Douglas Partners
Geotechnics / Environment / Groundwater

Report on
Geotechnical Investigation

Proposed Hastings Secondary College Port Macquarie
Campus Upgrade
16 Owen Street, Port Macquarie

Prepared for
School Infrastructure NSW
c\- Currie & Brown

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Geotechnical Investigation
Proposed Hastings Secondary College Port Macquarie Campus Upgrade
16 Owen Street, Port Macquarie

1. Introduction

Douglas Partners Pty Ltd (DP) has been commissioned by School Infrastructure NSW (SINSW) on behalf of the Department of Education (DOE) to undertake a geotechnical investigation to accompany a State Significant Development Application (SSDA) to the NSW Department of Planning, Industry and Environment (DPIE) for proposed upgrades to Hastings Secondary College (Port Macquarie Campus), previously known as Port Macquarie High School.

Hastings Secondary College consists of two campuses, being Westport and Port Macquarie. This report has been prepared for proposed works at the Port Macquarie Campus, which consists of two properties, the main campus and the Ag Plot.

The works subject to this proposal are to be carried out on the main Port Macquarie campus which is located at 16 Owen Street, Port Macquarie (the site). The site has a secondary street frontage to Burrawan Street and adjoins Oxley Oval along the eastern boundary.

On 23 December 2020, the Secretary of the DPIE issued Secretary's Environmental Assessment Requirements (SEARs) for SSD Application No. 11920082. This report has been prepared in accordance with the SEARs requirements.

The upgrades will support high-quality educational outcomes to meet the needs of students within the local community and deliver innovative learning and teaching spaces as follows:

- Demolition works to accommodate new works;
- Upgrade to school entry;
- Construction of new two (2) storey Creative and Performing Arts (CAPA) building;
- Construction of new Police Citizens Youth Club (PCYC);
- Partial refurbishment of Building L;
- Refurbishment and alteration to Building B;
- Removal of Building S and demountable buildings;
- New lift connections, covered outdoor learning area (COLA) and covered walkways;
- Associated earthworks, landscaping, stormwater works, service upgrades; and
- Tree removal/ tree safety works.

No change to current staff or student numbers is proposed.

The proposed development is shown on the fjmt Site Plan (Ref SSDA-120010 Rev 05) in Appendix D

The aim of the geotechnical investigation was to provide comment on the following:

- Subsurface soil and groundwater conditions at test locations;
- Desktop review of previous investigations undertaken at the school;
- Earthquake design parameters;
- Excavation conditions and safe batter slopes;
- Design parameters for retaining walls; and
- Geotechnical design parameters for high level or shallow piled footings.

The investigation included the drilling of five boreholes and laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the items listed above. This investigation was undertaken concurrently with a contamination assessment for the proposed development which has been report separately.

DP have previously prepared a desktop geotechnical assessment for the site (DP, 2019). The previous report presents desktop data including previous geotechnical investigations, regional geology, soil landscape, acid sulfate soils, naturally occurring asbestos and topography which this report should be read in conjunction with. The report also provided high level preliminary design geotechnical parameters for the site.

DP have also undertaken an intrusive geotechnical investigation at the site for the proposed development (DP, 2020). The previous investigation included the drilling of five (5) boreholes, laboratory testing of selected samples and the preparation of a geotechnical report.

2. Site Description

The site is located approximately 1.2km south east of the Port Macquarie town centre, with access from Oxley Highway (Gordon Street) via Owen Street to the centre, William Street via Owen Street to the north and Burrawan Street via Owen Street to the south. A maintenance access road exists to the east of the site along Burrawan Street.

The site is located at 16 Owen Street, Port Macquarie and is legally known as Lot 111 in DP 1270315. The Port Macquarie Campus site is located within a coastal setting (east), with residential (single two storey and residential flat buildings) located to the west and south and Port Macquarie Bowling Club to the north. The surrounding street network provides on-street parking. Maintenance vehicular access is located off Burrawan Street.

No Natural watercourses are mapped as traversing the site. Scattered vegetation is located throughout the site, with a small area of vegetation concentrated towards the pedestrian access area.

The Port Macquarie Campus site is gently sloping downwards in three general ‘platforms’ towards the north, with distinct views out towards the ocean and the Hastings River. It also has a distinct view line to the row of Norfolk pine trees along the coastline. The siting of the campus provides many opportunities for ongoing cultural connection to Country. Current built form has an established language of two (2) story, face brick, low pitched metal roof buildings.

The investigation was focussed on the following two areas proposed for redevelopment within the greater Port Macquarie Campus of Hastings Secondary College (the site) as indicated on Figure 1:

- Area 1 - Proposed PCYC building;
- Area 2 - Proposed CAPA building.

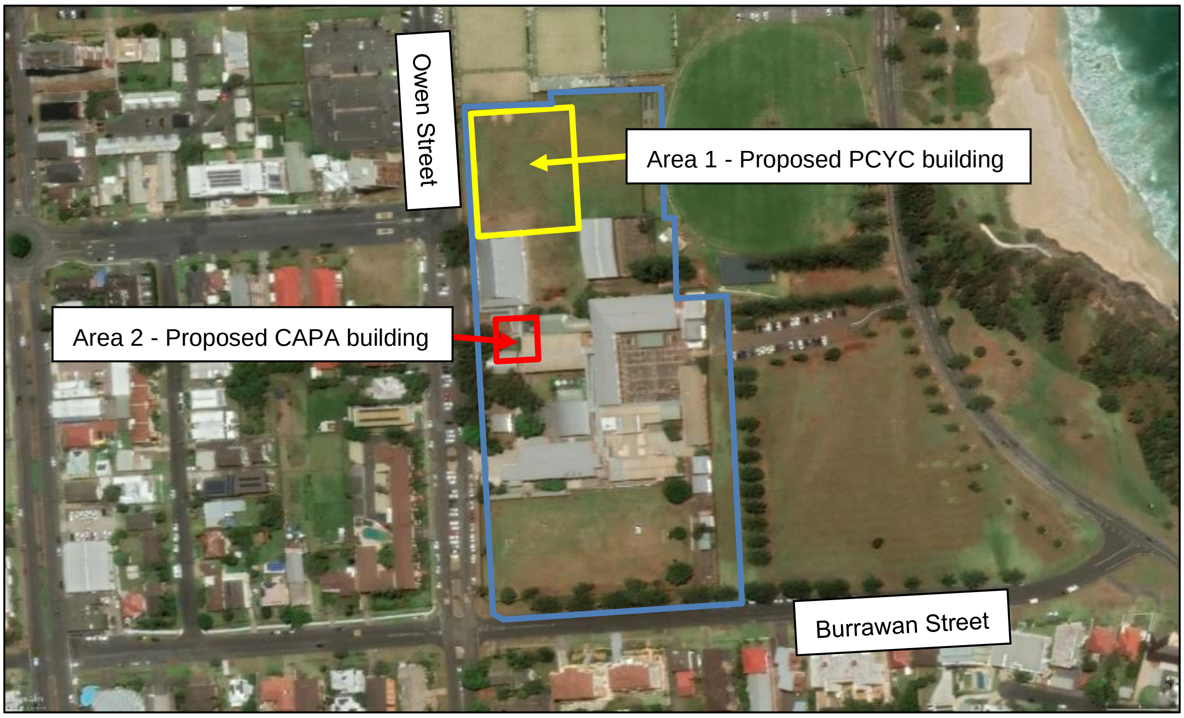


Figure 1: Boundary of Hastings Secondary College (blue outline), proposed PCYC building extent (yellow outline) and proposed CAPA building extent (red outline) (image sourced from Google Earth, dated January 2020)

Area 1 – PCYC Building

This area has a good covering of grass and is currently used as a playing field. The area is generally flat and level.

The following photos show parts of Area 1 during the investigation.

Figure 2: View of Area 1 from north-western corner of the site

Figure 3: View of Area 1 from south-western corner of Area 1

Figure 4: Drill rig on Bore 202 within Area 1 near the north-western boundary of the site

Area 2 – CAPA Building

This area consisted of a grassed area with some trees and a concrete and paver footpath. A wooden table and chairs, and above ground gas cylinder, were also present in the area. A retaining wall up to approximately 2 m in height is located along the northern boundary of the area adjacent to the existing MPC Hall building.

The following photos show parts of the area during the investigation.

Figure 5: View from the north-eastern corner of Area 2 with table and chairs, and above ground gas cylinder

Figure 6: Drill rig on Bore 203 within Area 2 near the western boundary of the site

Figure 7: View of retaining wall along the northern boundary of Area 2

3. Summary of Previous Investigations

The following relevant reports have been previously prepared by DP within the Port Macquarie Campus of Hastings Secondary College at 16 Owen Street, Port Macquarie (the site):

- *Report on Desktop Geotechnical Assessment, Proposed School Upgrade, Hastings Secondary College, Port Macquarie Campus, Owen Street, Port Macquarie*, Report 89754.00.R.001.Rev0 dated 3 December 2019 (DP, 2019); and
- *Report on Geotechnical Investigation, Proposed School Upgrade, Owen Street, Port Macquarie*, Report 89754.00.R.005.Rev0, dated 11 March 2020 (DP, 2020).

A summary of the relevant findings of the previous reports are provided below.

Desktop Geotechnical Assessment (DP, 2019)

The desktop assessment undertook a review of available in house projects and other readily available data (i.e. geology, soil landscape maps etc) to provide a high level assessment of the site from a geotechnical perspective.

Previous investigations within the nearby area indicated residual soil profile overlying weathered bedrock at relatively shallow depth with the depth to bedrock increasing towards the west.

Geology mapping indicated that the majority of the site is underlain by the Watonga Formation which typically comprises slate, chert, sandstone and metabasalt. The north-western corner of the site is underlain by the Tacking Point Complex which typically comprises serpentinite, rodingite and serpentinised peridotites and orthopyroenite.

Soil landscape mapping and previous investigations indicated that the site is underlain by residual soils of the Thrumster landscape. By definition, residual soils cannot be Acid Sulfate Soils (ASS). The site is not within a mapped area of acid sulfate soils. Further assessment of acid sulfate soil conditions against the relevant NSW Acid Sulfate Soil Manual and Guidelines was therefore not warranted.

The site is within an area of “high potential for occurrence” of naturally occurring asbestos.

The report provided an indicative site classification for the site of ‘Class P’, ‘Class M’ or ‘Class H1’ depending on the final location of the proposed development and the subsoil profile. Shallow strip or pad footings were considered feasible for the site. Piled footings were also considered suitable for the site founded in either stiff or stronger clay, or the underlying bedrock.

It was considered that the site is feasible for the proposed development from a geotechnical perspective, but additional investigations should be undertaken to confirm the assumptions within the desktop assessment.

Intrusive Geotechnical Investigation (DP, 2020)

Following the desktop assessment intrusive investigation at the site was undertaken. Five (5) boreholes were drilled at client nominated locations across the site to assess subsurface soil conditions and allow collection of samples for subsequent laboratory testing.

The location of the boreholes undertaken for this assessment are shown on Drawing 1 in Appendix D. Borehole logs from the previous investigation are also included in Appendix B. Generally the subsurface profile consisted of surficial fill up to 0.6m depth overlying very stiff to hard residual silty clay / clay to depths ranging from 2.5 m to 3.6 m depth. This was further underlain by extremely weathered bedrock to the depth of the investigation.

Laboratory testing included two (2) shrink swell tests on undisturbed samples of the residual clay which indicated shrink swell indices in the range of 2.0% to 3.2%. Two (2) samples were also submitted for pH, electrical conductivity (EC), soluble sulphate (SO_4) and soluble chloride (Cl), to provide an indication of the aggressivity of the sampled soils to buried steel and concrete. The results of the testing indicated that the soils were generally non-aggressive to steel and mildly aggressive to concrete.

The report indicated that the site would be classified as ‘Class P’ due to the presence of existing buildings and trees on the site which could have unusual subsoil moisture conditions. However, indicative surface movements of the site soils would be commensurate with a ‘Class M’ site classification.

The report indicated that shallow footings could be founded within the stiff clay below the surficial fill. Piled footings could also be suitable at the site within the extremely weathered bedrock.

The report also indicated recommended geotechnical design parameters for proposed retaining walls and earthquake design parameters for the site being a hazard factor of 0.06 and the site sub soil class would be C_e “Shallow Soil”.

4. Salinity Mapping

Reference to the NSW Central Resource for Sharing and Enabling Environmental Data (SEED) information system eSPADE indicates that soils in the surrounding area have shown no salting evident within available soil profiles.

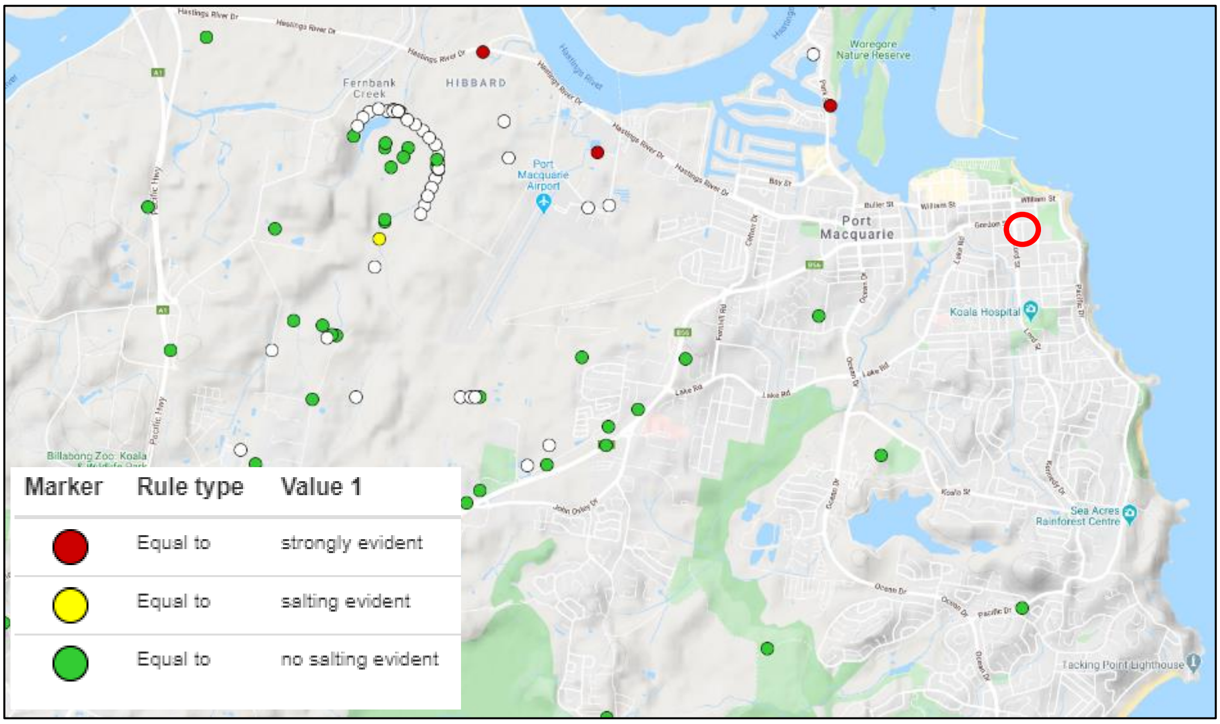


Figure 8: Soil profiles with salinity potential with approximate site location (red outline)

The following figures from eSPADE show modelled soil properties for soils 0.3 m to 1 m below the ground surface for Cation exchange capacity (CEC), electrical conductivity (EC) and exchangeable sodium percentage (ESP).

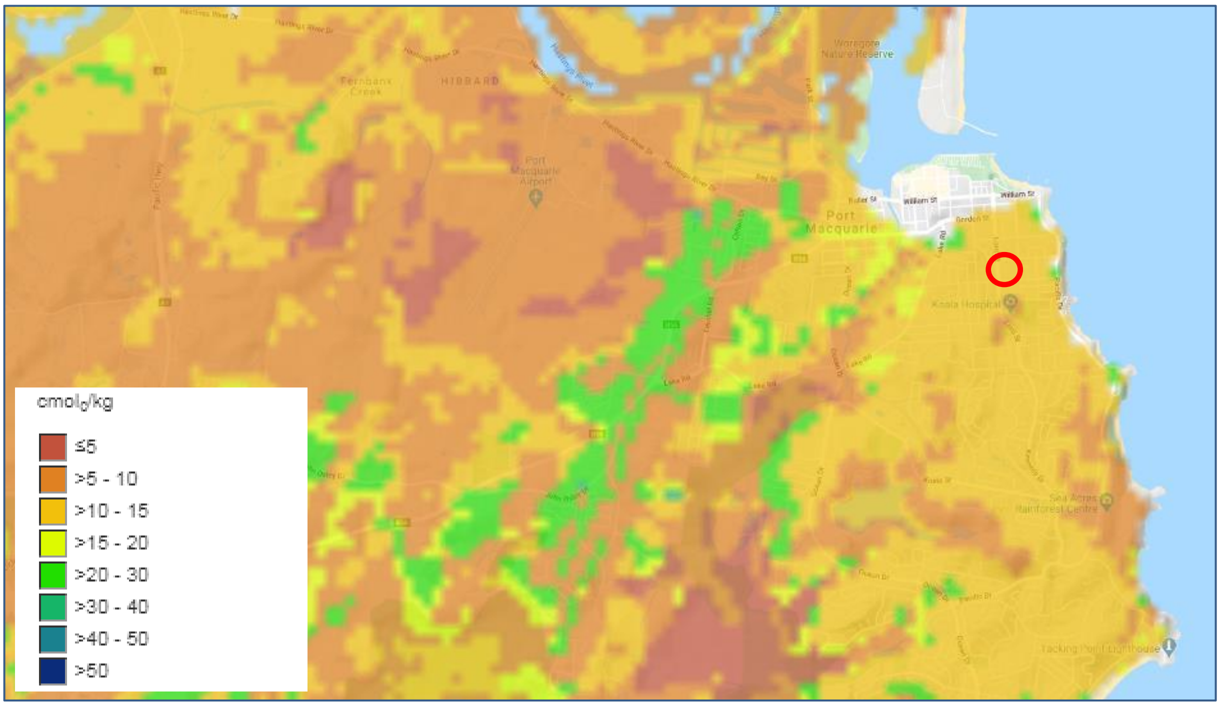


Figure 9: Modelled cation exchange capacity with approximate site location (red outline)

Figure 10: Modelled electrical conductivity with approximate site location (red outline)

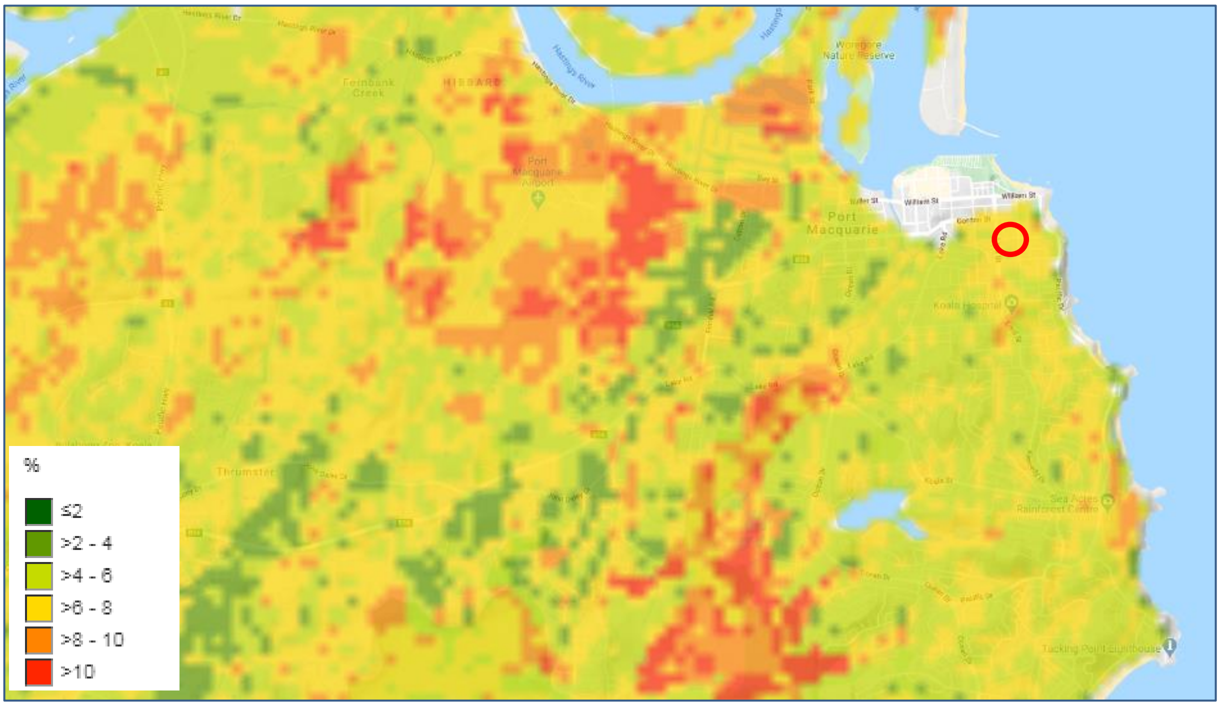


Figure 11: Modelled exchangeable sodium percentage with approximate site location (red outline)

5. Field Work

5.1 Methods

The field work was undertaken on 8 and 9 February 2021 and comprised services checking with a professional underground service locator and subsurface investigation which included the drilling of five (5) boreholes (Bore 201 to 205) within the three investigation areas (refer Drawing 1 in Appendix D and Figure 1, above). The boreholes were drilled using a track mounted drilling rig fitted with solid flight augers to depths of 5.0 m and 6.0 m.

Standard penetration tests (SPTs) were undertaken at regular depth intervals to provide information on the relative strengths or densities of the subsurface soils. Pocket penetrometer (PP) testing was also carried out on selected samples to supplement the SPTs.

In situ testing at each borehole included dynamic penetrometer tests (DPTs, with cone tip). The tests were carried out from the surface to a depth of up to 1.2 m.

The locations of the boreholes were recorded using a hand held GPS which generally has an accuracy of about ±5 m depending on satellite coverage and surrounding site conditions, to Map Grid of Australia (MGA). The surface levels for the bores were obtained by interpolating from 2 m elevation contours data obtained from the NSW Department of Planning. The coordinates and surface level of the bores are presented on the borehole logs in Appendix B and should be considered as approximate.

The boreholes were set out by a geotechnical engineer from DP with reference to accessible locations, the location of buried services and the layout of the proposed development. The approximate locations of the boreholes are shown on Drawing 1 in Appendix D. The geotechnical engineer logged the subsurface profile in each bore and collected regular samples for identification purposes and laboratory testing.

5.2 Results

The subsurface conditions encountered at the test locations are presented in detail in the borehole logs included in Appendix B. These should be read in conjunction with the accompanying notes in Appendix A, which explain the descriptive terms and classification methods used in the logs.

The subsurface conditions encountered within the bores for the current investigation are summarised below in Table 1.

Table 1: Summary of Subsurface Profile (Current Investigation, Bores 201 to 205)

Depth (m)		Stratum	Description
From	To		
Surface (0.0)	0.05 / 0.7	Topsoil / Fill	Generally brown, sandy silt / silty sand, trace clay and gravel, dry, M<Wp (encountered in Bores 201 and 202 50 mm thick concrete pavers and bedding sand were encountered in Bore 203. 100 mm thick concrete layer was encountered in Bore 204. 150 mm of concrete was also encountered on the surface in Bore 4 during the previous investigation.
Surface (0.0) / 0.7	0.15 / 2.0	Fill	Generally brown, red brown, dark grey, clay, gravelly clay, sandy silt and silty clay, M<Wp to M~Wp (encountered in all bores)
0.4 / 2.0	2.0 / 5.5	Clay	Generally very stiff to hard, grey, red brown, pale brown, with silt, trace gravel, M<Wp (encountered in all bores)
2.0 / 5.5	>5.0 / >6.0	Extremely Weathered Bedrock	Very stiff to hard, green grey, brown clay with rock like structure. Based on limited penetration of SPT and parent rock structure visible (encountered in all bores except Bore 205 and Bores 101 to 103 which were terminated at shallow depths)

Notes to Table 1:

M = Moisture content of soil W_p = Plastic limit of soil

Free groundwater was encountered at 5.7 m depth in Bore 201 and seepage at 2 m depth in Bore 202. No free groundwater was encountered in the remaining bores whilst they remained open. It should be noted that groundwater levels are affected by factors such as flooding, climatic conditions and soil permeability and will therefore vary with time.

The following table summarises the results of all tests undertaken at the site.

Table 2: Summary of All test Locations

Location	Total Depth (m)	Depth to base of profile (m)			
		Topsoil / Fill	Clay	Extremely Weathered Bedrock	Groundwater
1	4.0	0.4	3.55	>4.0	NE
2	4.0	0.6	3.55	>4.0	NE
3	4.0	0.2	3.5	>4.0	NE
4	4.0	0.18	2.5	>4.0	NE
5	4.45	0.15	2.5	>4.45	NE
101	1.0	0.55	>1.0	NE	NE
102	1.0	0.2	>1.0	NE	NE
103	1.0	0.2	>1.0	NE	NE
201	6.0	1.0	5.5	>6.0	5.7
202	5.0	2.0	3.5	>5.0	2.0*
203	5.0	0.6	2.5	>5.0	NE
204	5.0	0.4	2.0	>5.0	NE
205	5.0	0.6	>5.0	NE	NE

Notes to Table 2: NE – Not encountered * Groundwater seepage

6. Laboratory Testing

6.1 Geotechnical

Geotechnical laboratory testing was undertaken at DP Port Macquarie NATA registered laboratory on selected subsurface materials sampled from the boreholes and comprised three (3) shrink swell index tests on recovered undisturbed samples and one (1) Standard compaction and 4 day soak CBR test on anticipated subgrade samples.

The detailed results of laboratory testing are included in Appendix C and are summarized below in Table 3 and Table 4.

Table 3: Results of Shrink-Swell testing

Bore	Depth (m)	Description	FMC (%)	Shrinkage (%)	Swell (%)	Iss (% per ΔpF)
201	1.0 – 1.3	CLAY: grey mottled red brown and pale brown	26.6	4.8	0.4	2.8
203	1.0 – 1.34	CLAY: grey mottled red brown and pale brown	24.4	3.6	1.7	2.5
204	1.5 – 1.92	CLAY: red brown mottled pale brown	26.9	2.6	-0.1	1.4
1	0.55 – 0.81	Clay: red brown	25.9	0.7	6.0	2.0
4	1.50 – 1.83	Clay: red brown	32.2	5.8	-0.2	3.2

Notes to Table 3: FMC - Field moisture content Iss - Shrink/Swell Index

Table 4: Results of CBR testing

Bore	Depth (m)	Description	FMC (%)	SOMC (%)	SMDD (%)	CBR (%)	Swell (%)
202	2.5 – 3.5	CLAY: grey	14.0	14.0	1.83	1.0	4.0

Notes to Table 3: FMC - Field Moisture Content; SOMC - Standard Optimum Moisture Content; SMDD – Standard Maximum Dry Density; CBR - California Bearing Ratio (4 day soaked); TBC – Laboratory testing to be completed

6.2 Salinity Laboratory Testing

Laboratory testing was undertaken at Envirolab Service Pty Ltd, which is a NATA registered laboratory.

Thirteen (13) samples were analysed for the following:

- pH and electrical conductivity (EC); and
- Cation Exchange capacity (CEC) and Exchangeable Sodium Percent (ESP).

Detailed laboratory report sheets are attached in Appendix C and the results are summarised in Table 5 below.

Table 5: Results of Salinity Laboratory Testing

Bore	Depth	Description	pH	EC (µs/cm)	CEC (ppm)	ESP (%)
201	0.05	Sandy Silt / Silty Sand: brown (fill)	5.6	33	5.7	-
201	0.5	Sandy Silt / Silty Sand: brown (fill)	5.5	31	4.1	-
201	1.5-1.95	Clay: grey mottled red brown and pale brown	5.3	190	9.5	11
202	0.05	Sandy Silt: brown (fill)	6.1	35	4.7	-
202	0.7-1.0	Sandy Silt: dark grey (fill)	5.5	40	3.9	3
202	3.5-4.0	Clay: grey green (serpentinite)	7.6	29	17	8
203	0.5	Silty Clay: dark grey (fill)	7.0	22	4.4	-
203	1.0	Clay: grey mottled red brown and pale brown	4.1	150	4.0	8
203	2.5-2.95	Clay: pale grey mottled red brown	4.3	92	2.2	8
204	0.3	Gravelly Clay: red brown (fill)	9.9	200	38	<1
205	0.1	Sandy Silt: red brown (fill)	6.3	160	6.1	4
205	0.5	Gravelly Clay: red brown (fill)	5.5	78	4.3	5
205	1.0-1.45	Clay: red brown mottled pale brown	5.1	89	5.0	5

7. Comments

7.1 Appreciation of Site Conditions

The pertinent characteristics of the site and subsurface conditions are further summarised as follows;

- Silt, sand and clay topsoil and fill to depths of 0.4 m to 2.0 m;
- A residual clay profile underlain by possible extremely weathered bedrock at depths ranging from 2.0 m to 5.5 m; and
- Free groundwater encountered at 5.7 m in Bore 1 and seepage at 2.0 m in Bore 202. Seepage within Bore 202 could be perched on the underlying natural clay. These bores are located within the northern part of the site which is also the lowest area across the site. No free groundwater was observed in the remaining or previous bores during the current or previous investigations. It should be noted that groundwater levels are affected by factors such as flooding, climatic conditions and soil permeability and will therefore vary with time.

7.2 Site Preparation Measures

7.2.1 Subgrade Preparation and Engineered Filling

The following procedure is recommended for preparation of building platforms where shallow footings are to be used for support of the building, where required:

- Excavate to design subgrade level;
- Remove any additional topsoil, fill or unsuitable/deleterious materials. This would include the pre-existing fill encountered across the site;
- Grub out and remove tree stumps and roots, if present;
- Rubber tyred vehicles should not be allowed to traffic the surface to reduce rutting of the clay subgrade (where exposed);
- Engineered fill beneath buildings should be placed and compacted under Level 1 Earthworks and testing in accordance with AS 3798 (2007). Material should be placed in near horizontal layers not exceeding 300 mm loose thickness, with a maximum particle size not greater than two-thirds of the compacted layer thickness, and compacted to at least 100% Standard within a moisture content range of -2% of OMC to +2% of OMC;
- Maximum batter slopes of 1V:2H during construction are recommended and long term batters of 1V:3H or flatter are recommended for total excavations or fill of up to 2 m in total height. Specific investigation and advice should be sought for excavation or placement of fill to greater depth/height;
- Adequate surface drainage should be provided to direct surface water away from engineered fill.

Where piled foundations are to be used to support the building the following procedure is recommended:

- Excavate to design subgrade level;
- Proof roll the exposed surface to assess the suitability of the existing fill to remain in place to support non-structural fill;
- Additional fill should be placed in near horizontal layers not exceeding 300 mm loose thickness, with a maximum particle size not greater than two-thirds of the compacted layer thickness, and compacted to at least 100% Standard within a moisture content range of -2% of OMC to +2% of OMC;
- Maximum batter slopes of 1V:2H during construction are recommended and long term batters of 1V:3H or flatter are recommended for total excavations or fill of up to 2 m in total height. Specific investigation and advice should be sought for excavation or placement of fill to greater depth/height;
- Adequate surface drainage should be provided to direct surface water away from engineered fill.

Geotechnical inspection, compaction testing and proof rolling of all engineered fill is recommended.

Earthworks construction procedures should be in accordance with the Australian Standard AS 3798 (2007).

7.3 Excavation Conditions

It is expected that excavation conditions will generally comprise fill, stiff to hard clay and silty clay soils which will be further underlain by hard clay (possible extremely weathered bedrock). It is therefore expected that standard earthmoving equipment (i.e. diggers and excavators) should be sufficient for excavation at the site.

7.4 Site Classification

Site classification of foundation soil reactivity provides an indication of the propensity of the ground surface to move with seasonal variation in moisture. The site classification is based on procedures presented in AS 2870 (2011), the typical soil profiles revealed in the bores, and the results of laboratory testing.

Standard designs presented in AS 2870 only apply to structures of similar size and flexibility to residential buildings. Notwithstanding this, structural engineers often incorporate expected reactive movements into the design of other structures, as could be adopted for the proposed development.

Uncontrolled fill for non-cohesive soil types up to 0.8 m and 0.4 m for cohesive soil types is allowed with reference to AS 2870 (2011) to enable standard site classifications. It is noted, however that cohesive fill material was encountered to depths of 0.2 m to 2.0 m across the site during the current and previous investigations. On the basis of the results of the field investigation, together with the procedures presented in AS2870 (2011), the site is classified “Class P” due to the presence of uncontrolled fill to depths greater than 0.4 m, the presence of existing buildings on the site and numerous trees around the site. However based on the results of the field work and laboratory testing indicative characteristic free surface movements (y_s) of up to 40 mm could be expected which are commensurate with a ‘Class M’ site classification.

The above estimated y_s values may not apply if fill greater than 0.4 m depth, or excavation greater than 0.5 m is proposed, as required by AS 2870 (2011).

From observations of the site during field work activities a number of small to large trees were observed within or near to the approximate area of the proposed buildings.

It should be noted that trees increase soil suction and therefore increase potential reactive clay movement. AS 2870 (2011) provides guidance on methods to estimate additional movements that could be expected due to the presence of a tree or a group of trees and, by extension, soil movement due to removal of trees.

If new trees are proposed for the site they should not be planted closer to the building than a distance equal to the mature height of the tree, as advised in AS 2870 (2011).

Site classification, as above, is based on the information obtained from the test bores and have involved some interpolation between data points. In the event that the conditions encountered during construction are different to those presented in this report, it is recommended that advice be obtained from this office.

Articulation joints should be provided within masonry walls in accordance with TN61 (CCAA, 2008) in order to reduce the effects of differential movement.

It is recommended that the site should be maintained in accordance with Appendix B of AS 2870 (2011) and CSIRO Sheet BTF 18 which is included in Appendix A.

7.5 Footing Parameters

7.5.1 General

Footings must not be founded in proposed or existing fill unless it has been adequately compacted and tested as per AS 3798 (2007) and in general accordance with the methodology given in Section 7.2.1 of this report.

All footings for the proposed structures should be founded on strata of similar stiffness (i.e. not partially on clay and partially on bedrock). Allowance for potential shrink-swell movements should be made in the design of all proposed footings and structures.

All footing excavations should be inspected and tested by a geotechnical engineer to confirm design parameters have been achieved.

Depending on the final location of the proposed building, supplementary investigation may be required to confirm suitable foundation conditions.

7.5.2 Shallow Footings

Following site preparation in accordance with Section 7.2.1, shallow strip or pad footings could be used for the support of the proposed building, subject to design loads. However, it is anticipated that shallow footings are unlikely to be utilised for the PCYC building due to the presence of uncontrolled fill up to 2 m depth in this area.

Footings should be founded within the natural stiff or stronger clayey soils or Level 1 engineered fill, inspected and tested in accordance with Section 7.2.1. Footings should not be founded within uncontrolled fill. Where uncontrolled fill is present at foundation level, it should be over-excavated and replaced with engineered fill, placed and compacted in accordance with Section 7.2.1 of this report.

It should be noted that a retaining wall up to 2 m in height was observed near the proposed CAPA building (Area 2, refer Figure 7). All footings should be founded below a 45° line from the toe of the wall unless the retaining wall has been designed to accommodate the additional load from the building.

Shallow strip or pad footings founded within the stiff or stronger natural clays or controlled fill at approximately 0.5 m depth below proposed surface levels could be proportioned for a maximum allowable bearing pressure of 100 kPa. Shallow strip or pad footings should be embedded at a minimum depth of 0.5 m below finished ground levels.

Settlement of footings up to 1 m (i.e. maximum load of 100 kPa) width are expected to be masked by reactive clay movements but could be up to 15 mm. All footings should be founded within similar strata to minimise potential differential settlements between differing strata.

7.5.3 Piled Foundations

Piled foundations could also be utilised to support the proposed development dependant on design loads and building layout. It is anticipated that the PCYC building will be supported on piled foundations due to the presence of uncontrolled fill to depths of up to 2 m.

For the subsurface conditions encountered, it is anticipated that the following pile types may be considered suitable to support the proposed building:

- Open Bored Concrete Piles;
- Continuous Flight Auger (CFA) Piles;
- Steel Screw Piles; and
- Screw Cast Concrete Piles.

Driven piles were considered, however, they are unlikely to be suitable due to the proximity of existing structures and the vibrations associated with installation.

Where a piled foundation is to be utilised, piles should be installed to depths of greater than 4D, where D is the pile diameter of the installed pile.

The pile capacities are usually expressed in terms of the limit state Design Geotechnical Strength ($R_{d,g}$) as defined in AS 2159 (2009), whereby:

$R_{d,g} = \phi_g R_{d,ug}$, which must exceed the Design Action Effect E_d

$R_{d,ug}$ is the ultimate geotechnical strength, which was calculated using static theory, and therefore represents an estimate only. The geotechnical strength reduction factor ϕ_g depends on a number of factors including the extent of site investigation, type of analysis and pile testing regime during construction. For the preliminary analyses a value of $\phi_g = 0.40$ was adopted due to settlement considerations. Higher values of ϕ_g may be justifiable depending on pile type depth and configuration and provided sufficient load testing is conducted, as per AS 2159 (2009).

The traditional “allowable” capacity is related to “working” or serviceability load and is generally lower than $R_{d,g}$, depending on the structural factors applied to determine E_d (typically about 75% of $R_{d,g}$).

Table 6 shows the main geotechnical strata and the recommended design parameters for each stratum.

Table 6: Recommended Limit State Design Parameters for Piles

Founding Stratum	Approximate Depth to Top of Strata (m)										Ultimate End Bearing (MPa)(2)	Serviceability End Bearing (MPa)(2)	Ultimate Shaft Adhesion (kPa)(3)	Elastic Modulus (MPa)(4)
	1	2	3	4	5	201	202	203	204	205				
Silty Clay / Clay: Stiff to Very Stiff	0.4	0.6	0.2	0.18	0.15	1.0	2.0	0.6	0.4	0.6	0.9	0.4	25	8
Clay: Hard (Extremely Weathered Bedrock)	3.55	NE	2.5	2.5	2.5	5.5	3.5	2.5	2.0	NE	2	0.7	60	50

Notes to Table 6:

1. Rock classified in accordance with Pells et al (1998) "Foundations on Sandstone and Shale in the Sydney Region", Journal and News of the Australian Geomechanics Society, No. 33 Part 3, December 1998.
2. Assumes a minimum embedment of at least 0.3 m into the relevant bearing stratum.
3. Socket roughness R2 or greater.

Serviceability should be assessed using the tabulated modulus value to check that settlements are within tolerable limits.

Settlements of single piles at working loads equivalent to about 75% of the limit state design action would be approximately 1% of pile diameter; however greater settlements could occur for groups of piles. It is recommended that settlement of specific proposed pile groups be assessed as part of the detailed design.

Care should be taken to ensure the base of the bored piles are cleaned and free of all loose debris and water at the time of placing concrete.

Numerous geological factors control the depth of weathering and hence the rock surface level could be expected to vary considerably. Accordingly, geotechnical monitoring and inspection of cuttings should be undertaken during pile installation to confirm pile capacities and that the piles have been socketed into suitable material.

If CFA piles are proposed to be taken into bedrock, as this method does not allow the founding conditions to be assessed during installation it is recommended that additional boreholes or CPTs be undertaken to confirm founding conditions for piles.

Higher capacities than those presented in Table 6 may be achievable if load testing is undertaken during construction in accordance with AS 2159 (2009). Once loads and pile types are known specific analysis should be undertaken to further refine the geotechnical design of the piles.

7.6 Retaining Wall Design Parameters

Details of specific retaining wall locations and dimensions have not yet been advised to DP. Specific geotechnical assessment should be undertaken at the detailed design phase of the project. The following general comments could be adopted for preliminary design of retaining walls.

For permanent retaining walls, where the wall will be free to deflect, design should be based on “active” (K_a) earth pressure coefficients, assuming a triangular earth pressure distribution. This would comprise any non-propped or laterally un-restrained walls (e.g. cantilever type walls).

Where structures or services are near the crest, or if the retaining walls are laterally restrained by the structure and not free to deflect, retaining wall design should be based on “at-rest” (K_o) earth pressure coefficients.

The suggested long term (permanent) design soil parameters for ultimate load conditions are shown in Table 7 below. The earth pressure coefficients are for level backfill. Any additional surcharge loads, including those imposed by inclined slopes behind the wall, during or after construction, should be accounted for in design.

Table 7: Geotechnical Parameters for Retaining Structures

Parameter	Symbol	Engineered Fill or Natural Stiff or stronger Clay
Bulk Density (kN/m³)	γ_b	18
Active Earth pressure coefficient – cantilever design (free to deflect)	K_a	0.40
At-rest earth pressure coefficient – propped/restrained wall	K_o	0.58
Passive earth pressure coefficient	K_p	2.5

Retaining walls not designed for hydrostatic pressure should include free draining single size (10 mm single size gravel or coarser) aggregate backfill at the rear of the wall, with slotted drainage pipe at the base of the backfill. The pipes should discharge to the stormwater drainage system. The backfill should be encapsulated within geotextile fabric.

Retaining wall footings should be founded in the stiff or stronger clay or Level 1 controlled fill and should be proportioned for a maximum allowable bearing pressure of 100 kPa.

7.7 Earthquake Design Parameters

The Earthquake Code AS1170.4 (2007) provides seismic design parameters based on location and soil profile. Reference to Table 3.2 of AS1170.4 (2007) indicates a Hazard Factor (Z) of 0.06 for Port Macquarie.

The subsurface profile at this site, with reference to Table 4.1 and Section 4.2 of AS1170.4 (2007), indicates that the appropriate "Site Sub-soil Class" would be **C_e** "Shallow Soil", since loose or soft soils are not expected to significant depth at this site.

7.8 Salinity

The results of the assessment indicated the following with respect to potential soil salinity at the site:

- The NSW eSPADE website indicated the following although it is noted that site specific data from laboratory testing has been obtained:
    - Absence of mapped dryland or urban salinity indicators or salinity hazards across the site;
    - Low modelled cation exchange which is indicative of non-sodic soils;
    - Low modelled electrical conductivity which is indicative of non-saline conditions (DLWC, 2002); and
    - Modelled exchangeable sodium percentage which is indicative of slightly sodic soils.
- Based on the site specific investigation and laboratory testing the following is noted:
- Subsurface conditions typically comprise residual clayey soils underlain by bedrock;

- EC testing undertaken indicated clay soils as being non-saline; and
- No obvious indicators of salinity (e.g. salt scalds, plant distress) were observed during previous site inspections.

Based on the above results, it is considered that the site poses a low salinity risk. It is recommended, however, that future design and construction should be undertaken with respect to good practices as detailed in DLWC (2002) to minimise the potential for saline impact to occur. Typical construction practices include:

- Correctly installing a damp-proof course or equivalent within each building;
- Providing adequate floor ventilation beneath buildings if they are constructed on bearers and joists;
- Maintaining the natural water balance and maintaining good drainage to prevent rises in ground water levels;
- Maintaining good drainage and minimising excessive infiltration;
- Ensuring that paths which are provided around buildings slope away from the building;
- Careful design of landscaping and landscape watering methods;
- Adequate drainage provided behind retaining walls;
- Regular monitoring of pipes, etc. for leaks.

Most of the above features are consistent with the guidelines AS 2870 (2011) for standard non saline sites

8. References

AS 2159. (2009). *Piling - Design and Installation.* Standards Australia.

AS 2870. (2011). *Residential Slabs and Footings.* Standards Australia.

AS 3798. (2007). *Guidelines on Earthworks for Commercial and Residential Developments.* Standards Australia.

CCAA. (2008). *Technical Note 61 "Articulated Walling".* Cement and Concrete Aggregates Australia.

DLWC. (2002). *Site Investigations for Urban Salinity.* Department of Land and Water Conservation.

DP. (2019). *"Report on Desktop Geotechnical Assessment, Proposed School Upgrade, Hastings Secondary College, Port Macquarie Campus, Owen Street, Port Macquarie", Report 89754.00.R.001.Rev0, dated 3 December 2019.* Douglas Partners Pty Ltd.

DP. (2020). *Report on Geotechnical Investigation, Proposed School Upgrade, Owen Street, Port Macquarie.* Report 89754.00.R.005.Rev0, dated 11 March 2020: Douglas Partners Pty Ltd.

9. Limitations

Douglas Partners (DP) has prepared this report for this project at the Hastings Secondary College, Owen Street, Port Macquarie with reference to DP's proposal PMQ200104 dated 9 December 2020 and subsequent emails dated 29 January 2021 and 9 February 2021. The work was undertaken at the request of Tarren Miller of Currie & Brown on behalf of School Infrastructure NSW. The work was carried out as a variation to the original SINSW contract number: SINSW00285/19 dated 2 December 2019. This report is provided for the exclusive use of School Infrastructure NSW and Currie & Brown for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific 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 geotechnical 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

CSIRO BTF18
About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations

Foundation Maintenance and Footing Performance: A Homeowner's Guide

PUBLISHING

BTF 18-2011 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay

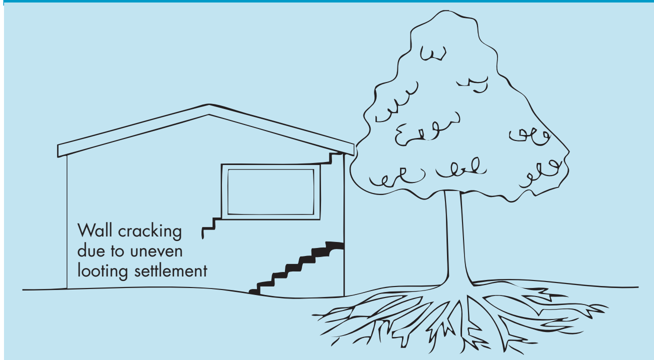
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Trees can cause shrinkage and damage



Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

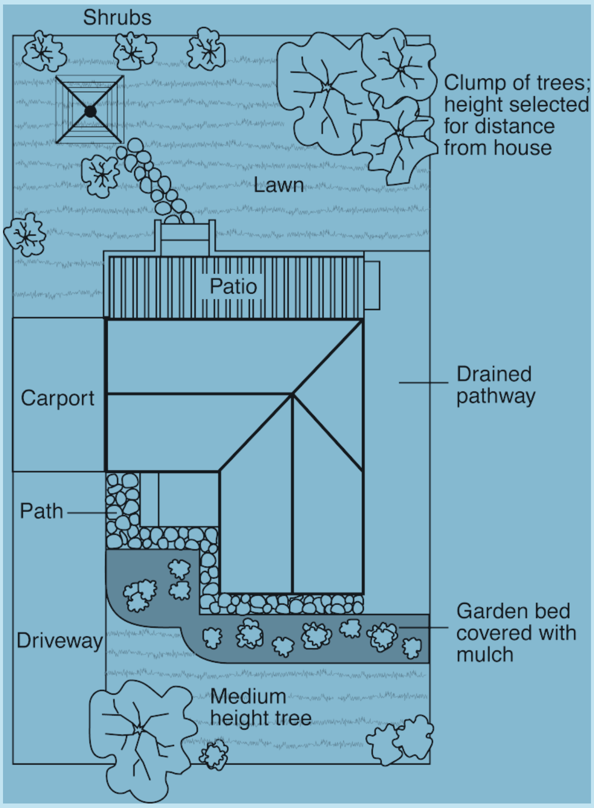
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.

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.

Soil Descriptions

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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:

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

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

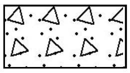
Symbols & Abbreviations

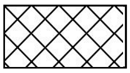
Graphic Symbols for Soil and Rock

General

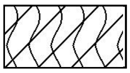
 Asphalt

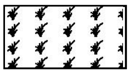
 Road base

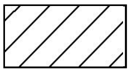
 Concrete

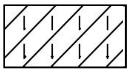
 Filling

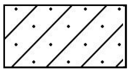
Soils

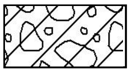
 Topsoil

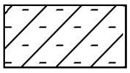
 Peat

 Clay

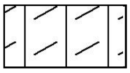
 Silty clay

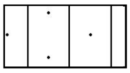
 Sandy clay

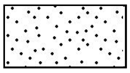
 Gravelly clay

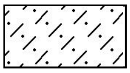
 Shaly clay

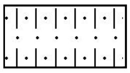
 Silt

 Clayey silt

 Sandy silt

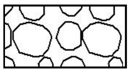
 Sand

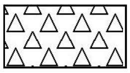
 Clayey sand

 Silty sand

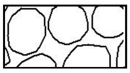
 Gravel

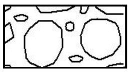
 Sandy gravel

 Cobbles, boulders

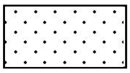
 Talus

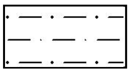
Sedimentary Rocks

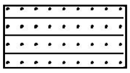
 Boulder conglomerate

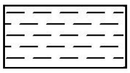
 Conglomerate

 Conglomeratic sandstone

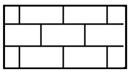
 Sandstone

 Siltstone

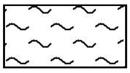
 Laminite

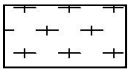
 Mudstone, claystone, shale

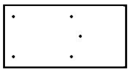
 Coal

 Limestone

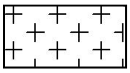
Metamorphic Rocks

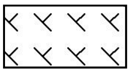
 Slate, phyllite, schist

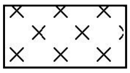
 Gneiss

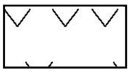
 Quartzite

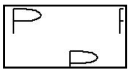
Igneous Rocks

 Granite

 Dolerite, basalt, andesite

 Dacite, epidote

 Tuff, breccia

 Porphyry

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

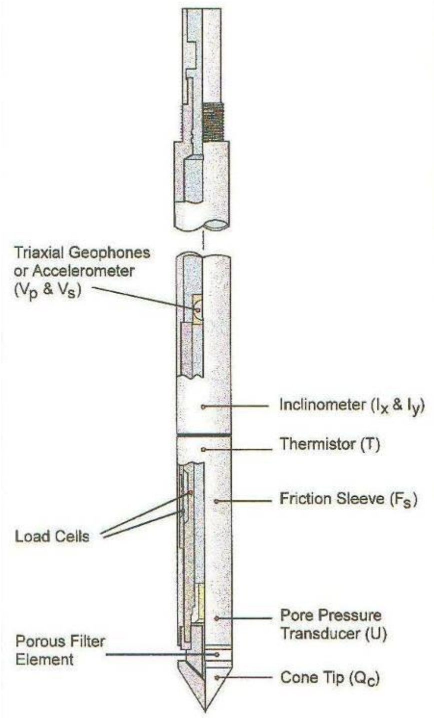


Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

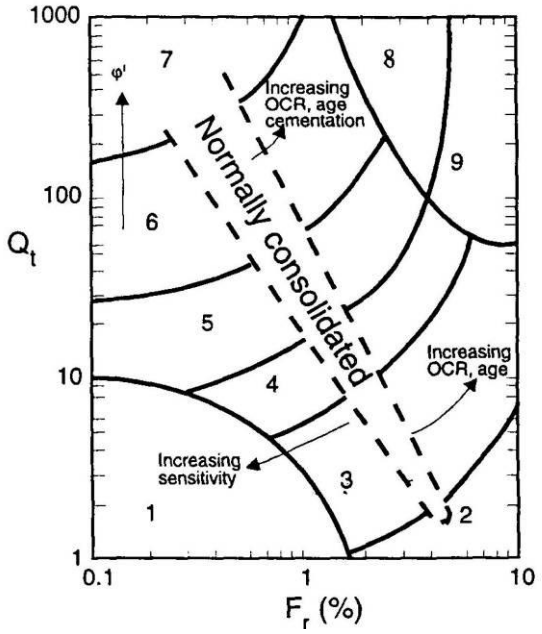


Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

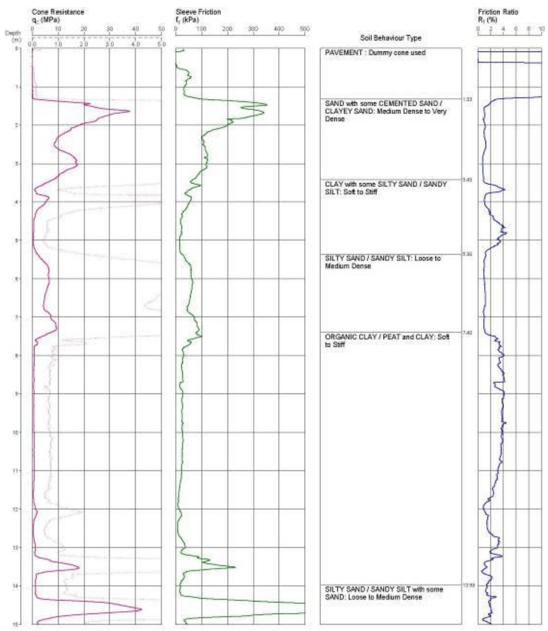


Figure 4: Sample Cone Plot

Appendix B

Borehole Logs (Bores 201 to 205) – Current Investigation
Borehole Logs (Bores 1 to 5) – Project 89754.00
Borehole Logs (Bores 101 to 103) – Project 89754.02

BOREHOLE LOG

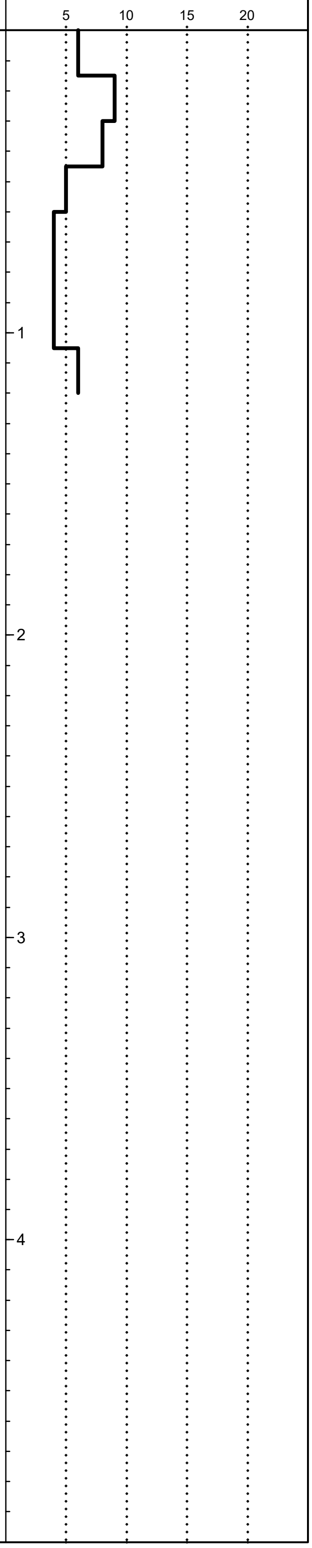
CLIENT: School Infrastructure NSW
PROJECT: Proposed Hastings Secondary College Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 11 AHD
EASTING: 492396
NORTHING: 6522494
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 89754.03
DATE: 8/2/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Type	Depth	Sample	Results & Comments
11		FILL/TOPSOIL - Brown, fine grained, sandy silt/silty sand, trace gravel and terracotta, abundant rootlets, (gravel predominantly subangular, up to 40mm in size), dry/M<Wp	D/E	0.05		PID<1
			D/E	0.5		PID<1
	0.7	FILL - Brown, clay, with silt, trace gravel (iron stained), (gravel predominantly subangular, up to 40mm in size), M~Wp	D/E	0.7		pp = 100-125 PID<1
10	1 / 1.0	CLAY - Stiff, grey mottled red brown and pale brown, high plasticity, with silt, (residual), M~Wp	U50	1.0–1.3		pp = 150-200
			S/E	1.5–1.95		pp = 150 2,2,4 N = 6 PID<1
9	2		D/E	2.0		pp = 150 PID<1
		From 2.5m, trace iron stained gravel, (gravel predominantly subangular, up to 30mm in size)	S	2.5–2.95		pp = 150 3,3,4 N = 7
8	3					
			D/E	3.5		pp = 150 PID<1
7	4	From 4.0m, red brown mottled grey	S	4.0–4.45		pp = 200 4,4,5 N = 9
			D/E	4.5		PID<1
				5.0		

Dynamic Penetrometer Test (blows per 150mm)



RIG: Geo305 **DRILLER:** Ground Test **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid Flight Auger to 6.0 (tc bit)
WATER OBSERVATIONS: Free groundwater observed at 5.7m
REMARKS:

☐ 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

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Hastings Secondary College Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 11 AHD
EASTING: 492396
NORTHING: 6522494
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 89754.03
DATE: 8/2/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
6		CLAY - Stiff, grey mottled red brown and pale brown, high plasticity, with silt, (residual), M~Wp *(continued)*							
		From 5.5m, grey mottled pale brown, grading to weathered serpentinite, (slight rock structure visible)		S	5.5 – 5.95		pp = 150-200 3,4,4 N = 8	▼	
5	6.0	Bore discontinued at 6.0m, limit of investigation							
4	7								
3	8								
2	9								

RIG: Geo305 **DRILLER:** Ground Test **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid Flight Auger to 6.0 (tc bit)
WATER OBSERVATIONS: Free groundwater observed at 5.7m
REMARKS:

☐ 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

BOREHOLE LOG

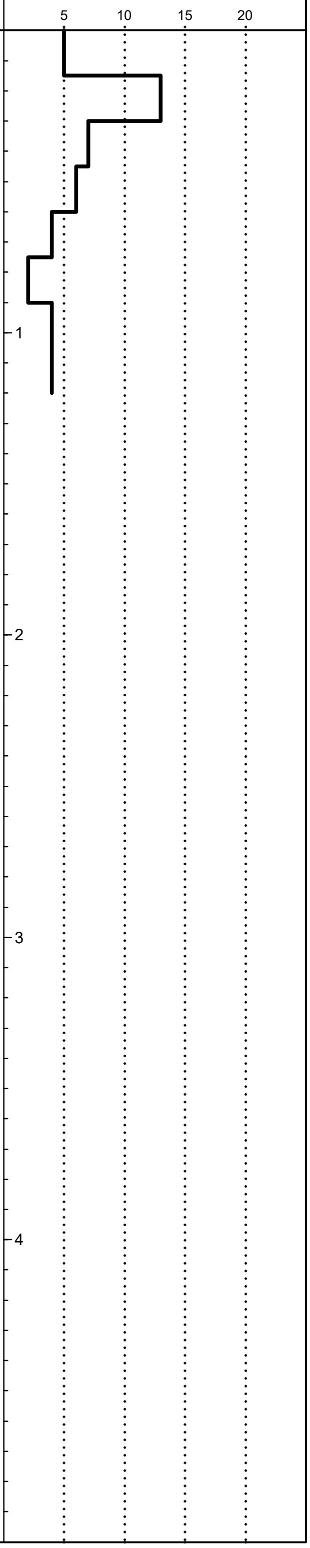
CLIENT: School Infrastructure NSW
PROJECT: Proposed Hastings Secondary College Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 11 AHD
EASTING: 492450
NORTHING: 6522498
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 89754.03
DATE: 8/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
11		TOPSOIL - Brown, fine grained, sandy silt, trace clay and gravel, abundant rootlets, (gravel predominantly subangular, up to 40mm in size), M<Wp	D/E	0.05		PID<1	
	0.4	FILL - Brown, clay, with silt and gravel, (gravel predominantly subrounded, up to 40mm in size), M<Wp to M~Wp	D/E	0.5		pp >400 PID<1	
	0.6	FILL - Dark grey, fine grained, sandy silt, trace gravel and terracotta, (gravel predominantly subangular, up to 30mm in size), M<Wp	D/E	0.7		PID<1	
10	1		S	1.0 1.45		pp = 150 5,4,6 N = 10	
9	2 / 2.0	CLAY - Stiff, grey, medium to high plasticity, with silt, M~Wp to M>Wp	D/E	2.0		pp = 100 PID<1	▷
			S	2.5 2.95		pp = 150 0,2,3 N = 5	
8	3		B			pp = 150	
		From 3.5m, stiff to very stiff, grey green, trace gravel and fine to medium grained sand, grading to weathered serpentinite, (gravel predominantly subangular, up to 20mm in size)	D/E	3.5 4.0		PID<1	
7	4						
	5.0		S/E	4.55 5.0		pp = 200-250 7,10,11 N = 21 PID<1	

Dynamic Penetrometer Test (blows per 150mm)



Bore discontinued at 5.0m, limit of investigation

RIG: Geo305 **DRILLER:** Ground Test **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid Flight Auger to 5.0 (tc bit)
WATER OBSERVATIONS: Seepage observed at 2.0m
REMARKS:

☐ 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

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Hastings Secondary College Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 15 AHD
EASTING: 492419
NORTHING: 6522369
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 89754.03
DATE: 9/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
15	0.05	CONCRETE PAVERS - (50mm thick)							
	0.075	FILL - Grey, fine grained, silty sand, dry to moist		D/E	0.1		PID<1		
		FILL - Dark grey, silty clay, with gravel and rootlets, trace fine to medium grained sand, (gravel predominantly subrounded, up to 30mm in size), M<Wp to M~Wp		D/E	0.5		PID<1		
	0.6	CLAY - Very stiff to hard, grey mottled red brown and pale brown, with silt, M<Wp to M~Wp							
14	1			D/E	1.0				1
				U50	1.0 – 1.34		pp = 400		
13	2			D/E	2.0		pp = 250-300 PID<1		2
		From 2.5m, pale grey mottled red brown, (weathered rock)		S/E	2.5 – 2.95		pp >400 6,9,16 N = 25 PID<1		
12	3								3
				D/E	3.5		pp = 300-350 PID<1		
11	4								4
				S/E	4.55 – 5.0		pp >400 2,2,6 N = 8 PID<1		
	5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Geo305 **DRILLER:** Ground Test **LOGGED:** Cudmore **CASING:** Nil

TYPE OF BORING: Solid Flight Auger to 5.0 (tc bit)

WATER OBSERVATIONS: No free groundwater observed

REMARKS: SPT result at 4.55m to 5.0m potentially erroneous due to equipment dropped in hole

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: School Infrastructure NSW
PROJECT: Proposed Hastings Secondary College Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 20 AHD
EASTING: 492480
NORTHING: 6522309
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 89754.03
DATE: 9/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
20		CONCRETE SLAB - (100mm thick)							
	0.1	FILL - Red brown, gravelly clay, with fine grained sand, (gravel predominantly subangular, up to 40mm in size), M~Wp		D/E	0.3		PID<1		
	0.4	CLAY - Very stiff to hard, red brown and pale brown, with silt, trace iron stained gravel, (gravel predominantly subangular, up to 30mm in size) (residual), M<Wp		D/E	0.6		PID<1		
19	1			S/E	1.0–1.45		pp = 400 5,6,10 N = 16 PID<1		1
				U50	1.5–1.92		pp >400		
18	2	From 2.0m, pale grey mottled red brown, (weathered rock)		D/E	2.0		pp >400 PID<1		2
				S/E	2.5–2.95		pp >400 8,12,16 N = 28 PID<1		
17	3								3
				D/E	3.8		PID<1 QA1		
16	4								4
	5.0			S/E	4.55–5.0		pp >400 5,12,19 N = 31 PID<1		

Bore discontinued at 5.0m, limit of investigation

RIG: Geo305 **DRILLER:** Ground Test **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid Flight Auger to 5.0 (tc bit)
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

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

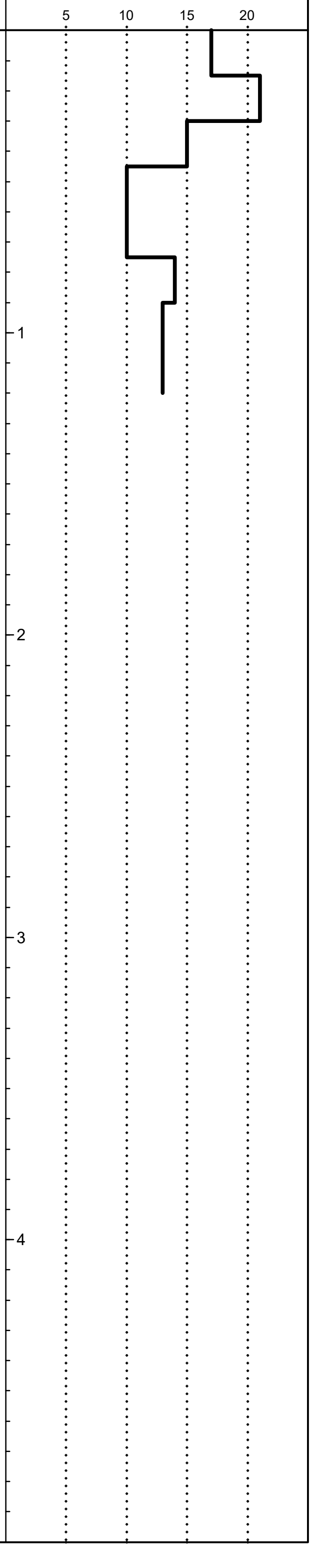
CLIENT: School Infrastructure NSW
PROJECT: Proposed Hastings Secondary College Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 20 AHD
EASTING: 492482
NORTHING: 6522295
DIP/AZIMUTH: 90°/--

BORE No: 205
PROJECT No: 89754.03
DATE: 9/2/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
20		FILL - Red brown, sandy silt, with clay, gravel and building rubble, M<Wp		D/E	0.1		PID<1	
	0.15	FILL - Red brown, gravelly clay, with silt, (gravel predominantly subangular, up to 20mm in size), M<Wp to M~Wp		D/E	0.5		pp >400 PID<1	
	0.6	CLAY - Very stiff to hard, red brown mottled pale brown, with silt, trace iron stained gravel, (gravel predominantly subangular, up to 40mm in size), M<Wp to M~Wp						
19	1			S/E	1.0–1.45		pp >400 5,9,13 N = 22 PID<1	
18	2			D/E	2.0		pp >400 PID<1	
		From 2.5m, pale grey mottled red brown		S/E	2.5–2.95		pp >400 6,12,17 N = 29 PID<1	
17	3							
				D/E	3.7		pp >400 PID<1	
16	4							
				S	4.55–5.0		pp >400 7,12,21 N = 33	
	5.0	Bore discontinued at 5.0m, limit of investigation						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Geo305 **DRILLER:** Ground Test **LOGGED:** Cudmore **CASING:** Nil

TYPE OF BORING: Solid Flight Auger to 5.0 (tc bit)

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ 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

BOREHOLE LOG

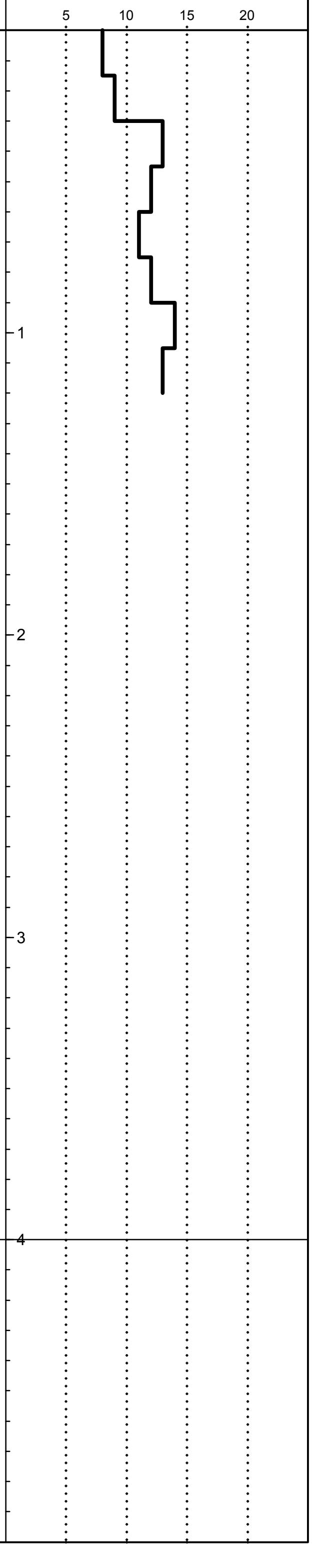
CLIENT: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 12 AHD
EASTING: 492453
NORTHING: 6522430
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 89754.00
DATE: 15/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
12		FILL - Grey brown, fine to medium grained, silty sand, abundant rootlets (grass covered), dry		D/E	0.05		PID<1	
	0.4	CLAY - Very stiff to hard, red brown, with silt, trace fine grained sand, M<Wp		D/E	0.5		PID<1	
				U50	0.55 0.81			
11	1	From 1.0m, red brown mottled light grey		S/E	1.0 1.45		pp >400 6,8,9 N = 17 PID<1	
10	2							
		From 2.5m, light grey mottled red brown, stiff to very stiff		S/E	2.5 2.95		pp >400 3,6,8 N = 14 PID<1	
9	3							
		From 3.55m, green grey (possible extremely weathered serpentinite)		S/E	3.55 4.0		pp = 350-400 2,7,9 N = 16 PID<1	
8	4 4.0	Bore discontinued at 4.0m, limit of investigation						

Dynamic Penetrometer Test (blows per 150mm)



RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid flight auger to 4.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☐ 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

BOREHOLE LOG

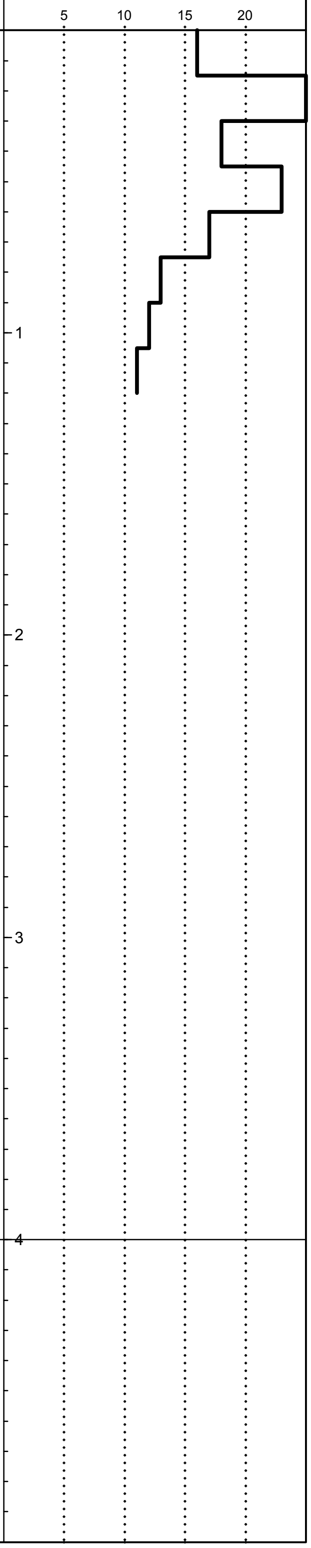
CLIENT: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 12 AHD
EASTING: 492412
NORTHING: 6522453
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 89754.00
DATE: 15/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
12		FILL - Grey brown, fine to medium grained, silty sand, trace clay and gravel, abundant rootlets (gravel predominantly up to 20mm in size) (grass covered), dry		D/E	0.05		PID<1	
				D/E	0.5		PID<1	
	0.6	SILTY CLAY - Hard, brown, trace fine grained sand, M<Wp		D/E	0.7		PID<1	
	0.9	CLAY - Very stiff to hard, red brown, with silt, M<Wp						
11	1			S/E	1.0 – 1.45		pp >400 5,11,11 N = 22 PID<1	
10	2							
		From 2.4m, light grey mottled light brown, M~Wp, (medium to high plasticity)		S/E	2.5 – 2.95		pp >400 5,7,7 N = 14 PID<1	
9	3							
		From 3.55m, stiff to very stiff, green grey (possible extremely weathered serpentinite)		S/E	3.55 – 4.0		pp = 300 3,7,7 N = 14 PID<1	
8	4 4.0	Bore discontinued at 4.0m, limit of investigation			4.0			

Dynamic Penetrometer Test (blows per 150mm)



RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid flight auger to 4.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☐ 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

BOREHOLE LOG

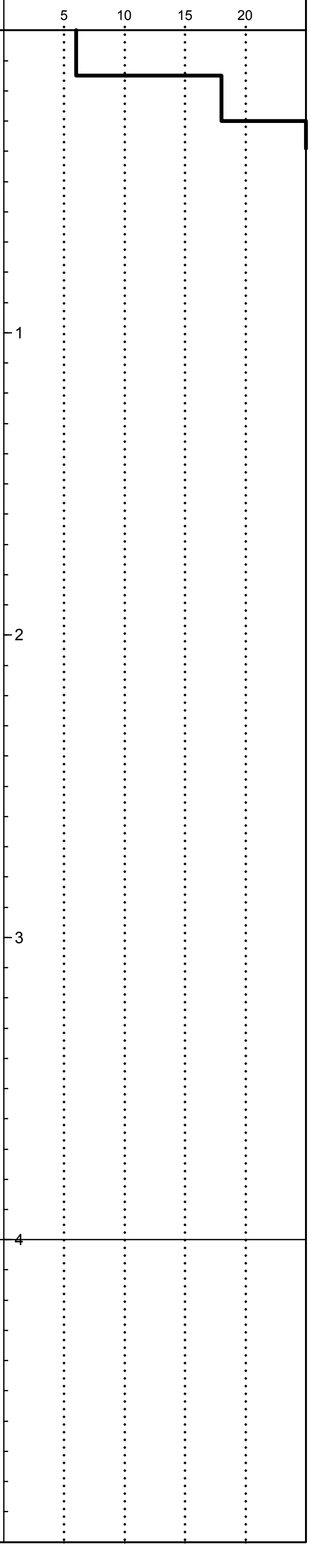
CLIENT: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 14 AHD
EASTING: 492403
NORTHING: 6522381
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 89754.00
DATE: 16/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
14		FILL - Grey brown, silty sand, trace clay and gravel, abundant rootlets (gravel predominantly subangular, up to 60mm in size) (grass covered), dry		D/E	0.05		PID<1	
	0.2	SILTY CLAY - Hard, brown, trace fine to medium grained sand, M<Wp		D/E	0.5		PID<1	
	0.6	CLAY - Very stiff to hard, red brown mottled light grey, with silt, M<Wp						
13	1			S/E	1.0 – 1.45		pp >400 5,9,13 N = 22 PID<1	
12	2							
		From 2.5m, light grey mottled red brown (possible extremely weathered bedrock)		S/E	2.5 – 2.85		pp >400 8,16,25/50 refusal PID<1	
11	3							
		From 3.6m, green grey (possible extremely weathered serpentinite)		S/E	3.55 – 4.0		pp >400 6,12,23 N = 35 PID<1	
10	4 – 4.0	Bore discontinued at 4.0m, limit of investigation						

Dynamic Penetrometer Test (blows per 150mm)



RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid flight auger to 4.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☐ 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

BOREHOLE LOG

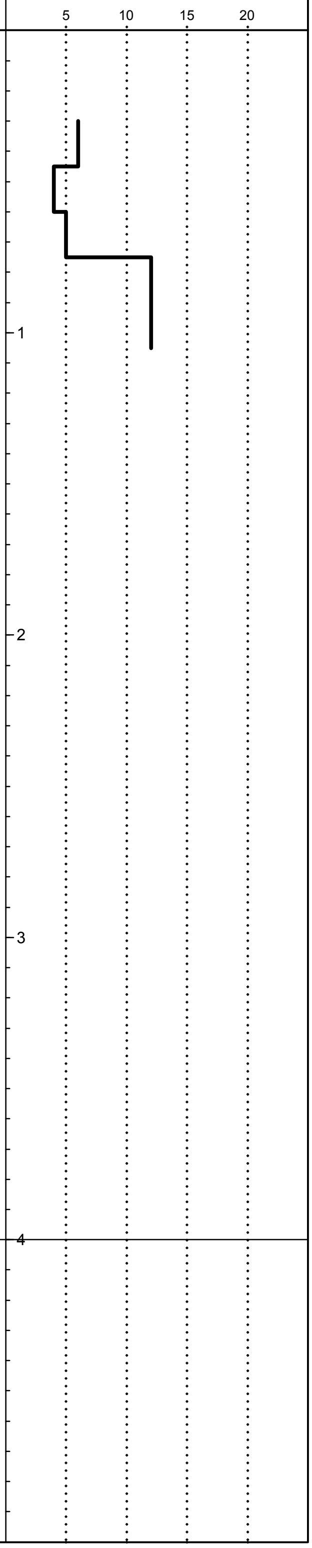
CLIENT: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 20 AHD
EASTING: 492508
NORTHING: 6522310
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 89754.00
DATE: 15/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
20		CONCRETE - (150mm thick)						
	0.15							
	0.18	FILL - Fine to medium grained, sand fill, trace silt, dry		D/E	0.2		PID<1	
		CLAY - Stiff to very stiff, red brown, with silt, M<Wp		D/E	0.5		PID<1	
19	1			S/E	1.0 – 1.45		pp = 150-200 2,6,5 N = 11 PID<1	
				U50	1.5 – 1.83			
18	2							
		From 2.5m, very stiff to hard, red mottled yellow brown (possible extremely weathered bedrock, parent rock structure visible)		S/E	2.5 – 2.95		pp >400 4,10,13 N = 23 PID<1	
17	3							
				S	3.55 – 4.0		pp >400 3,11,16 N = 27 PID<1	
16	4.0	Bore discontinued at 4.0m, limit of investigation						

Dynamic Penetrometer Test (blows per 150mm)



RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid flight auger to 4.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☐ 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

BOREHOLE LOG

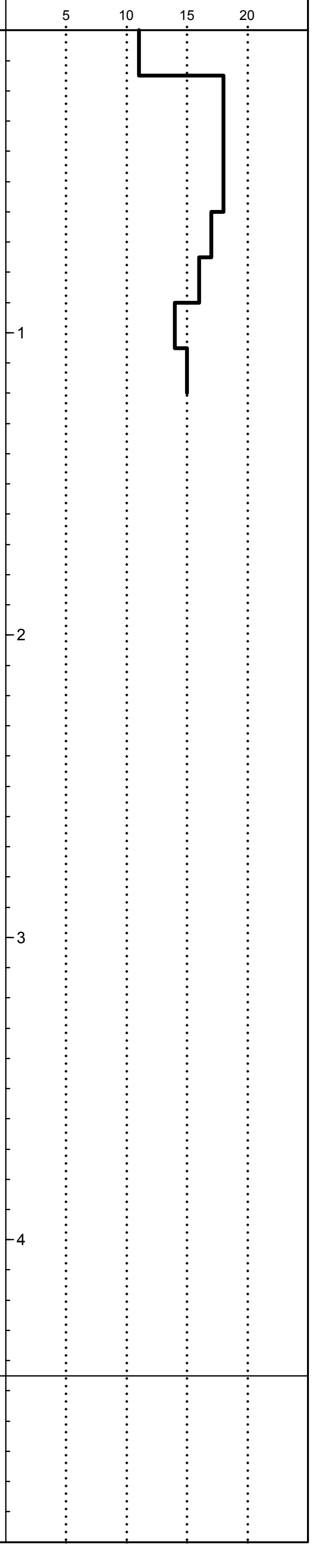
CLIENT: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: 22 AHD
EASTING: 492505
NORTHING: 6522272
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 89754.00
DATE: 15/1/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Type	Depth	Sample	Results & Comments
22	0.15	FILL - Grey brown, fine to medium grained, silty sand, trace clay, abundant rootlets (grass covered), dry	D/E	0.05		PID<1
		SILTY CLAY - Very stiff to hard, brown, trace fine grained sand, M<Wp	D/E	0.5		PID<1
21	1		S/E	1.0 – 1.45		pp >400 7,9,12 N = 21 PID<1 QA1
	1.4	CLAY - Hard, red brown, with silt, M<Wp				
20	2		D/E	2.0		PID<1
		From 2.5m, possible extremely weathered bedrock, parent rock structure visible	S/E	2.5 – 2.95		pp >400 10,19,20 N = 39 PID<1
19	3					
18	4		S/E	4.0 – 4.45		pp >400 14,14,17 N = 31 PID<1
	4.45	Bore discontinued at 4.45m, limit of investigation				

Dynamic Penetrometer Test (blows per 150mm)



RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: Solid flight auger to 4.45m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☐ 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: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: --
EASTING: 492435
NORTHING: 6522266
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 89754.02
DATE: 26/11/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
		FILL - Brown, fine grained, silty sand, trace clay, abundant rootlets, dry		D/E	0.05		PID<1		
	0.2	FILL - Red brown, clay, with silt, trace gravel and fine grained sand, (gravel predominantly subangular, up to 10mm in size), M<Wp to M~Wp		D/E	0.5		pp >400 PID<1		
	0.55	SILTY CLAY - Stiff, dark grey, trace fine grained sand, M~Wp		D/E	0.75		pp = 150-200 PID<1		
	0.8	CLAY - Very stiff, grey mottled red brown, with silt, trace gravel, (gravel predominantly subangular, up to 10mm in size) (residual), M<Wp to M~Wp		D/E	0.95		pp = 350 PID<1		
1	1.0	Bore discontinued at 1.0m, limit of investigation							1

RIG: DT100 / Hand Tools **DRILLER:** Hickman / Cudmore **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: 75mm ϕ Hand Auger to 0.3m, Solid Flight Auger to 1.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

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: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: --
EASTING: 492453
NORTHING: 6522260
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 89754.02
DATE: 26/11/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
		FILL - Brown, fine grained, silty sand, trace gravel, abundant rootlets, (gravel predominantly subangular, up to 15mm in size), dry		D/E	0.05		PID<1		
	0.2	SILTY CLAY - Stiff, dark grey, with fine grained sand, M<Wp		D/E	0.3		PID<1		
	0.5	CLAY - Very stiff to hard, red brown, with silt, trace gravel, (gravel predominantly subangular, up to 10mm in size) (residual), M<Wp to M~Wp		D/E	0.55		pp >400 PID<1 QA1		
				D/E	0.95		pp = 350-400 PID<1		
1	1.0	Bore discontinued at 1.0m, limit of investigation							

RIG: DT100 / Hand Tools **DRILLER:** Hickman / Cudmore **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: 75mm ϕ Hand Auger to 0.2m, Solid Flight Auger to 1.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

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: School Infrastructure NSW
PROJECT: Proposed School Upgrade
LOCATION: Owen Street, Port Macquarie

SURFACE LEVEL: --
EASTING: 492471
NORTHING: 6522269
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 89754.02
DATE: 26/11/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
		FILL - Brown, fine grained, silty sand, abundant rootlets, dry		D/E	0.05		PID<1		
				D	0.1				
	0.2	CLAY - Very stiff to hard, red brown mottled dark grey, with silt, trace gravel and organics, (gravel predominantly subangular, up to 15mm in size) (residual), M<Wp to M~Wp		D/E	0.3		pp = 300-350 PID<1		
		From 0.5m, red brown							
				D/E	0.6		pp >400 PID<1		
				D/E	0.95		pp >400 PID<1		
1	1.0	Bore discontinued at 1.0m, limit of investigation							

RIG: DT100 / Hand Tools **DRILLER:** Hickman / Cudmore **LOGGED:** Cudmore **CASING:** Nil
TYPE OF BORING: 75mm ϕ Hand Auger to 0.2m, Solid Flight Auger to 1.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

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

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Unit 2, 32 Geebung Drive
Port Macquarie NSW 2444
PO Box 5463
Port Macquarie NSW 2444
Phone: (02) 6581 5992

Results of Dynamic Penetrometer Tests

Dynamic Cone Penetrometer - DCP

Client School Infrastructure NSW
Project Proposed School Upgrade
Location Owen Street, Port Macquarie

Project No. 89754.03
Date 8&9/2/2021
Page No. 1 of 1

Test Location	201	202	203	204	205					
RL of Test (AHD)	11	11	15	20	20					
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 - 0.15	6	5			17					
0.15 - 0.30	9	13			21					
0.30 - 0.45	8	7			15					
0.45 - 0.60	5	6			10					
0.60 - 0.75	4	4			10					
0.75 - 0.90	4	2			14					
0.90 - 1.05	4	4			13					
1.05 - 1.20	6	4			13					
1.20 - 1.35										
1.35 - 1.50										
1.50 - 1.65										
1.65 - 1.80										
1.80 - 1.95										
1.95 - 2.10										
2.10 - 2.25										
2.25 - 2.40										
2.40 - 2.55										
2.55 - 2.70										
2.70 - 2.85										
2.85 - 3.00										
3.00 - 3.15										
3.15 - 3.30										
3.30 - 3.45										
3.45 - 3.60										

Test Method AS 1289.6.3.2, Cone Penetrometer ☑
AS 1289.6.3.3, Sand Penetrometer ☐

Tested By JSC
Checked By

Remarks Ref = Refusal, 25/110 indicates 25 blows for 110 mm penetration

Appendix C

Geotechnical Laboratory Test Results
Geo-Chemical Laboratory Test Results

Material Test Report

Report Number: **89754.03-1**
Issue Number: 1
Date Issued: 18/02/2021
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Roman Pilch
Project Number: 89754.03
Project Name: Proposed School Upgrade
Project Location: Owen Street, Port Macquarie
Work Request: 10912
Dates Tested: 10/02/2021 - 11/02/2021

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
Port Macquarie Laboratory
Unit 2, 32 Geebung Drive Port Macquarie NSW 2444
Phone: (02) 6581 5992
Email: adam.jeffery@douglaspartners.com.au

ilac-MRA NATA

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Adam Jeffery
Senior Technician
Laboratory Accreditation Number: 828

Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	PM-10912A	PM-10912C	PM-10912D		
Date Sampled	08/02/2021	08/02/2021	08/02/2021		
Date Tested	11/02/2021	11/02/2021	11/02/2021		
Material Source	Ground Test	Ground Test	Ground Test		
Sample Location	BH 201 (1.0 - 1.3)	BH 203 (1.0 - 1.34)	BH 204 (1.5 - 1.92)		
Inert Material Estimate (%)	**	**	**		
Pocket Penetrometer before (kPa)	200	350	450		
Pocket Penetrometer after (kPa)	150	330	520		
Shrinkage Moisture Content (%)	26.6	24.4	26.9		
Shrinkage (%)	**4.8**	**3.6**	**2.6**		
Swell Moisture Content Before (%)	38.1	29.5	27.9		
Swell Moisture Content After (%)	41.0	30.5	32.6		
Swell (%)	**0.4**	**1.7**	**-0.1**		
Shrink Swell Index Iss (%)	**2.8**	**2.5**	**1.4**		
Visual Description	Clay - grey mottled red brown and pale brown	Clay - grey mottled red brown and pale brown	Clay - red brown mottled pale brown		
Cracking	MC	SC	SC		
Crumbling	**	**	**		
Remarks	**	**	**		

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.
NATA Accreditation does not cover the performance of pocket penetrometer readings.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 261469

Client Details

Client	Douglas Partners Pty Ltd (Port Macquarie)
Attention	Chris Bozinovski, James Cudmore
Address	PO Box 5463, Port Macquarie, NSW, 2444

Sample Details

Your Reference	**89754.03, Port Macquarie**
Number of Samples	14 SOIL
Date samples received	11/02/2021
Date completed instructions received	11/02/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	12/02/2021
Date of Issue	12/02/2021

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Asbestos Approved By

Analysed by Asbestos Approved Identifier: Panika Wongchanda
Authorised by Asbestos Approved Signatory: Matt Mansfield

Results Approved By

Jaimie Loa-Kum-Cheung, Metals Supervisor
Matt Mansfield, QHSE manager
Priya Samarawickrama, Senior Chemist
Steven Luong, Organics Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

ACCREDITED FOR TECHNICAL COMPETENCE

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	92	93	109	89	107

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	102	110	102	99	103

vTRH(C6-C10)/BTEXN in Soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021
TRH C_6 - C_9	mg/kg	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	105	107	102

svTRH (C10-C40) in Soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH $>C_{10}$-C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH $>C_{10}$ - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH $>C_{16}$-C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH $>C_{34}$-C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	77	82	83	85	78

svTRH (C10-C40) in Soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH $>C_{10}$-C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH $>C_{10}$ - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH $>C_{16}$-C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH $>C_{34}$-C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	78	76	80	76	77

svTRH (C10-C40) in Soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50
Surrogate o-Terphenyl	%	76	78	79

PAHs in Soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	97	101	102	103	100

PAHs in Soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	101	101	100	98	97

PAHs in Soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021
Naphthalene	mg/kg	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	99	103	100

Organochlorine Pesticides in soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	107	106	106	104

Organochlorine Pesticides in soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	105	101	102	100	101

Organochlorine Pesticides in soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021
alpha-BHC	mg/kg	<0.1	<0.1	<0.1
HCB	mg/kg	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	106	103

Organophosphorus Pesticides in Soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	107	106	106	104

Organophosphorus Pesticides in Soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	105	101	102	100	101

Organophosphorus Pesticides in Soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021
Dichlorvos	mg/kg	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	106	103

PCBs in Soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	107	106	106	104

PCBs in Soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	105	101	102	100	101

PCBs in Soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date extracted	-	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	11/02/2021	11/02/2021	11/02/2021
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	106	103

Acid Extractable metals in soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Arsenic	mg/kg	<4	<4	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	150	340	62	530	110
Copper	mg/kg	4	2	20	8	3
Lead	mg/kg	28	11	4	17	8
Mercury	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Nickel	mg/kg	12	10	22	31	50
Zinc	mg/kg	26	5	13	21	4

Acid Extractable metals in soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Arsenic	mg/kg	<4	<4	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	210	72	69	27	260
Copper	mg/kg	4	2	<1	2	380
Lead	mg/kg	<1	15	5	8	6
Mercury	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	310	9	1	4	39
Zinc	mg/kg	2	12	1	<1	22

Acid Extractable metals in soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021
Arsenic	mg/kg	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4
Chromium	mg/kg	400	380	250
Copper	mg/kg	1	<1	<1
Lead	mg/kg	7	7	5
Mercury	mg/kg	<0.1	0.1	0.1
Nickel	mg/kg	12	12	3
Zinc	mg/kg	3	2	1

Moisture						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Moisture	%	22	18	28	21	23

Moisture						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	11/02/2021	11/02/2021	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Moisture	%	17	11	25	22	22

Moisture				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date prepared	-	11/02/2021	11/02/2021	11/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021
Moisture	%	14	19	25

Asbestos ID - soils						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Sample mass tested	g	Approx. 45g	Approx. 40g	Approx. 30g	Approx. 40g	Approx. 50g
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown clayey soil & rocks	Red coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Sample mass tested	g	Approx. 65g	Approx. 60g	Approx. 40g	Approx. 35g	Approx. 70g
Sample Description	-	Grey clayey soil & rocks	Beige clayey soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date analysed	-	12/02/2021	12/02/2021	12/02/2021
Sample mass tested	g	Approx. 50g	Approx. 50g	Approx. 45g
Sample Description	-	Brown fine-grained soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected

Misc Inorg - Soil						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
pH 1:5 soil:water	pH Units	5.6	5.5	5.3	6.1	5.5
Electrical Conductivity 1:5 soil:water	µS/cm	33	31	190	35	40

Misc Inorg - Soil						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
pH 1:5 soil:water	pH Units	7.6	7.0	4.1	4.3	9.9
Electrical Conductivity 1:5 soil:water	µS/cm	29	22	150	92	200

Misc Inorg - Soil				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021
pH 1:5 soil:water	pH Units	6.3	5.5	5.1
Electrical Conductivity 1:5 soil:water	µS/cm	160	78	89

ESP/CEC						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Exchangeable Ca	meq/100g	2.6	1.9	0.8	2.8	1.9
Exchangeable K	meq/100g	0.2	0.1	<0.1	0.2	<0.1
Exchangeable Mg	meq/100g	2.8	2.0	7.5	1.7	1.8
Exchangeable Na	meq/100g	<0.1	<0.1	1.1	<0.1	0.11
Cation Exchange Capacity	meq/100g	5.7	4.1	9.5	4.7	3.9
ESP	%	[NT]	[NT]	11	[NT]	3

ESP/CEC						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Exchangeable Ca	meq/100g	1.5	3.4	1.1	0.1	37
Exchangeable K	meq/100g	<0.1	<0.1	<0.1	<0.1	0.1
Exchangeable Mg	meq/100g	14	0.87	2.5	1.8	0.57
Exchangeable Na	meq/100g	1.4	<0.1	0.34	0.17	0.11
Cation Exchange Capacity	meq/100g	17	4.4	4.0	2.2	38
ESP	%	8	[NT]	8	8	<1

ESP/CEC				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021
Exchangeable Ca	meq/100g	4.8	1.8	0.9
Exchangeable K	meq/100g	<0.1	<0.1	<0.1
Exchangeable Mg	meq/100g	1.0	2.2	3.8
Exchangeable Na	meq/100g	0.24	0.23	0.25
Cation Exchange Capacity	meq/100g	6.1	4.3	5.0
ESP	%	4	5	5

Misc Soil - Inorg						
Our Reference		261469-1	261469-2	261469-3	261469-4	261469-5
Your Reference	UNITS	BH201	BH201	BH201	BH202	BH202
Depth		0.05	0.5	1.5-1.95	0.05	0.7-1.0
Date Sampled		8/02/2021	8/02/2021	8/02/2021	8/02/2021	8/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Hexavalent Chromium, Cr^{6+}	mg/kg	<2	<2	<1	<2	<2

Misc Soil - Inorg						
Our Reference		261469-6	261469-7	261469-8	261469-9	261469-10
Your Reference	UNITS	BH202	BH203	BH203	BH203	BH204
Depth		3.5-4.0	0.5	1.0	2.5-2.95	0.3
Date Sampled		8/02/2021	9/02/2021	9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021	12/02/2021	12/02/2021
Hexavalent Chromium, Cr^{6+}	mg/kg	1	<2	<1	<1	<2

Misc Soil - Inorg				
Our Reference		261469-11	261469-12	261469-13
Your Reference	UNITS	BH205	BH205	BH205
Depth		0.1	0.5	1.0-1.45
Date Sampled		9/02/2021	9/02/2021	9/02/2021
Type of sample		SOIL	SOIL	SOIL
Date prepared	-	12/02/2021	12/02/2021	12/02/2021
Date analysed	-	12/02/2021	12/02/2021	12/02/2021
Hexavalent Chromium, Cr^{6+}	mg/kg	<2	<1	2

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically. Waters samples are filtered on receipt prior to analysis.
Metals-020	Determination of various metals by ICP-AES.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-021	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-021	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-022	Determination of VOCs sampled onto coconut shell charcoal sorbent tubes, that can be desorbed using carbon disulphide, and analysed by GC-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS.

Method ID	Methodology Summary
Org-022/025	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-MS/GC-MSMS. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date extracted	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Date analysed	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
TRH C_6 - C_9	mg/kg	25	Org-023	<25	1	<25	<25	0	102	91
TRH C_6 - C_{10}	mg/kg	25	Org-023	<25	1	<25	<25	0	102	91
Benzene	mg/kg	0.2	Org-023	<0.2	1	<0.2	<0.2	0	107	94
Toluene	mg/kg	0.5	Org-023	<0.5	1	<0.5	<0.5	0	117	105
Ethylbenzene	mg/kg	1	Org-023	<1	1	<1	<1	0	95	84
m+p-xylene	mg/kg	2	Org-023	<2	1	<2	<2	0	96	85
o-Xylene	mg/kg	1	Org-023	<1	1	<1	<1	0	103	90
naphthalene	mg/kg	1	Org-023	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-023	110	1	92	99	7	111	101

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
TRH C_6 - C_9	mg/kg	25	Org-023	[NT]	11	<25	<25	0	[NT]	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-023	[NT]	11	<25	<25	0	[NT]	[NT]
Benzene	mg/kg	0.2	Org-023	[NT]	11	<0.2	<0.2	0	[NT]	[NT]
Toluene	mg/kg	0.5	Org-023	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
Ethylbenzene	mg/kg	1	Org-023	[NT]	11	<1	<1	0	[NT]	[NT]
m+p-xylene	mg/kg	2	Org-023	[NT]	11	<2	<2	0	[NT]	[NT]
o-Xylene	mg/kg	1	Org-023	[NT]	11	<1	<1	0	[NT]	[NT]
naphthalene	mg/kg	1	Org-023	[NT]	11	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-023	[NT]	11	105	103	2	[NT]	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date extracted	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Date analysed	-			12/02/2021	1	12/02/2021	12/02/2021		12/02/2021	12/02/2021
TRH C_{10} - C_{14}	mg/kg	50	Org-020	<50	1	<50	<50	0	125	115
TRH C_{15} - C_{28}	mg/kg	100	Org-020	<100	1	<100	<100	0	102	94
TRH C_{29} - C_{36}	mg/kg	100	Org-020	<100	1	<100	<100	0	77	77
TRH >C_{10} -C_{16}	mg/kg	50	Org-020	<50	1	<50	<50	0	125	115
TRH >C_{16} -C_{34}	mg/kg	100	Org-020	<100	1	<100	<100	0	102	94
TRH >C_{34} -C_{40}	mg/kg	100	Org-020	<100	1	<100	<100	0	77	77
Surrogate o-Terphenyl	%		Org-020	81	1	77	83	8	121	82

QUALITY CONTROL: svTRH (C10-C40) in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	12/02/2021	12/02/2021		[NT]	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-020	[NT]	11	<50	<50	0	[NT]	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-020	[NT]	11	<100	<100	0	[NT]	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-020	[NT]	11	<100	<100	0	[NT]	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-020	[NT]	11	<50	<50	0	[NT]	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-020	[NT]	11	<100	<100	0	[NT]	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-020	[NT]	11	<100	<100	0	[NT]	[NT]
Surrogate o-Terphenyl	%		Org-020	[NT]	11	76	77	1	[NT]	[NT]

QUALITY CONTROL: PAHs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date extracted	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Date analysed	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Naphthalene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	101	101
Acenaphthylene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	109	109
Fluorene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	102	104
Phenanthrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	105	105
Anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	105	109
Pyrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	104	109
Benzo(a)anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	112	116
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-022/025	<0.05	1	<0.05	<0.05	0	85	93
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	97	1	97	100	3	98	101

QUALITY CONTROL: PAHs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Naphthalene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Acenaphthylene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Phenanthrene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Anthracene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Pyrene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-022/025	[NT]	11	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-022/025	[NT]	11	<0.05	<0.05	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	[NT]	11	99	101	2	[NT]	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date extracted	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Date analysed	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
alpha-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	104	101
HCB	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	98	96
gamma-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	107	81
delta-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	110	114
Heptachlor Epoxide	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	107	103
gamma-Chlordane	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	106	109
Dieldrin	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	109	111
Endrin	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	100	105
Endosulfan II	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	92	97
Endrin Aldehyde	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	107	114
Methoxychlor	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-022/025	104	1	102	105	3	105	106

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
HCB	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
gamma-BHC	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
delta-BHC	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
gamma-Chlordane	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Dieldrin	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endrin	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endosulfan II	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Methoxychlor	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-022/025	[NT]	11	102	107	5	[NT]	[NT]

QUALITY CONTROL: Organophosphorus Pesticides in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date extracted	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Date analysed	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Dichlorvos	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	102	96
Dimethoate	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ronnel	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	104	107
Fenitrothion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	89	103
Malathion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	124	129
Chlorpyriphos	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	109	115
Parathion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	80	88
Bromophos-ethyl	mg/kg	0.1	Org-022	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	103	121
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-022/025	104	1	102	105	3	105	106

QUALITY CONTROL: Organophosphorus Pesticides in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Dimethoate	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Ronnel	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Fenitrothion	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Malathion	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Parathion	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-022	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-022/025	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-022/025	[NT]	11	102	107	5	[NT]	[NT]

QUALITY CONTROL: PCBs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date extracted	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Date analysed	-			11/02/2021	1	11/02/2021	11/02/2021		11/02/2021	11/02/2021
Aroclor 1016	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-021	[NT]	1	<0.1	<0.1	0	90	100
Aroclor 1260	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-021	104	1	102	105	3	105	106

QUALITY CONTROL: PCBs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	11/02/2021	11/02/2021		[NT]	[NT]
Aroclor 1016	mg/kg	0.1	Org-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1260	mg/kg	0.1	Org-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-021	[NT]	11	102	107	5	[NT]	[NT]

QUALITY CONTROL: Acid Extractable metals in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-16	261469-2
Date prepared	-			12/02/2021	1	12/02/2021	12/02/2021		12/02/2021	12/02/2021
Date analysed	-			12/02/2021	1	12/02/2021	12/02/2021		12/02/2021	12/02/2021
Arsenic	mg/kg	4	Metals-020	<4	1	<4	<4	0	108	##
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	111	78
Chromium	mg/kg	1	Metals-020	<1	1	150	140	7	106	#
Copper	mg/kg	1	Metals-020	<1	1	4	5	22	107	91
Lead	mg/kg	1	Metals-020	<1	1	28	27	4	104	76
Mercury	mg/kg	0.1	Metals-021	<0.1	1	<0.1	<0.1	0	109	113
Nickel	mg/kg	1	Metals-020	<1	1	12	13	8	109	82
Zinc	mg/kg	1	Metals-020	<1	1	26	30	14	112	81

QUALITY CONTROL: Acid Extractable metals in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	12/02/2021	12/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	12/02/2021	12/02/2021		[NT]	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	11	<4	<4	0	[NT]	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	11	<0.4	<0.4	0	[NT]	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	11	400	450	12	[NT]	[NT]
Copper	mg/kg	1	Metals-020	[NT]	11	1	2	67	[NT]	[NT]
Lead	mg/kg	1	Metals-020	[NT]	11	7	8	13	[NT]	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	11	12	13	8	[NT]	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	11	3	3	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	[NT]
Date prepared	-			12/02/2021	4	12/02/2021	12/02/2021		12/02/2021	[NT]
Date analysed	-			12/02/2021	4	12/02/2021	12/02/2021		12/02/2021	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	4	6.1	6.0	2	100	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	4	35	36	3	98	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	12/02/2021	12/02/2021		[NT]	[NT]
Date analysed	-			[NT]	12	12/02/2021	12/02/2021		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	12	5.5	5.5	0	[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	12	78	81	4	[NT]	[NT]

QUALITY CONTROL: ESP/CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date prepared	-			12/02/2021	1	12/02/2021	12/02/2021		12/02/2021	12/02/2021
Date analysed	-			12/02/2021	1	12/02/2021	12/02/2021		12/02/2021	12/02/2021
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	1	2.6	2.6	0	91	96
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	1	0.2	0.2	0	103	95
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	1	2.8	2.7	4	95	96
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	1	<0.1	<0.1	0	118	103

QUALITY CONTROL: ESP/CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	12/02/2021	12/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	12/02/2021	12/02/2021		[NT]	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	[NT]	11	4.8	5.2	8	[NT]	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	[NT]	11	<0.1	0.1	0	[NT]	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	[NT]	11	1.0	1.1	10	[NT]	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	[NT]	11	0.24	0.26	8	[NT]	[NT]
ESP	%	1	Metals-020	[NT]	11	4	4	0	[NT]	[NT]

QUALITY CONTROL: Misc Soil - Inorg					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-17	261469-2
Date prepared	-			12/02/2021	1	12/02/2021	12/02/2021		12/02/2021	12/02/2021
Date analysed	-			12/02/2021	1	12/02/2021	12/02/2021		12/02/2021	12/02/2021
Hexavalent Chromium, Cr^{6+}	mg/kg	1	Inorg-024	<1	1	<2	<2	0	106	#

QUALITY CONTROL: Misc Soil - Inorg					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	12/02/2021	12/02/2021		[NT]	[NT]
Date analysed	-			[NT]	11	12/02/2021	12/02/2021		[NT]	[NT]
Hexavalent Chromium, Cr^{6+}	mg/kg	1	Inorg-024	[NT]	11	<2	<2	0	[NT]	[NT]

Result Definitions	
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Asbestos: Excessive sample volumes were provided for asbestos analysis.
A portion of the supplied samples were sub-sampled according to Envirolab procedures.
We cannot guarantee that these sub-samples are indicative of the entire sample.
Envirolab recommends supplying 40-50g (50mL) of sample in its own container as per AS4964-2004.
Note: Samples 261469-1-8,10-13 were sub-sampled from bags provided by the client.

Asbestos: A portion of the supplied sample was sub-sampled for asbestos analysis according to Envirolab procedures.
We cannot guarantee that this sub-sample is indicative of the entire sample.
Envirolab recommends supplying 40-50g of sample in its own container.
Note: Sample 261469-9 was sub-sampled from a jar provided by the client.

8 metals in soil:
-# Percent recovery is not possible to report due to the high concentration of the element in the sample. However an acceptable recovery was obtained for the LCS.
-## Low spike recovery was obtained for this sample. Sample matrix interference is suspected. However, an acceptable recovery was obtained for the LCS

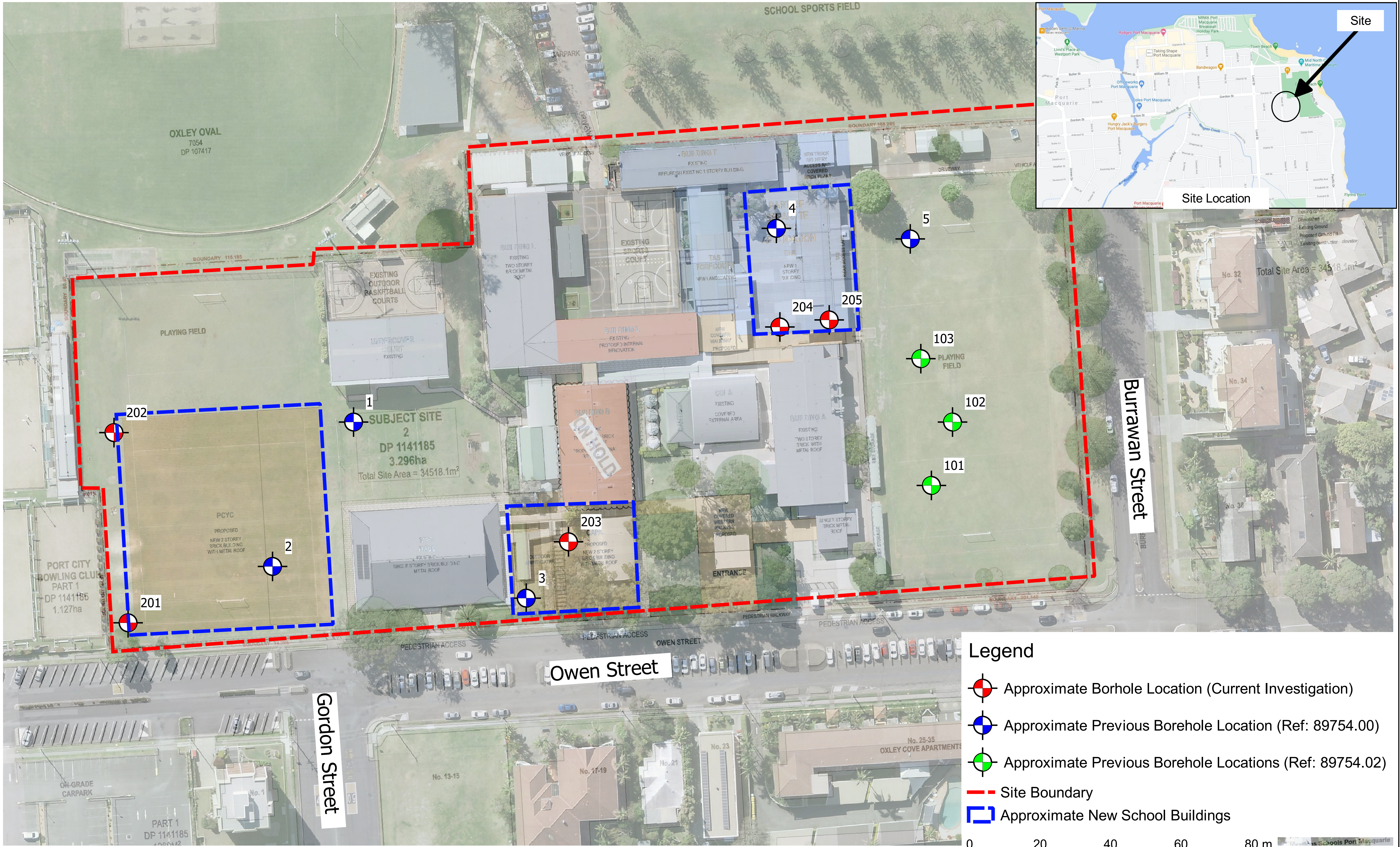
MISC_INORG_CRVI: Hexavalent Chromium PQL has been raised due to matrix interferences, samples were diluted and reanalysed however same results were achieved.

MISC_INORG_CRVI: # Percent recovery not reported due to matrix interferences. Samples were diluted and reanalysed and the poor recovery was confirmed. However an acceptable recovery was obtained for the LCS.

ESP: Where the exchangeable Sodium is less than the PQL and CEC is less than 10meq/100g, the ESP cannot be calculated.

Appendix D

Drawing 1 – Test Location Plan
fjmt Site Plan – Proposed (SSDA-120010, Rev05)



Drawing adapted from aerial imagery from Metro Map dated 17 September 2020 and Client supplied drawing titled "Site Plan - Proposed" Drawing SSDA-120010, dated 12 February 2021, Rev01, by fjmt Studio

Test locations are approximate only and were located using Handheld GPS and Measured off site features

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Schools Infrastructure NSW		TITLE: **Test Location Plan** **Proposed Hastings Secondary College Upgrade** **16 Owen Street, Port Macquarie**	Project: 89754.03
	OFFICE: Port Macquarie	DRAWN BY: JRC		DRAWING No: 1
	SCALE: 1:1000 @A3	DATE: 18.February.2021		REVISION: 0

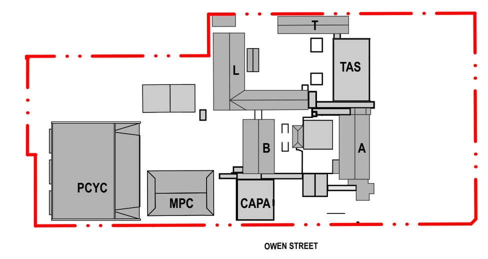
DP.QGIS.A3LandscapeDrawingLayout.DftA

0 5 10 20m

GENERAL NOTES

- ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR BEFORE PROCEEDING WITH THE WORK.
- ALL LEVELS RELATIVE TO 'AUSTRALIAN HEIGHT DATUM'.
- DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS ONLY.

keyplan



legend

- BOUNDARY LINE
- AREA UNDER ALTERNATIVE PLANNING PATHWAY
- PROPOSED REFURBISHMENT
- NEW CONSTRUCTION
- EXISTING TREES
- PROPOSED TREES

rev	date	name	by	chk
05	14/4/21	SSDA	MJ	
04	26/3/21	SSDA	KT	
03	19/3/21	SSDA - Consultant Background Issue	AD	
02	23/2/21	Draft SSDA 02	KT	
01	12/2/21	Draft SSDA	MJ	

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project
Hastings Schools Port Macquarie
Hastings Secondary College
Port Macquarie NSW 2444

title
Site
Site Plan - Proposed

scale	1:500 @ A1	first issued	12/2/21
project code	sheet no.	revision	
HSPM	SSDA-120010	05	