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		E	0.0		PID<1ppm		
				E	0.1		PID<1ppm		
	0.35	FILL/Silty SAND SM: fine to coarse, brown and orange-brown, moist		E	0.2		PID<1ppm		
	0.5				0.3				
					0.35				
	0.8	FILL/Silty SAND SM: fine to medium, dark grey, trace ash and charcoal, moist			0.45				
				E	0.9		PID<1ppm		
		FILL/SAND SP: fine to medium, grey, trace ash, moist (possible natural)			1.0				
				E	1.4		PID<1ppm		
		SAND SP: fine to medium, grey, moist, alluvial and estuarine			1.5				
		- From 1.0m: pale grey		E	1.9		PID<1ppm		
					2.0				
	2.65	SAND SP: fine to medium, dark brown, trace rootlets, indurated, moist, alluvial and estuarine							
	3.0	Bore discontinued at 3.0m - Target Depth Reached, refusal on coffee rock							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.9 AHD
EASTING: 342213.9
NORTHING: 6270007.2
DIP/AZIMUTH: 90°/--

BORE No: BH04
PROJECT No: 86973.01
DATE: 21/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/TOPSOIL (Silty SAND) SM: fine to coarse, dark brown, trace rootlets, moist		E	0.0		PID<1ppm		Well Plug and Flush Gatic Cover Concrete 0-0.15m
	0.3	FILL/Gravelly CLAY CH: medium to high plasticity, orange-brown, ironstone, sandstone, igneous, trace silt, w~PL		E*	0.1		PID<1ppm		
					0.3				Bentonite 0.15-0.9m
				E	0.4		PID<1ppm		Plain PVC 0-1.5m
		SAND SP: fine to medium, grey, moist, alluvial and estuarine			0.5				
		- From 0.4m: fine, pale grey		E	0.9		PID<1ppm		
					1.0				
				E	1.5		PID<1ppm		
					1.6				
	2.1	- From 2.0m: wet							
		SAND SP: fine to medium, brown and dark brown, indurated, wet, alluvial and estuarine		E**	2.4		PID<1ppm		
					2.5				Gravel 0.9-4.5m
									Machine Slotted PVC Screen 1.5-4.5m
					3.5				
	3.6	Sandy CLAY CL: low plasticity, brown and dark brown, fine to medium sand, trace sub-rounded gravel, wet, alluvial and estuarine		E			PID<1ppm		
					4.0				
					4.5				End Cap
				E			PID<1ppm		
					5.0				
	5.2	SAND SP: fine to medium, yellow-brown, trace sub-rounded gravel, saturated, alluvial and estuarine			5.5				
				E			PID<1ppm		
					6.0				
					6.5				
				E			PID<1ppm		
					7.0				
					7.5				
				E			PID<1ppm		
	8.0	Bore discontinued at 8.0m - Target Depth Reached			8.0				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.0m, Solid flight augers (TC-bit) to 8.0m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 2.0m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD4/20200121 taken from 0.1-0.3m, **Blind replicate sample BD5/20200121 taken from 2.4-2.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342193.8
NORTHING: 6269948.2
DIP/AZIMUTH: 90°/--

BORE No: BH05
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	FILL/TOPSOIL (Silty SAND) SM: fine to coarse, brown, trace rootlets, gravel, moist		E	0.0 0.1		PID<1ppm		
		FILL/Silty SAND SM: fine to coarse, grey, trace ash and charcoal, moist		E	0.4 0.5		PID<1ppm		
	0.8	Silty SAND SM: fine to medium, grey and pale grey, moist, alluvial and estuarine		E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
	1.5	Silty SAND SM: fine to medium, brown, trace rootlets, moist, alluvial and estuarine		E	1.9 2.0		PID<1ppm		
		- From 2.4m: red-brown							
	3.0	Bore discontinued at 3.0m - Target Depth Reached		E*	2.9 3.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD8/20200122 taken from 2.9-3.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.7 AHD
EASTING: 342195.8
NORTHING: 6269907.2
DIP/AZIMUTH: 90°/--

BORE No: BH06
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05 0.15		PID<1ppm		Well Plug and Flush Gatic Cover Concrete 0-0.15m
	0.2	FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist		E	0.4 0.5		PID<1ppm		
		SAND SP: fine to medium, grey, moist From 0.7m: pale grey		E	0.9 1.0		PID<1ppm		Backfill 0.15-1.3m
				E*	1.4 1.5		PID<1ppm		Plain PVC 0-2.8m
				E	1.9 2.0		PID<1ppm		Bentonite 1.3-2.3m
	2.3	SAND SP: fine to medium, brown and red-brown, indurated, moist, alluvial and estuarine		A	2.4 2.5		PID<1ppm		
	3.2	SAND SP: fine to medium, pale grey, moist, alluvial and estuarine						▼	Gravel 2.3-5.8m Machine slotted PVC Screen 2.8-5.8m
	6.0	Bore discontinued at 6.0m - Target Depth Reached							End Cap

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 4.0m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD4/20200122 taken from 1.4-1.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.3 AHD
EASTING: 342224.6
NORTHING: 6269898.6
DIP/AZIMUTH: 90°/--

BORE No: BH07
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05		PID<1ppm		
	0.05	ROADBASE: gravel, igneous <20mm			0.15				
		FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist		E	0.4		PID<1ppm		
	0.7				0.5				
		SAND SP: fine to medium, pale grey, moist, alluvial and estuarine		E	0.9		PID<1ppm		
					1.0				
				E*	1.4		PID<1ppm		
					1.5				
				E	1.9		PID<1ppm		
					2.0				
				E	2.4		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached			2.5				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD5/20200122 taken from 1.4-1.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342263.8
NORTHING: 6269899.7
DIP/AZIMUTH: 90°/--

BORE No: BH08
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05		PID<1ppm		
	0.05				0.15				
	0.15	ROADBASE: gravel, igneous <20mm		E	0.4		PID<1ppm		
		FILL/Silty SAND SM: fine to coarse, dark grey, trace ash and chemical , moist			0.5				
	0.9	FILL/Silty SAND SM: fine to medium, grey, trace ash, moist		E	0.9		PID<1ppm		
					1.0				
		Silty SAND SM: fine to medium, grey, moist, alluvial and estuarine		E	1.4		PID<1ppm		
					1.5				
	1.7	Silty SAND SM: fine to medium, brown and red-brown, indurated, moist, alluvial and estuarine		E*	1.9		PID<1ppm		
					2.0				
				E			PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached			2.5				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD6/20200122 taken from 1.9-2.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342223.1
NORTHING: 6269873
DIP/AZIMUTH: 90°/--

BORE No: BH09
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND SM: fine to coarse, dark grey, trace plastic, ash, moist		E	0.0		PID<1ppm		
					0.1				
				E	0.2		PID<1ppm		
				E*	0.4		PID<1ppm		
					0.5				
	0.7	SAND SP: fine, pale grey, moist, alluvial and estuarine							
				E**	0.9		PID<1ppm		
					1.0				
				E	1.4		PID<1ppm		
					1.5				
				E	1.9		PID<1ppm		
					2.0				
				E	2.4		PID<1ppm		
					2.5				
				E	2.9		PID<1ppm		
	3.0	SAND SP: fine to coarse, dark brown, wet, alluvial and estuarine			3.0				
				E	3.1		PID<1ppm	▼	
		- From 3.3m: saturated			3.2				
	3.5			E	3.4		PID<1ppm		
		Silty SAND SM: fine to coarse, brown and yellow-brown, trace shells, saturated, alluvial and estuarine			3.5				
				E			PID<1ppm		
					4.0				
					4.5				
				E			PID<1ppm Slight Sulfidic Odour		
					5.0				
					5.5				
				E			PID<1ppm Slight Sulfidic Odour and Stain		
					6.0				
					6.5				
				E			PID<1ppm		
					7.0				
					7.5				
				E			PID<1ppm		
	8.0	Bore discontinued at 8.0m - Target Depth Reached			8.0				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) to 8.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 3.3m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200121 taken from 0.4-0.5m, **Blind replicate sample BD3/20200121 taken from 0.9-1.0, Bulk sample for CBR taken from 0.2-0.8m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 3.8 AHD
EASTING: 342270.9
NORTHING: 6269850.6
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, with clay, trace rootlets, moist		E	0.0		PID<1ppm		Well Plug and Flush Gatic Cover
				E	0.1		PID<1ppm		Concrete 0-0.15m
	0.35	FILL/Silty CLAY CL-CH: low to medium plasticity, orange and brown, with sand and ironstone gravel, trace rootlets, moist		E	0.2		PID<1ppm		Backfill 0.15-0.5m
					0.3				
					0.4				
					0.5				
	1	Silty SAND SM: fine to medium, grey, dry, alluvial and estuarine		E*	0.9		PID<1ppm		Plain PVC 0-2.0m
		- From 0.8m: pale grey			1.0				Bentonite 0.5-1.5m
				E	1.4		PID<1ppm		
					1.5				
	1.8	Silty SAND SM: fine to medium, dark brown, indurated, moist, alluvial and estuarine		E	1.9		PID<1ppm		
					2.0				
				E	2.4		PID<1ppm		
					2.5				
				E	2.9		PID<1ppm		
					3.0				
		- From 3.1m: wet							
	3.3	SAND SM-SC: fine to medium, brown and yellow-brown, trace silt and clay, wet, alluvial and estuarine							Gravel 1.5-6.0m
					4.0				Machine Slotted PVC Screen 2.0-6.0m
				A			PID<1ppm		
					4.5				
		- From 5.1m: silty							
	6.0	Bore discontinued at 6.0m							End cap
		- Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) to 6.0m

WATER OBSERVATIONS: Free groundwater obserbed whilst augering at 3.1m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200121 taken from 0.9-1.0m,

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.2 AHD
EASTING: 342289.3
NORTHING: 6269918.2
DIP/AZIMUTH: 90°/--

BORE No: BH11
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE							
	0.25	ROADBASE: gravel, igneous <20mm		E	0.3 0.4		PID<1ppm		
		FILL/Silty SAND SM: fine to medium, grey, trace roots, moist		E*	0.9 1.0		PID<1ppm		
	1.3	Silty SAND SM: fine to medium, pale brown and pale grey, trace roots, moist, alluvial and estuarine - From 1.5m: pale brown		E	1.5 1.7		PID<1ppm		
				E	1.9 2.0		PID<1ppm		
	2.3	Silty SAND SM: fine to medium, dark grey, moist, alluvial and estuarine		E	2.4 2.5		PID<1ppm		
				E	2.9 3.0		PID<1ppm		
	3.0	Bore discontinued at 3.0m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD7/20200122 taken from 0.9-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.4 AHD
EASTING: 342259.1
NORTHING: 6269921.8
DIP/AZIMUTH: 90°/--

BORE No: BH12
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE		E	0.05 0.15		PID<1ppm		
	0.2	FILL/Silty SAND SM: fine to medium, dark grey, trace ash and charcoal, moist		E	0.4 0.5		PID<1ppm		
		SAND SP: fine to medium, pale grey, trace ash, dry, alluvial and estuarine		E	0.9 1.0		PID<1ppm		
	1.5	Bore discontinued at 1.5m - Target Depth Reached		E	1.4 1.5		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.0 AHD
EASTING: 342230.9
NORTHING: 6269984.8
DIP/AZIMUTH: 90°/--

BORE No: BH13
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILL/Silty SAND SM: fine to coarse, brown and dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
		FILL/Silty SAND SM: fine to medium, dark grey, trace ash, moist		E	0.4 0.5		PID<1ppm		
	0.8	SAND SP: fine to medium, pale grey, moist		E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
				E	1.9 2.0		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342269.2
NORTHING: 6269752.5
DIP/AZIMUTH: 90°/--

BORE No: BH102
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
2	0.3	FILL/Silty SAND SM: fine to coarse, dark brown, trace clay and rootlets, moist		E B	0.0 0.03 0.1		PID<1ppm		
		FILL/SAND SW: fine to coarse, pale brown, trace gravel, concrete and glass, moist		E B	0.4 0.5		PID<1ppm PID<1ppm		
1	1.0	Silty SAND SM: fine to medium, dark grey, moist, alluvial and estuarine - From 1.3m: pale grey, wet		E* E	1.0 1.1 1.4 1.5		PID<1ppm PID<1ppm	▼	1
0	2.0	Bore discontinued at 2.0m - Target Depth Reached							2
-1	3								3
-2	4								4
-3	5								5
-4	6								6
-5	7								7
-6	8								8
-7	9								9

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 2.0m

WATER OBSERVATIONS: Free groundwater observedwhilst push tubing at 1.3m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD4/20200123 taken at 1.0-1.1m, Bulk sample for CBR taken from 0.5-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 1.9 AHD
EASTING: 342186.3
NORTHING: 6269783
DIP/AZIMUTH: 90°/--

BORE No: BH103
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.03	ASHPALTIC CONCRETE							
	0.12	CONCRETE: grey with aggregate <20mm		A	0.15 0.25		PID=5ppm		
	0.4	FILL/SAND SW: fine to coarse, brown, with sandstone gravels and cobbles, trace shells, moist		A	0.4 0.5		PID<1ppm		
				E					
	1	SAND SP: fine to medium, pale grey, moist, alluvial and estuarine			1.0				
				E*	1.4 1.5		PID<1ppm	▼	
	1.5	Bore discontinued at 1.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push Tube to 1.5m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200120 taken at 1.4-1.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.3 AHD
EASTING: 342153.3
NORTHING: 6269733.5
DIP/AZIMUTH: 90°/--

BORE No: BH104
PROJECT No: 86973.01
DATE: 21/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		A*	0.0 0.1		PID<1ppm		Well Plug and Flush Gatic Cover
		FILL/SAND SW: fine to coarse, pale brown, with shell fragments, moist		A	0.4 0.5		PID<1ppm		Concrete 0-0.15m Bentonite 0.15-1.1m Plain PVC 0-1.1m
	0.9			A	0.9		PID<1ppm		
	0.95	FILL/Silty CLAY CL-CH: low to medium plasticity, dark brown, trace rootlets and organic matter, moist (possible original topsoil)		E	0.95 1.0		PID<1ppm		
	1.38	FILL/SAND SW: fine to coarse, pale yellow-brown, with shell fragments, moist		E	1.4 1.5		PID<1ppm	▼	
		Silty SAND SM: fine to medium, grey, trace shells, moist, alluvial and estuarine		E	1.9 2.0		PID<1ppm		
		- From 1.6m: dark grey, wet							
		- From 2.3m: with organic matter		E	2.4 2.5		PID<1ppm		
	2.7	SAND SP: fine to medium, dark grey, trace shells, wet, alluvial and estuarine							
		- From 3.5m: saturated		E	3.5		PID<1ppm		Gravel 1.1-6.0m Machine Slotted PVC Screen 1.1-6.0m
					4.0				
				E	4.5		PID<1ppm		
					5.0				
				E	5.5		PID<1ppm		
					6.0				End Cap
		- From 6.5m: brown and grey		E	6.5		PID<1ppm		
	7.0	Silty SAND SM: fine to medium, brown, trace shell fragments, saturated, alluvial and estuarine			7.0				
				E	7.5		PID<1ppm		
	8.0	Bore discontinued at 8.0m - Target Depth Reached			8.0				

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** HW Cased to 6.0m

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 6.0m, Wash bore to 8.0m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.6m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD3/20200120 taken from 0-0.1m

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342146.9
NORTHING: 6269682.5
DIP/AZIMUTH: 90°/--

BORE No: BH105
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		A	0.0 0.1		PID<1ppm		
		FILL/SAND SW: fine to coarse, brown, trace shells and gravel, moist		A	0.4 0.5		PID<1ppm		
				E	0.9 1.0		PID=1ppm		
	1.4	- From 1.3m : dark brown		E	1.3		PID<1ppm		
		Silty SAND SM: fine to medium, grey, moist, alluvial and estuarine		E	1.4 1.5		PID<1ppm	▼	
		- From 1.62m: wet		E	1.9 2.0		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached		E	2.4 2.5		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 2.5m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.62m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342210.2
NORTHING: 6269674.3
DIP/AZIMUTH: 90°/--

BORE No: BH106
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		Well Plug and Flush Gatic Cover
	0.5	FILL/SAND SP: fine to medium, brown, trace glass, moist		E E*	0.3 0.4 0.5		PID<1ppm PID<1ppm		Concrete 0-0.15m Bentonite 0.15-0.4m Plain PVC 0-1.0m
		FILL/Sandy CLAY CH: medium to high plasticity, mottled red, yellow-brown, pale-brown and pale grey, with igneous, sandstone and ironstone gravel, trace clinker, moist		E	0.9 1.0		PID<1ppm		
	1.48	Silty SAND SM: fine to medium, grey, wet, alluvial and estuarine		E	1.4 1.5		PID<1ppm	▼	
				E	1.9 2.0		PID<1ppm		Gravek 0.4-4.0m
	2.5	SAND SP: fine to medium, grey, saturated, alluvial and estuarine		E	2.9 3.0		PID<1ppm		Machine Slotted PVC Screen 1.0-4.0m
	4.0	Bore discontinued at 4.0m - Target Depth Reached							End Cap

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m, Solid flight augers (TC-bit) 4.0m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200122 taken from 0.4-0.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.0 AHD
EASTING: 342209
NORTHING: 6269638.7
DIP/AZIMUTH: 90°/--

BORE No: BH107
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.28	FILL/Silty SAND SM: fine to coarse, dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
	0.72	FILL/SAND SW: fine to coarse, pale yellow-brown, trace shells, dry to moist		E*	0.4 0.5		PID<1ppm		
	1	FILL/SAND SW: fine to coarse, pale brown, with shell fragments, moist to wet		E	0.9 1.0		PID<1ppm		
	1.5			E	1.4 1.5		PID<1ppm	▼	
	1.7	FILL/Silty SAND SM: fine to medium, dark grey, trace ash, wet							
	2	SAND SP: fine to medium, grey, wet, alluvial and estuarine		E	1.9 2.0		PID<1ppm		
		- From 2.5m: dark grey		E	2.4 2.5		PID<1ppm		
	3.0	Bore discontinued at 3.0m - Target Depth Reached		E	2.9 3.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD1/20200122 taken at 0.4-0.5m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342248.5
NORTHING: 6269728.1
DIP/AZIMUTH: 90°/--

BORE No: BH108
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	FILL/TOPSOIL (Silty SAND) SM : fine to coarse, dark brown, with gravel, trace rootlets and ash, moist		E*	0.0 0.1		PID<1ppm		
	0.7	FILL/Silty SAND SM: fine to medium, brown, trace gravel, rootlets and ash, moist		E	0.4 0.5		PID<1ppm		
	1.2	FILL/SAND SW: fine to coarse, pale brown, trace shell, moist		E	0.9 1.0		PID<1ppm		
		SAND SP: fine to medium, pale grey, moist, alluvial and estuarine - From 1.5m: wet		E	1.4 1.5		PID<1ppm	▼	
		- From 2.1m: saturated		E	1.9 2.0		PID<1ppm		
	2.5	Bore discontinued at 2.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube 2.5m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD3/20200123 taken at 0.0-0.1m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342192
NORTHING: 6269605.7
DIP/AZIMUTH: 90°/--

BORE No: BH109
PROJECT No: 86973.01
DATE: 22/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/TOPSOIL (Silty SAND) SM: dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
	0.5	FILL/SAND SW: fine to coarse, pale brown, trace brick, moist		E	0.3 0.5		PID<1ppm		
		FILL/SAND SW: fine to coarse, pale brown, trace shells, moist		E*	0.9 1.0		PID<1ppm		
	1.45			E	1.4 1.45		PID<1ppm	▼	
	1.55	FILL/Silty SAND SM: dark grey, fine to coarse grained, trace rootlets, wet			1.55				
		SAND SP: grey, fine to medium grained, wet, alluvial and estuarine		E E	1.9 2.0		PID<1ppm PID<1ppm		
		- 2.4m: dark grey, sulphidic odour, mottled brown colour		E	2.4 2.5		PID<1ppm Slight Sulfidic Odour		
		= 2.7m: wuth shells to 2.9m, slight to no odour		E	2.9 3.0		PID<1ppm		
	3.0	Bore discontinued at 3.0m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 3.0m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.45m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD3/20200122 taken from 0.9-1.0

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.2 AHD
EASTING: 342180.6
NORTHING: 6269708.6
DIP/AZIMUTH: 90°/--

BORE No: BH110
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
2	0.05	FILL/Silty SAND SM: fine to medium, dark brown, trace roots, moist		A	0.1		PID<1ppm		
				A	0.2		PID<1ppm		
	0.35	FILL/Silty SAND SM: fine to medium, dark brown, moist		A	0.3		PID<1ppm		
					0.4				
	0.6	SAND SC: fine to medium, pale brown with gravel, trace clay, moist, alluvial and estuarine			0.5				
1				A	0.9		PID<1ppm		1
	1.1	SAND SW: fine to coarse, pale brown, trace shells, moist, alluvial and estuarine							
				A	1.2		PID<1ppm		
					1.3				
	1.5	SAND SW: fine to coarse, dark grey, moist, alluvial and estuarine - From 1.5m: fine to medium, pale grey		A	1.4		PID<1ppm		
					1.5				
0		Bore discontinued at 1.5m - Target Depth Reached							2
									3
-1									4
-2									5
-3									6
-4									7
-5									8
-6									9
-7									

RIG: Hand Tools **DRILLER:** LT/TB **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Hand auger to 1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342166.6
NORTHING: 6269590.6
DIP/AZIMUTH: 90°/--

BORE No: BH111
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILL/Silty SAND SM: fine to medium, dark brown, trace shells, gravel, organics and plastic, moist		A	0.0–0.1		PID<1ppm		Well Plug and Flush Gatic Cover Concrete 0-0.15m
				A	0.4–0.5		PID<1ppm		Bentonite 0.15-0.7m
	0.7	FILL/SAND SW: fine to coarse, pale brown, trace shells, moist							Plain PVC 0-1.0m
				E*	0.9–1.0		PID<1ppm		
	1.4	FILL/SAND SM: fine to coarse, dark grey, trace organic matter, ash and clay, moist		E	1.4–1.5		PID<1ppm	▼	
	1.7	SAND SP: fine to medium, grey and pale grey, trace roots and shell fragments, wet, alluvial and estuarine		E	1.9–2.0		PID<1ppm		
				E	2.4–2.5		PID<1ppm		
				E	3.0–3.5		PID<1ppm		Gravel 0.7-6.0
									Machine Slotted PVC Screen 1.0-6.0m
				E	4.0–4.5		PID<1ppm		
				E	5.0–5.5		PID<1ppm		
				E	6.0–6.5		PID<1ppm		End Cap
				E	7.0–7.5		PID<1ppm		
				E	7.5–8.0		PID<1ppm		
	8.0	Bore discontinued at 8.0m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** HW Cased to 6.0m

TYPE OF BORING: Solid flight augers (TC-bit) to 0.5m, Push tube to 5.5m, Wash bore to to 8.0m

WATER OBSERVATIONS: Free groundwater observed whlist push tubing at 1.5m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200120 taken at 0.9-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.1 AHD
EASTING: 342159.5
NORTHING: 6269622.3
DIP/AZIMUTH: 90°/--

BORE No: BH112
PROJECT No: 86973.01
DATE: 20/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
				A	0.0		PID<1ppm		
	0.3	FILL/TOPSOIL (Silty SAND) SM: fine to medium, dark brown, trace rootlets and clay, moist			0.1				
		FILL/Silty SAND SM: fine to coarse, brown with sandstone and igneous gravels and cobbles, trace concrete, buildling rubble and fibre cement sheet (asbestos containing material), moist		A	0.4		PID<1ppm		
	0.6			A1	0.5		Fibre cement sheet sample 'A1'		
					0.6				
		Bore discontinued at 0.6m - Refusal at depth 0.6m on possible gravel							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 0.6m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 2.3 AHD
EASTING: 342209.6
NORTHING: 6269719.7
DIP/AZIMUTH: 90°/--

BORE No: BH113
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.13	CONCRETE: grey with aggregate <20mm							
	0.16	FILL/GRAVEL GP: fine to coarse, grey brown, igneous and sandstone, with sand, moist		E	0.2		PID<1ppm		
	0.3			E	0.3		PID<1ppm		
					0.4				
		FILL/SAND SW: fine to coarse, brown and pale brown, with shells, moist		E	0.7		PID<1ppm		
	0.85				0.8				
		FILL/Clayey SAND SC: fine to coarse, brown, trace gravel, roots and ash, moist		E*	0.9		PID<1ppm		
					1.0				
		SAND SW: fine to coarse, dark grey and grey, moist, alluvial and estuarine		E	1.4		PID<1ppm		
					1.5			▼	
		- From 1.8m: wet		E	1.9		PID=2ppm		
		- From 2.1m: Saturated			2.0				
	2.5	Bore discontinued at 2.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 2.5m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 1.8m

REMARKS: Location coordinates are in MGA94 Zone 56. *Blind replicate sample BD2/20200123 taken at 0.9-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 3.4 AHD
EASTING: 342245.1
NORTHING: 6269787.8
DIP/AZIMUTH: 90°/--

BORE No: BH114
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/Silty SAND: fine to medium, dark brown, trace rootlets, moist		E	0.0 0.1		PID<1ppm		
		FILL/SAND SM: fine to coarse, brown, with shells and organic matter, trace silt moist		E	0.4 0.5		PID<1ppm		
				E	0.9 1.0		PID<1ppm		
		- From 1.8m: with irontstone and concrete gravel							
	2.6	Bore discontinued at 2.6m - Refusal at 2.6m on possible gravel							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 2.6m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 5.0 AHD
EASTING: 342260.1
NORTHING: 6269797.7
DIP/AZIMUTH: 90°/--

BORE No: BH116
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	FILL/Silty SAND SM: fine to medium, trace clay, roots							
		FILL/SAND SW: fine to coarse, pale brown, with shells, moist		E	0.4 0.5		PID<1ppm		
				E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
				E	1.9 2.0		PID<1ppm		
				E	2.4 2.5		PID<1ppm		
				E	2.9 3.0		PID<1ppm		
	3.1			E	3.1 3.2		PID=2ppm		
	3.2	FILL.Silty SAND SM: fine to coarse, brown, trace clay, moist		E	3.4		PID<1ppm		
	3.5	FILL/SAND SP: fine to medium, red-brown, moist		E	3.5 3.6		PID<1ppm		
	3.7	Silty SAND SM: fine to medium, dark brown, trace organic matter, moist			3.7				
		SAND SP: fine to medium, pale brown, moist, alluvial and estuarine		E	4.1 4.2		PID<1ppm		
	4.5	- From 4.4m: wet		E	4.4 4.5		PID<1ppm	▼	
		Bore discontinued at 4.5m - Target Depth Reached							

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Push tube to 4.5m

WATER OBSERVATIONS: Free groundwater observed whilst push tubing at 4.5m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: NSW Department of Education
PROJECT: Narrabeen Education Project
LOCATION: Namona St, North Narrabeen

SURFACE LEVEL: 4.5 AHD
EASTING: 342258.2
NORTHING: 6269781.2
DIP/AZIMUTH: 90°/--

BORE No: BH117
PROJECT No: 86973.01
DATE: 23/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL/SAND SM: fine to medium, dark brown, trace silt and roots, moist		E	0.1 0.2		PID<1ppm		
	0.6	FILL/SAND SM: fine to coarse, pale brown, with shells, trace ash and asphaltic concrete, dry		E	0.4 0.5		PID<1ppm		
		FILL/ Silty SAND SM: fine to coarse, brown, with shells, trace gravel, moist		E	0.9 1.0		PID<1ppm		
				E	1.4 1.5		PID<1ppm		
				E*	1.9 2.0		PID<1ppm		
				E	2.4 2.5		PID<1ppm		
	2.7	SAND SW: fine to coarse, orange-brown, trace shell grafments, moist		E	2.9 3.0		PID=2ppm		
	3.0	SAND SP: fine to medium, pale grey, moist, alluvial and estuarine - From 3.5m: wet		E	3.4 3.5		PID<1ppm	▼	
	4.0	Bore discontinued at 4.0m - Target Depth Reached		E	3.9 4.0		PID<1ppm		

RIG: MD-200 **DRILLER:** Tightsite **LOGGED:** LT **CASING:** Uncased

TYPE OF BORING: Solid flight augers (TC-bit) to 4.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 3.5m

REMARKS: Location coordinates are in MGA94 Zone 56. * Blind replicate sample BD5/20200123 taken at 1.9-2.0m

SAMPLING & IN SITU TESTING LEGEND

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

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Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with 'Mix of Soil and Cobbles/Boulders' with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

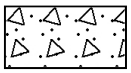
Symbols & Abbreviations

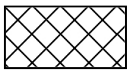
Graphic Symbols for Soil and Rock

General

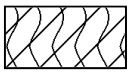

Asphalt

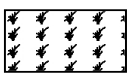

Road base

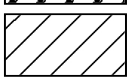

Concrete


Filling

Soils


Topsoil

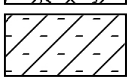

Peat


Clay


Silty clay

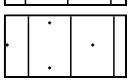

Sandy clay

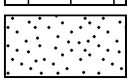

Gravelly clay

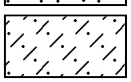

Shaly clay

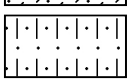

Silt


Clayey silt


Sandy silt

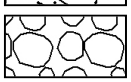

Sand


Clayey sand


Silty sand


Gravel

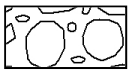

Sandy gravel


Cobbles, boulders

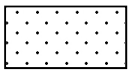

Talus

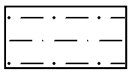
Sedimentary Rocks

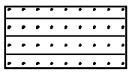

Boulder conglomerate

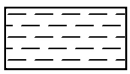

Conglomerate


Conglomeratic sandstone

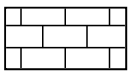

Sandstone


Siltstone

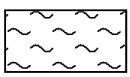

Laminite

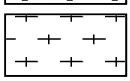

Mudstone, claystone, shale

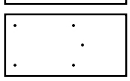

Coal


Limestone

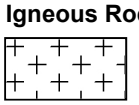
Metamorphic Rocks

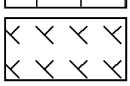

Slate, phyllite, schist

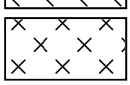

Gneiss

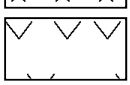

Quartzite

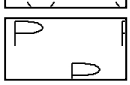
Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix D

Action Criteria and Treatment Verification

Appendix D
Action Criteria and Treatment Verification
Narrabeen Education Precinct, Namona Street, Narrabeen

D1.0 Introduction

This appendix details the acid sulfate soil (ASS) action criteria, ASS treatment verification criteria, equations for net acidity and waste classification criteria. The action criteria are based on Sullivan *et al* (2018).

D2.0 Action Criteria

The following section provides the action criteria to determine if material is classified as ASS and therefore if ASS management is required.

D2.1 Field Screening

Field screening indicators do not form part of the action criteria as such but can be used to provide an indication of the ASS status and to assist in selecting samples for laboratory testing for comparison against the action criteria.

Field screening is indicative only and can give false positive and false negative indications of the presence of ASS. False positives can be caused by organic matter, which often "froths" during oxidation. False negatives can be caused by shells in the soil. Indicators of ASS from field screening comprise:

- Field pH is less than or equal to pH 4;
- pHfox (pH of oxidised sample) is less than 3.5;
- A decrease of more than 1 pH unit from the field pH to the pHfox;
- Bubbling, production of heat or release of sulphur odours during pHfox testing; and
- Change in colour from grey to brown tones during oxidation.

D2.2 Laboratory Analysis

The action criteria triggers are the basis for determining if ASS management (and associated plan) is required. They are based on Net Acidity (refer Section D3.2.1 for further detail). As clay content tends to influence a soil's natural buffering capacity, the action criteria are grouped by three broad texture categories - coarse, medium and fine. If the Net Acidity of any individual soil material tested is equal to or greater than the action criteria a detailed ASSMP needs to be prepared.

The test results can be used to evaluate the presence / absence of ASS through comparison with the action criteria. If the results indicate the absence of ASS, treatment is not required. The following Table D1 provides the action criteria taken from Table 4.4, ASSMAC (1998).

Table D1: Action Criteria

Type of Material		Net Acidity#			
		1-1000 t Materials Disturbed		>1000 t Materials Disturbed	
Texture Range (NCST 2009)*	Approximate Clay Content %)	% S-equiv (oven dried basis)	Mol H+/t (oven dried basis)	% S-equiv (oven dried basis)	Mol H+/t (oven dried basis)
Fine: Light medium to heavy clay	>40	≥ 0.1	≥ 62	≥ 0.03	≥ 18
Medium: Clayey sand to light clays	5-40	≥ 0.06	≥ 36	≥ 0.03	≥ 18
Coarse and Peats: Sands to loamy sands	<5	≥ 0.03	≥ 18	≥ 0.03	≥ 18

* If bulk density values are not available for the conversion of cubic meters to tonnes of soil, then the default bulk densities based on the soil texture in Table D2, may be used.

Net Acidity can only include a soil material's measured Acid Neutralising Capacity where this measure has been corroborated by other data (for example slab incubation data) that demonstrates the soil material does not experience acidification during complete oxidation under field conditions (Equation D1). Where the Acid Neutralising Capacity has not been corroborated, the Net Acidity must be determined using Equation D2.

Table D2: Default Bulk Densities Based on Soil Texture

Texture	Bulk Density (t/m^3)
Sand	1.8
Loamy Sand	1.8
Sandy Loam	1.7
Loam	1.6
Silty Loam	1.5
Clay Loam	1.5
Clay	1.4
Peat	1.0

D3.0 Verification of Treatment

The treatment of ASS typically comprises the addition of a neutralising agent such as lime. The actual treatment requirements are outlined in the ASSMP. The following section provides the equations and methods of verifying that the neutralisation treatment has been successful / completed.

D3.1 Field Screening

Field screening results generally indicate that the soils have been successfully neutralised if the following conditions are met. When soils do meet the following criteria, confirmatory laboratory testing should be undertaken (noting that field results are a screen only and should not be taken in isolation as a means of verification).

- Field pH is ≥ 5.5 (but ideally between pH 6.5 and 8.5); and
- pHfox ≥ 6.5.

D3.2 Laboratory Testing

The material will be considered to successfully treated where:

- pHKCL is ≥ 6.5;
- TAA (total actual acidity) = 0; and
- Net acidity ≤ 0. Net Acidity must be determined by one of the methods outlined in Section D3.2.1.

Note: Where TAA and net acidity are calculated to be less than the laboratory reporting limit, the result is assumed to be 0 for the purpose of the above.

D3.2.1 Net Acidity

Net acidity is the quantitative measure of the acidity hazard of ASS materials. It is determined from an Acid Base Accounting (ABA) approach using either:

- Equation D1 - When the effectiveness of a soil material's measured Acid Neutralising Capacity has been corroborated by other data demonstrating the soil material does not experience acidification during complete oxidation under field conditions; or
- Equation D2 - When the effectiveness of a soil material's measured Acid Neutralising Capacity has not been corroborated by other data; or
- Equation D3 - When the effectiveness of a management approach involving the addition of liming materials is being verified post treatment via calculation of the Verification Net Acidity.

Equations D1 and D2 are used to determine the net acidity prior to treatment of ASS / PASS and therefore if acid sulfate soil treatment and / or management plan is required. Equation D3 is used to determine the neutralisation treatment has been successful.

Equation D1 Net Acidity whereby acid neutralising capacity (ANC) has been corroborated by other data.

Net Acidity = potential sulfidic acidity + actual acidity + retained acidity - Acid Neutralising Capacity

Net Acidity = Scr + S-TAA at pH 6.5 + SNAS - s-ANCBT

Equation D2 Net Acidity whereby ANC has not been corroborated by other data.

Net Acidity = potential sulfidic acidity + actual acidity + retained acidity

Net Acidity = Scr + S-TAA at pH 6.5 + SNAS

Equation D3 Verification Net Acidity.

Verification Net Acidity = potential sulfidic acidity + actual acidity + retained acidity - (post neutralised Acid Neutralising Capacity - pre neutralised Acid Neutralising Capacity)

Verification Net Acidity = Scr + S-TAA at pH 6.5 + SNAS - (ANCBT of treated material - ANCBT of untreated material)

D4.0 Off-Site Disposal Requirements

Prior to disposal off-site the treated material must be classified in accordance with the relevant guidelines. The following subsections discuss disposal options.

D4.1 Waste Classification

If soil is disposed to landfill post treatment, it must be classified in accordance with *Protection of the Environment Operations Act 1997*, including the current guidelines, namely the *Waste Classification Guidelines - Part 1: Classifying Waste* and *Part 4: Acid Sulfate Soils* (NSW EPA, 2014).

Referenced should also be made to DP (2022) for additional waste classification information.

D4.2 Disposal as PASS

Further guidance for the disposal of untreated natural material as PASS is provided in Appendix F of this ASSMP.

D4.3 Virgin Excavated Natural Material

In addition, the following additional information is provided with respect to natural soils.

The POEO Act defines virgin excavated natural material (VENM) as:

'natural material (such as clay, gravel, sand, soil or rock fines):

(a) That has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities; and

(b) That does not contain any sulphidic ores or soils or any other waste.

and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA Gazettal notice.'

ASS and treated ASS cannot be classified as VENM.

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Appendix E

Liming Rate Equations

Appendix E
Liming Rate Equations
Narrabeen Education Precinct, Namona Street, Narrabeen

E1. Introduction

This Appendix provides the equations for the calculation of liming rates.

E2. Liming Rates

The required dosing rate can be calculated from one of the following formulas.

Equation E1:

Neutralising Material Required (kg CaCO3/tonne soil) = (Net acidity (mol H+/t) / 19.98) x FOS x 100/ENV

Equation E2:

Neutralising Material Required (kg CaCO3/m3 soil) = D (tonne/m3) x (Net acidity (mol H+/t) / 19.98) x FOS x 100/ENV

Where:

- Net acidity (mol H+/t) is derived using the 95% UCL of the Net Acidity (%S) using the methods in Appendix D;
- 19.98 converts to kg CaCO3/tonne;
- FOS (factor of safety) = a minimum value of 1.5 needs to be adopted, although values of up to 2 can be suitable;
    - ENV = Effective Neutralising Value (e.g., Approx. 98% for fine (0.3 mm grain size) ag lime with an NV of 98%).
    - D = bulk density, site specific results can be used, or the bulk densities in Table 2 of Appendix D should be used.

Notes:

The ENV is calculated based on the molecular weight, particle size and purity of the neutralising agent and should be assessed for proposed materials in accordance with ASSMAC (1998).

Natural net acidity must not be used.

An initial liming rate based on the laboratory result calculation (excluding ANC) is considered appropriate where it includes a safety factor of 1.5, the use of ag lime with an NV of at least 98% and a grain size of less than 0.5 mm.

The liming rate to be calculated from the analytical results should therefore be considered as a “starting point”, and pH monitoring should be conducted during treatment to assess the progress of the neutralisation, and need for additional mixing and/ or addition of ag lime. Material will only be considered to have been successfully treated when all soil has been verified in accordance with Section 8.

Douglas Partners Pty Ltd

Appendix F

Contingency Options to On-Site Treatment

Appendix F
Contingency Options to On-Site Treatment
Narrabeen Education Precinct, Namona Street, Narrabeen

F1. Introduction

This Appendix provides the contingency options to on-site treatment of acid sulfate soils (ASS).

F2. Off-Site Treatment and Disposal

Where on-site treatment of ASS is not possible and / or practical then off-site treatment at a facility appropriately licenced to accept and treat such material can be considered. Once a licensed facility is nominated for the treatment of ASS, the below general procedure should be followed for off-site treatment:

- Loading the material into trucks. Note if the soils are wet, they will be heavier than soils as normally transported at field moisture. This should be taken into consideration when loading trucks to ensure that trucks are not overloaded;
- Transport must be conducted in a sealed truck which prevents water leaking from the truck during transport;
- Completion of site records of the above and all information required by the treatment facility, and provision of copies of these records to the treatment facility;
- Transporting of material to the treatment facility;
- Once the ASS has been accepted by treatment facility they will treat and manage it in accordance with ASSMAC (1998)[1] and their Environmental Protection License (EPL) conditions, subject to the verification procedures documented herein. The indicative liming rate based on current data is provided in DP (2022), which also incorporates results from DP (2020), and referenced in Section 7.1.2 of the ASSMP;
- Verification of the treatment of the ASS and classification of the soil by an environmental consultant in accordance with Section 8 of this ASSMP; and
- Transport of the treated and verified ASS back to the site, or a nominated and licensed disposal facility.

[1] Acid Sulfate Soils Management Advisory Committee, *Acid Sulfate Soils Manual,* 1998 (ASSMAC, 1998.)

F3. Off-Site Disposal as PASS

For potential acid sulfate soil (PASS) associated with natural soils the following management options are available.

F3.1 PASS Criteria

EPA (2014), Part 4 states that:

'*Potential ASS may be disposed of in water below the permanent water table, provided:*

- *This occurs before they have had a chance to oxidise, i.e., within 24 hours of excavation; and*
- *They meet the definition of 'virgin excavated natural material' (VENM) under the Protection of the Environment Operations Act 1997, even though they contain sulfidic ores or soils*.'

For the purposes of this ASSMP, PASS is defined in accordance with the NSW EPA (2014) *Waste Classification Guidelines, Part 4: Acid Sulfate Soils.*

This classification is applicable for direct disposal of untreated PASS to a landfill licenced by the EPA to accept PASS.

EPA (2014) allows direct disposal of ASS which are classified as PASS and managed as below:

- The soils meet the definition of VENM in all aspects other than the presence of sulphidic soils or ores;
- The pH of soils in their undisturbed state is pH 5.5 or more;
- The soil has not dried out or undergone any oxidation of its sulphidic minerals;
- Soil is received at the disposal point within 16 hours of excavation, and kept wet at all times between excavation and reburial at the disposal point;
- Appropriate records are provided to the receiving site with every truck load confirming that it meets the above criteria; and
- The receiving site meets its obligations under EPA (2014) and its licence conditions.

F3.2 Disposal as PASS

The below works are to be undertaken by an appropriately trained staff:

- Agreement with receiving site on acceptance times for trucks, and allowable time lapse between excavation and acceptance by receiving site;
- Materials kept wet at all times, and are to be sprayed with water if required to keep them wet;
- Recording of the excavation date, time and source chainage of the excavated material;
- Inspection of the excavated material for moisture content, material texture / signs of contamination concern, such as anthropogenic odours, staining or inclusions by nominated personnel involved in the management / handling of the soils;

- Limited to natural soils not impacted by fill other contaminants;
- Measuring the pH in at least one sample per 50 m^3 and a minimum of five per shift, using a calibrated pH meter;
- If the pH is less than or equal to 6.5, the material will not be classified as PASS, and the material is to be segregated for further assessment and treatment;
- Loading the material into trucks and ensuring the material is moist enough to prevent it drying out during transport. Note: due to the soils being wet, they will be heavier than soils as normally transported at field moisture (PASS is estimated to be at least 2 t/m^3). This should be taken into consideration when loading trucks to ensure that trucks are not over loaded;
- Material is to be loaded and transported as soon as possible to minimise the risk of oxidisation, which prevents it from being classified as PASS;
- Transport must be conducted in a sealed truck which prevents water leaking from the truck during transport;
- Completion of site records of the above;
- Completion of records of all information required by the receiving site, and provision of copies of these records to the receiving site, including copies sent with the truck driver for the load being carried;
- Transporting of material meeting the PASS requirements to of the receiving site within 16 hours of excavation (or earlier if required by the receiving site);
- Once the PASS has been accepted by the receiving site they are required to manage it in accordance with the their EPL conditions; and
- Any material which is rejected by receiving site is to be transported back to the site and managed in accordance with the ASSMP.

Douglas Partners Pty Ltd