Douglas Partners
Geotechnics / Environment / Groundwater

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Report on
Stage 1 (Preliminary) Site Investigation for Contamination

Proposed Childhood Early Learning Centre
Part of 2 High Valley Close and 689 The Entrance Road, Wamberal

Prepared for
Mistlake Investments Pty Ltd

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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 Stage 1 (Preliminary) Site Investigation for Contamination
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1. Introduction

This report presents the results of a Stage 1 (Preliminary) Site Investigation (PSI) for Contamination undertaken at part of 2 High Valley Close and 689 The Entrance Road, Wamberal, NSW. The investigation was commissioned in an email dated 26 September 2019 received from Andrew Brand of Mistlake Investments Pty Ltd and was undertaken with reference to Douglas Partners Pty Ltd (DP)'s proposal CCT190345, dated 20 September 2019.

It is understood that the site covers an area of approximately 5,000 m^2 (0.5 ha) and the proposed development comprises construction of a childhood early learning centre. Detailed architectural plans have not been provided to DP, however the client has indicated that the development will likely comprise realignment of the site boundary and construction of a new centre building along with associated driveway access and car park pavements. Cut / fill of between 2 m and 3 m may also be required.

The aim of the PSI was to provide an initial assessment of the site's contamination status and comment on the nature and extent of contamination (if present). This report should be read with reference to the notes 'About this Report' presented in Appendix A and other attachments to the report.

A geotechnical investigation was also completed and reported separately in *Report on Geotechnical Investigation, Proposed Childhood Early Learning Centre, 2 High Valley Close, Wamberal*, dated 19 November 2019 (Ref. 83717.00.R.001.Rev0) (DP, 2019).

2. Scope of Work

The scope of work comprised:

- Review of information obtained from the following sources:
  - Published data, including topographical, geological and hydrogeological maps;
  - Registered groundwater bore licence search;
  - NSW EPA Contaminated Land and Protection of Environment Operations databases;
  - NSW Government Planning Report;
  - Council records; and
  - Historical aerial photographs;
- Site walkover to assess potential contamination sources and receptors;

- Precautionary services scan of proposed test locations by a licensed services location contractor;
- Four bores were drilled to depths of between 1.9 m and 3.0 m using a utility-mounted push-tube rig;
- Each test location was surveyed using a differential GPS;
- The bores were logged and soil samples were collected from each soil stratum and upon signs of contamination;
- All samples were screened for the presence of volatile organic compounds (VOC) using a photo-ionisation detector (PID);
- Selected primary soil samples and 10 % QA samples were dispatched to a NATA registered laboratory for testing of potential contaminants of concern, those being heavy metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethyl-benzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organochlorinated pesticides (OCP), organophosphorous pesticides (OPP) and asbestos; and
- Preparation of this report.

3. Site Identification and Location

The site comprises part of 2 High Valley Close and 689 The Entrance Road, Wamberal and is identified as part of Lots 70 and 71 in Deposited Plan 1215036.

The site is an irregular shape, covers an area of approximately 0.5 ha and is zoned DM Deferred Matter. According to Central Coast Council's website, the DM zoning is an interim measure applying to rural sites previously earmarked by Council for its Coastal Open Space System. . The site is located within the local government area of Central Coast Council, formerly Gosford City Council.

The site is bounded by High Valley Close to the north-west, The Entrance Road / Central Coast Highway to the south, land occupied by a ground level duplex to the east and the remaining vacant parts of the Lots 70 and 71 to the north and north-east. The surrounding area to the north of The Entrance Road is occupied by rural residential properties and the surrounding area south of The Entrance Road is occupied by residential properties.

Refer to Drawing 1 in Appendix A.

4. Geology, Topography and Hydrogeology

Reference to geological mapping indicates the site is underlain by Terrigal Formation belonging to the Narrabeen Group which is generally comprised of sandstone, siltstone, conglomerate, mudstone and rare coal.

Reference to soil landscape mapping indicates that the site is underlain by the Erina erosional landscape group which is generally comprised of yellow podzolic soils and yellow earths weathered from the underlying bedrock.

Reference to the Gosford Acid Sulfate Soil Risk mapping indicates that the site is not within an area identified as having a risk of occurrence of acid sulfate soils.

Reference to NSW 2 m Elevation Contours indicates that the site surface levels ranged from approximately 32 m AHD at the south-western boundary to 18 m AHD at the north-eastern boundary. The site slopes down toward the north and north-east. The southern boundary of the site adjoins The Entrance Road, which appears to be positioned at the crest of a broad ridge, with an approximate west to north-east alignment.

The mapping also indicates that the nearest waterbody to the site would Wamberal Lagoon which is located approximately 1 km to the east of the eastern site boundary.

The mapping indicates that surface water runoff would discharge to the street stormwater drainage system and then an intermittent creek located approximately 200 m north of the site and then discharge to Terrigal Lagoon, located approximately 1 km south-east of the site.

A search of the NSW Department of Primary Industries Office of Water database was undertaken on 16 October 2019 and indicated that there are 11 registered groundwater bores identified within approximately 1 km radius of the site. Four of the 11 registered bores (GW201173 to GW201176) are monitoring bores located within an operational service station which is located approximately 1 km to the east of the site (up-gradient of the site).

The authorised or intended purposes for the remaining bores were stated as either for irrigation, stock or domestic use. Standing water levels ranged from 2.1 m to 6.0 m below ground level with the exception of one which recorded the standing water level at 34.0 m (GW202198). No registered bores were located between the site and the intermittent watercourse (likely groundwater discharge point).

5. Site History

The desktop component of this investigation involved a review of historical information relating to potential contamination sources at the site. Relevant findings are provided below and are based on a review of NSW EPA Contaminated Land and Protection of Environment Operations databases, council records and historical aerial photographs.

The site history documents reviewed are provided in Appendix B.

5.1 Regulatory Notices

The EPA publishes records of contaminated sites under Section 58 of the CLM Act on a public database, accessible via the internet. The notices relate to investigation and / or remediation of significant contamination as defined under the CLM Act. More specifically the notices relate to the following:

- Actions taken by the EPA under Sections 15, 17, 19, 21, 23, 26 or 28 of the CLM Act;
- Actions taken by the EPA under Sections 35 or 36 of the Environmentally Hazardous Chemicals Act 1985; and
- Site audit statements provided to the EPA under section 52 of the CLM Act on sites subject to an in-force remediation order.

The search of the database on 16 October 2019 revealed that the subject site is not listed nor are any other sites in Wamberal.

It should be noted that the EPA record of notices for contaminated land does not provide a record of all contaminated land in NSW.

The NSW EPA also issues environmental protection licenses under Section 308 of the POEO Act. The register contains:

- Environmental protection licenses;
- Applications for new licenses and to transfer or vary or extend licenses;
- Environment protection and noise control licenses;
- Convictions and prosecutions under the POEO Act;
- The result of civil proceedings;
- License review information;
- Exemptions and provisions of the POEO Act or Regulations;
- Approvals granted under Clause 9 of the POEO (Control of Burning) Regulation; and
- Approvals granted under Clause 7a of the POEO (Clean Air) Regulation.

A search of the public register on the 16 October 2019 indicated the site is not listed nor were any other sites in Wamberal.

5.2 NSW Government Property Report

The NSW Government Planning Report was provided by the client on 21 October 2019 and indicated the local Aboriginal Land Council is Darkinjung. No matters pertaining to potential land contamination were included in the report.

5.3 Council Records

An informal access request was lodged with Central Coast Council on 16 October 2019. DP viewed Council records on 25 October 2019. The following reports were accessed in relation to potential for contamination at the site. All appear to have been prepared following the RMS upgrade of The Entrance Road. DP was allowed to view the reports but not allowed a copy of the reports.

- JBS&G prepared a report entitled *Phase 1 & 2 Environmental Site Assessment* for RMS dated November 2015, Rev1 (Ref. 50923 / 101344). The following points were of interest:
  - WorkCover records indicated:
    - 1971: An application was lodged for a UST which was located north of the house which was visible in 1964 and 1974 aerial photographs (It is noted that this location would approximately correlate with Bore 4 in Drawing 1);
    - 1976: Reapplication for the tank was approved;
    - 1982: Reapplication for the tank was approved;
    - April 1987: Reapplication for the tank was approved; and
    - September 1987: Reapplication for the tank was approved.
  - Title Deeds indicated:
    - From 1916 until about the 1960s the site was owned by farmers, widows, graziers, nurserymen, a carpenter and a plant mechanic;
    - 1960-2007 the site was owned by companies which likely operated a poultry farm, a property developer and then a house builder; and
    - From 2010 the site was owned by Roads and Maritime Services (RMS).
  - The report stated that the potentially contaminating activities were agriculture, UST associated with the plant mechanic's use of the site and RMS's use of the site for storage from 2010.
  - 22 test pits were excavated across the site to depths of between about 0.8 m and 2.2 m.
  - Fill was encountered to depths of between 0.2 m and 2.2 m and contained sandstone, wood, concrete, plastic and cloth.
  - Natural soils generally comprised red brown and orange brown clay.
  - One fragment of ACM was found at the surface and was removed by JBS&G.

  It is noted that asbestos identification testing was completed. The assessment did not include a calculation of asbestos concentration.
  - No evidence of the UST was noted i.e. backfill sand, infrastructure or odours.
  - All results were within the site assessment criteria (SAC) for the childcare centre which was proposed at the time.
  - The report identified a data gap regarding the previous UST which appeared to have been removed in the 1970s and 1980s.

  - It is noted that the UST may have been removed some time after September 1987 given that a reapplication for the tank was approved in 1987.
  - The report concluded the site was suitable for the proposed childcare centre provided the data gaps surrounding the previous UST were addressed including recommending a targeted investigation be completed in the area of the previous UST.
- JBS&G prepared a report entitled *Data Gap Assessment* for RMS dated May 2016, Rev0 (Ref. 50923 / 103668). The following point were of interest:
  - The report aimed to address the recommendation made in the Phase 1 & 2 report.
  - The scope of work included five shallow bores (max 2.8 m) and installation of three groundwater monitoring wells targeted to the location of the previous UST.
  - Staining was noted in the fill between 1.5 m and 2.8m.
  - Hydrocarbon odours were noted in the fill between 0.85 m and 2.5 m.
  - PID results in fill ranged between 11 and 67 ppm to a depth of 2.5 m.
  - Natural soils did not exhibit any signs of contamination. PID readings were <1 ppm. No hydrocarbon odours or staining were noted.
  - No ACM was observed.
  - Soil results were within the SAC with the exception of TRH F1 and xylene in fill at a depth of 1.4 m to 1.6 m in one test location which exceeded the health investigation and screening levels and ecological investigation and screening levels adopted by JBS&G.
  - No groundwater exceedances were recorded.
  - The reported stated that, based on the groundwater results, there was no potential for off-site migration.
  - The report concluded that the site can be made suitable for the proposed child care centre subject to the management of soil impacted in the area of the previous UST and that a Remediation Action Plan should be prepared for the site.
- JBS&G prepared a report entitled *Remediation Action Plan* for RMS dated August 2017, Rev0 (Ref. 50923 / 106713). The report outlined the remedial actions required and included an unexpected finds protocol and contingency plan.

It is noted that Council did not have record of a Validation Report following the proposed remediation, thus it is unclear whether the proposed remediation was completed.

5.4 Aerial Photographs

Historic aerial photographs for the years 1954, 1975 and 1991 were obtained from the DP archival database and photographs for the years 2010 to 2019 were obtained from NearMap. These photographs were studied in order to identify the likely past uses and changes to the site and surrounding area, particularly those of a potentially contaminating nature. The findings are summarised below and the photographs are presented in Appendix B.

1954
The site appears occupied by orchards / market gardens and some buildings / structures. The surrounding area appears occupied by a mix of bushland, farmland / market garden and residential type buildings.

1975
The site appears to no longer be occupied by market gardens / orchards. The buildings / structures appear consistent with the 1954 photograph. The market gardens / orchards appear to have been removed from the surrounding area compared to the 1954 photograph.

1991
The site condition appears similar to the 1975 photograph. The surrounding area north of The Entrance Road appears to have been largely cleared with some residential type buildings and possibly sheds immediately north of the road. The surrounding area south of The Entrance Road appears mostly developed for residential purposes.

2010, November
The site appears partly occupied by buildings / structures. A residential type building and detached shed / garage occupy the southern portion of the site and two or three shed structures, possibly used for farming or market gardening or possible a builders / contractors depot occupy the eastern portion of the site (refer to Section 5.3). The area east of the sheds appears bitumen paved. The remaining site area is covered by lawns. The surrounding area appeared occupied by residential or rural residential properties.

2010, May
The site and surrounding area appear similar to the November 2010 photograph.

2011, January
The site and surrounding area appear generally similar to the May 2010 photograph, although the sheds noted at the south-eastern end of the site appear to have been removed / demolished. The duplex noted in the site walkover (see Section 6) appears to the east of the site boundary.

2011, June
The site appears to have been completely cleared since May 2010. No buildings, structures or lawn are visible. A few trees remain. The site appears to be undergoing earthworks, possible cut / fil, possible associated with the RMS upgrade of the Entrance Road. Some stockpiled materials are visible along with an access track through about the middle of the site. Significant quantities of materials and equipment appeared to be stored / active at the site. The surrounding area appears similar to the 2010 photograph with the exception of the area to the north-east, east and south-west which appear to also have been cleared and possibly undergoing earthworks also. The duplex noted in the site walkover (see Section 6) appears to the east of the site boundary.

2012, June
The site appears to be occupied by small structure, possibly demountables, stockpiles, vehicles and construction materials. The Entrance Road, located directly to the south of the southern site boundary appears to be undergoing expansion / realignment. It is likely that the subject site was utilised as a construction site office / depot during the road construction. The remaining surrounding area appears similar to the June 2011 photograph.

2013, April
The site and surrounding area appear generally similar to the June 2012 photograph. The Entrance Road appears to be undergoing duplication and a smaller access road appears to be constructed north of the Entrance Road.

2013, December
The Entrance Road duplication and access road appear to have been completed. The site still appears occupied by some stockpiles and construction materials and possibly still utilised as a site office / depot. The surrounding area appears generally similar to the April 2013 photograph.

2019, July
The site and surrounding area appear similar to the current conditions noted at the time of the site walkover. Refer to Section 6 of this report.

6. Site Walkover / Description

A walkover was completed on 15 October 2019. Photographs 1 to 4 are presented in Appendix A.

At the time of the walkover, the site was vacant and covered in long grass. A few large trees were present. No buildings or structures were present. The site boundaries were fenced, with the exception of the south-eastern boundary.

The site sloped down steeply toward the north-east. Several mounds or possible vegetated stockpiles were noted at the southern end of the site and some concrete fragments were noted at the surface.

No potentially asbestos-containing materials (ACM) were noted at the site's surface during the site walkover, however, it should be noted that due to the lawn and long grass, a comprehensive visual inspection of the site's surface could not be completed. Thus the presence of ACM at the surface could not be ruled out.

The mounds / stockpiles were not assessed / classified as part of this investigation.

At the time of sampling (also 15 October 2019), the resident in the neighbouring duplex to the north-north-east of the site indicated that the site previously contained a diesel UST in the eastern portion of the site, located north-north-west of DP Bore 4. This location is consistent with that stated in the JBS&G report (Section 5.3). Following receipt of this information, DP lodged a request to view Council records (Section 5.3).

7. Preliminary Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or in the future i.e. it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

7.1 Potential Contamination Sources and Contaminants of Concern

Based on the current investigation, the following potential sources of contamination and associated contaminants of concern have been identified (Table 1).

Table 1: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
Imported fill of unknown origin (S1)	Uncontrolled fill: historical aerial photograph indicate fill may have been used to level the site in the past.	Common contaminants associated with fill include heavy metals, TRH, BTEX, PAH, PCB, OCP, OPP and asbestos.
Previous commercial / industrial activities on site (S2)	Storage of diesel (previous UST) and other chemicals or equipment associated with previous and site uses.	Heavy metals, TRH, BTEX, PAH, PCBs, phenols, VOCs and asbestos.
Previous Stockpiled Materials (S3)	Stockpiles of soil, aggregates and construction materials were noted on the historical aerial photographs.	Common contaminants associated with fill include heavy metals, TRH, BTEX, PAH, PCB, OCP, OPP and asbestos.

Notes to Table 1:
TRH - total recoverable hydrocarbons
BTEX - benzene, toluene, ethylbenzene, xylene
PAH - polycyclic aromatic hydrocarbons
PCB - polychlorinated biphenyls
OCP - organochlorine pesticides
OPP - organophosphorous pesticides
VOC - Volatile organic compounds

The potential contamination sources (S) on the site are therefore as follows:

S1 Fill of unknown origin;

S2 Previous commercial / industrial activities on site and neighbouring sites; and

S3 Previous stockpiled materials.

7.2 Potential Receptors

7.2.1 Human Health Receptors

R1 Construction and maintenance workers;

R2 Future end users (including children, site workers and visitors); and

R3 Land users in adjacent areas (residential).

7.2.2 Environmental Receptors

R4 Groundwater;

R5 Surface water; and

R6 Terrestrial ecology.

7.2.3 Potential Pathways

Potential pathways for the identified contamination to impact on the receptors include the following:

P1 Ingestion and dermal contact;

P2 Inhalation of dust and / or vapour;

P3 Leaching of contaminants and vertical migration into groundwater;

P4 Surface water run-off;

P5 Lateral migration of groundwater; and

P6 Contact with terrestrial ecology.

7.3 Summary of Preliminary CSM

A 'source – pathway – receptor' approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1 to S3) and receptors (R1 to R6) are provided in Table 2 below.

Table 2: Potential Complete Pathways

Source	Pathway	Receptor
S1 Fill of unknown origin S2 Previous commercial / industrial activities on site S3 Previous Stockpiled Materials	P1: Ingestion and dermal contact	R1: Construction and maintenance workers R2: Future end users
	P2: Inhalation of dust and / or vapour / hazardous ground gases	R1: Construction and maintenance workers R2: Future end users R3: Land users in adjacent areas (residential)
	P3: Leaching of contaminants and vertical migration into groundwater	R4: Groundwater
	P4: Surface water run-off P5: Lateral migration of groundwater	R5: Surface water
	P6: Contact with terrestrial ecology	R6: Terrestrial ecology

8. Fieldwork and Analysis

8.1 Data Quality Objectives and Project Quality Procedures

This PSI has been devised with reference to the seven step data quality objective (DQO) process which is provided in Appendix B, Schedule B2 of NEPC (2013). The DQO process is outlined as follows:

- State the problem;
- Identify the decision;
- Identify inputs into the decision;
- Define the boundary of the assessment;
- Develop a decision rule;
- Specify acceptable limits on decision errors; and
- Optimise the design for obtaining data.

Referenced sections for the respective DQOs listed above are provided in Appendix D.

8.2 Data Quality Indicators

The performance of the assessment in achieving the DQO was assessed through the application of data quality indicators (DQI) as defined by:

Precision: A quantitative measure of the variability (reproducibility) of data;

Accuracy: A quantitative measure of the closeness of reported data to the "true" value;

Representativeness: The confidence (expressed qualitatively) that data are representative of each media present on the site;

Completeness: A measure of the useable data from a data collection activity; and

Comparability: The confidence (expressed qualitatively) that data can be considered equivalent for each sampling and analytical event.

Further comments on the DQIs are presented in Appendix D.

8.3 Soil Sampling Locations and Rationale

Table A of NSW EPA *Sampling Design Guidelines* (1995) recommends a minimum of 13 sampling points for a site of 0.5 ha for site characterisation based on the detection of circular hot spots using a systemic grid sampling pattern. Four bores were completed to provide preliminary information on the contamination status of the soils at the site and confirm the finding of JBS&G (2015 and 2016).

Intrusive works were undertaken on 15 October 2019 at the locations shown in Drawing 1 in Appendix A.

8.4 Soil Sampling Procedures

Environmental sampling was performed with respect to the standard operating procedures outlined in the DP *Field Procedures Manual*. All sampling data was recorded on bore logs presented in Appendix C and selected samples for laboratory analysis were recorded on DP chain-of-custody (COC) sheets provided in Appendix D. The general soil sampling procedure comprised:

- Collecting soil samples directly from the sampling tube using disposable gloves or stainless steel sampling equipment. Care was taken to remove any extraneous material deposited on the core sample.
- Use of disposable sampling equipment including nitrile gloves;
- Transfer of samples into laboratory prepared glass jars and bottles (with appropriate preservatives for analytes) and capping immediately with Teflon lined lids;
- Labelling of sampling containers with individual and unique identification, including project number, sample identification and sample depth;
- Placement of sample containers and bags into a cooled, insulated and sealed container for transport to the laboratory; and

- COC was maintained at all times and countersigned by the receiving laboratory on transfer of the samples.

Envirolab Services Pty Ltd (ELS), accredited by NATA, was employed to conduct the sample analysis. ELS is required to carry out in-house procedures.

8.5 Analytical Rationale

The analytical scheme was designed to obtain an indication of the potential presence and possible distribution of identified contaminants of concern (COC) based on information obtained in the preliminary CSM. The primary contaminants of concern as identified in Section 7 are heavy metals, TRH, BTEX, PAH, OCP, OPP, PCB and asbestos.

Soil samples were selected for analysis based on site observations (i.e. odour, staining etc.), and their location within the subsoil strata (i.e. surface, fill or natural), with an emphasis on fill and possible impacts from the previous UST where it would be expected that the bulk of identified COC would be present.

8.6 Field Quality Assurance and Quality Control

The field QC procedures for sampling were completed with respect to the Douglas Partners' *Field Procedure Manual*, and are outlined in Appendix D.

Field replicates were recovered and analysed for a limited suite of contaminants by means of intra-laboratory analysis. These samples were collected with reference to standard industry practice and guidelines.

8.7 Laboratory QA / QC

The analytical laboratory, accredited by NATA, is required to conduct in-house QA / QC procedures. These are normally incorporated into every analytical run and include reagent blanks, spike recovery, surrogate recovery and duplicate samples. These results are included in the laboratory certificates in Appendix D.

The results of the DP assessment of laboratory QA / QC are shown in Appendix D, along with the full laboratory certificates of analysis.

9. Assessment Criteria

The assessment criteria have been sourced from the National Environment Protection Council (NEPC) *National Environment Protection Measure (Assessment of Site Contamination)* 1999, as amended 2013 (NEPC 2013).

The site assessment criteria (SAC) comprise health-based investigation levels (HILs), health screening levels (HSLs) and management limits for TRH. The laboratory Practical Quantitation Limit (PQL) has also been adopted as a screening level for some contaminants.

9.1 Health-based Investigation Levels (Non-petroleum Chemical Contaminants)

Table 3 shows the HILs that have been adopted by NEPC (2013) Schedule B1, Table 1A (1) for assessing the human health risk from a contaminant via relevant pathways of exposure, as detailed in the CSM. Table 3 only includes contaminants analysed during this assessment, not the full list provided in NEPC (2013). Given the objective of the PSI, the proposed development into a childhood early learning centre and the potential receptors identified in the CSM, the adopted SAC were for the most conservative land use scenario, being a residential land use with gardens and accessible soil (i.e. HIL A).

Table 3: Health Investigation Levels (Non-petroleum Chemical Contaminants)

Contaminant	HIL A (mg/kg)
Metals and Inorganics	
Arsenic	100
Cadmium	20
Chromium (IV)	100
Copper	6,000
Lead	300
Mercury (inorganic)	40
Nickel	400
Zinc	7,400
PAH	
Carcinogenic PAH (as benzo(a)pyrene TEQ)	3
Total PAH	300
Naphthalene	3
OCP	
DDT + DDD + DDE	240
Aldrin + Dieldrin	6
Chlordane	50
Endosulfan (total)	270
Endrin	10
Hepatchlor	6
HCB	10
Methoxychlor	300
OPP	
Chlorpyrifos	160
PCB	1

9.2 Petroleum Contaminants (Health Screening Levels and Management Limits)

Health Screening Levels

Table 4 shows petroleum hydrocarbon compounds adopted from NEPC (2013) Schedule B1, Table 1A(3) and are based on the exposure to petroleum hydrocarbons through the dominant vapour inhalation exposure pathway. The screening levels are adopted given the exposure risk identified during the CSM.

The HSLs are based on overlying soil type and depth. HSLs for sand have been used as they are most conservative. Using the most conservative values, the depth range of 0 m to <1 m has been used.

Table 4: Soil Health Screening Levels for Vapour Intrusion

Contaminant	Soil Type	HSL A (mg/kg)
		Depth 0 m to <1m
Toluene	Sand	160
Ethylbenzene		55
Xylenes		40
Naphthalene		3
Benzene		0.5
TRH C_6-C_{10} less BTEX [F1]		45
TRH >C_{10}-C_{16} less naphthalene [F2]		110

Direct Contact Screening Levels

Direct contact HSLs have also been considered for the future land use, considering that some parts of the site may be available for direct contact such as grassed areas or in garden beds and vegetated areas. These are provided in Table 5.

Table 5: Direct Contact Health Screening Levels (mg/kg)

Contaminant	HSL A	Intrusive Maintenance Worker
Toluene	14,000	120,000
Ethylbenzene	4,500	85,000
Xylenes	12,000	130,000
Naphthalene	1,400	29,000
Benzene	100	1,100
C_6-C_{10}	4,400	82,000
>C_{10}-C_{16}	3,300	62,000
>C_{16}-C_{34}	4,500	85,000
>C_{34}-C_{40}	6,300	120,000

Management Limits (TRH Only)

NEPC (2013) Table 1B (7) provides 'management limits' for TRH fractions, which are applied after consideration of relevant HSLs. The management limits have been adopted to avoid or minimise the following potential effects of petroleum hydrocarbons:

- Formation of non-aqueous phase liquids (NAPL);
- Fire and explosive hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

The presence of TRH contamination at the site below the management limits does not imply that there is no need for administrative notification or controls in accordance with jurisdictional requirements. The adopted management limits are shown in Table 6 and have been selected based on the CSM. Management limits for coarse material are presented in Table 6, since the coarse texture management limits are more conservative of the two management limits available.

Table 6: Management Limits for TRH Fractions in Soil

TRH Fraction	Soil Texture	Management Limit: (mg/kg)
C_6-C_9 [F1]	Coarse	700
>C_{10}-C_{16} [F2]	Coarse	1,000
>C_{16}-C_{34} [F3]	Coarse	2,500
>C_{34}-C_{40} [F4]	Coarse	10,000

9.3 Ecological Investigation Levels

Ecological Investigation Levels (EIL) have been derived for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems (NEPC, 2013). EIL depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant based on the sum of the ambient background concentration (ABC) and an added contaminant limit (ACL). The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ACL is the added concentration (above the ABC) of a contaminant above which further appropriate investigation and evaluation of the impact on ecological values is required.

The EIL is calculated using the following formula:

EIL = ABC + ACL,

The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al *Trace element concentrations in soils from rural and urban areas of Australia*, Contaminated Sites monograph no. 4, South Australian Health Commission, Adelaide, Australia 1995 (Olszowy, 1995) or Hamon et al, *Geochemical indices allow estimation of heavy metal background concentrations in soils*, Global Biogeochemical Cycles, vol. 18, GB1014, (Hamon, 2004). The ACL is based on the soil characteristics of pH, CEC and clay content.

EIL (and ACLs where appropriate) have been derived in NEPC (2013) for only a short list of contaminants comprising As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EIL for these contaminants, and has been provided in the ASC NEPM Toolbox available on the SCEW (Standing Council on Environment and Water) website (http://www.scew.gov.au/node/941).

The adopted EIL, derived from Tables 1B (1) to 1B(5), Schedule B1 of NEPC (2013) the *Interactive (Excel) Calculation Spreadsheet* are shown in the following Table 7. The following site specific data and assumptions have been used to determine the EILs:

- Given the likely source of soil contaminants (i.e. historical site use/fill) the contamination is considered as “aged” (>2 years); and
- ABCs have been derived using the *Interactive (Excel) Calculation Spreadsheet* using input parameters of aged soil, using assumed parameters as follows:
    - CEC of 5 $cmol_c/kg$;
    - pH of 4 for the State in which the site is located, and high for traffic volumes; and
    - Assumed clay content of 10%.

Table 7: Ecological Investigation Levels (EIL) in mg/kg

Analyte		EIL	Comments
Metals	Arsenic	100	Assumed pH of 4 and CEC of 5 $cmol_c/kg$; assumed clay content 10%
	Copper	55	
	Nickel	35	
	Chromium III	410	
	Lead	1,100	
	Zinc	150	

9.4 Ecological Screening Levels – Petroleum Hydrocarbons

Ecological Screening Levels (ESL) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESL apply to the top 2 m of the soil profile as for the EIL.

ESL have been derived in NEPC (2013) for petroleum fractions F1 to F4 as well as BTEX and benzo(a)pyrene. Site specific data and assumptions as summarised in Table 8 have been used to determine the ESL. The adopted ESL, from Table 1B(6), Schedule B1 of NEPC (2013) are shown in Table 9.

Table 8: Inputs to the Derivation of ESL

Variable	Input	Rationale
Depth of ESL application	Top 2 m of the soil profile	The top 2 m depth below ground level corresponds to the root zone and habitation zone of many species.
Land use	Residential (including childcare)	Childcare land use is proposed
Soil Texture	Coarse	Based on the most conservative approach

Table 9: Ecological Screening Levels (ESL) in mg/kg

Analyte		ESL	Comments
TRH	C6 – C10 (less BTEX) [F1]	180*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	>C10-C16 (less Naphthalene) [F2]	120*	
	>C16-C34 [F3]	300	
	>C34-C40 [F4]	2,800	
BTEX	Benzene	50	
	Toluene	85	
	Ethylbenzene	70	
	Xylenes	105	
PAH	Benzo(a)pyrene	0.7	

9.5 Asbestos

Presence / absence testing for asbestos in soil was carried out on selected soil samples as a screening assessment using the laboratory detection limit of 0.1 g / kg.

9.6 Contaminants with No Assessment Criteria

Where no guidance is provided in NEPC (2013) for a specific analyte, the PQL was used as the initial screening criteria.

If concentrations are recorded above the PQL, reference criteria were sourced from other national and international guidance as relevant and used to determine the significance of the detected analyte.

The referenced criteria are provided in Tables D1 and D2, Appendix D.

10. Fieldwork Observations

The approximate bore locations are shown in Drawing 1 in Appendix A. The bore logs are provided in Appendix C along with notes on descriptive terms and symbols.

The subsurface conditions encountered comprised:

Fill:

- Brown silty sand fill encountered in Bores 1, 3 and 4 to depths of between 0.1 m and 0.15 m;
- Orange brown and red brown clay fill with sandstone fragments encountered in all bores between the surface and 0.9 m. This fill also contained trace concrete and plastic in Bores 1 and 3; and
- Grey brown sandy gravel fill with concrete and asphalt (Bore 2 only) was encountered in Bores 2 and 3 depths of between 0.15 m and 0.7 m.

Natural:

- Grey brown and brown residual silty clay and clay was encountered in all bores to depths of between 1.4 m and 2.7 m; and
- Yellow brown and grey residual sandy clay to termination depths of between 1.9 m and 3.0 m.

Bore 1 reached the target depth of 3.0 m, whereas, Bores 2 to 4 were terminated due to refusal on sandstone.

Groundwater was not encountered in the bores during drilling. It should be noted that groundwater levels are dependent on climatic conditions and soil permeability and therefore vary with time.

Other than the concrete, asphalt and plastic encountered in fill and the concrete fragments found on the site's surface during the walkover (Section 6), no other anthropogenic materials were found at the site.

No other obvious indications of gross contamination (e.g. staining or odours) were observed in the bores.

All PID results were less than 1 ppm, indicating no gross contamination from volatile contaminants in the soil.

11. Results

The results of the laboratory analysis are presented in Tables D1 and D2, Appendix D. The NATA laboratory reports together with the chain-of-custody and sample receipt information are presented in Appendix D.

12. Discussion of Results

The laboratory results (Tables D1 and D2) indicate that all contaminant concentrations in the soil samples analysed were within the adopted SAC.

Asbestos was not detected in any of the soil samples tested.

13. Conclusions and Recommendations

Based on the findings of this PSI, it is considered that the site is generally compatible with the proposed Childhood Early Learning Centre, with the exception of the area of the previous UST.

Historical information suggests the UST may have been removed some time after September 1987 given that a reapplication for the tank was approved in 1987 and a targeted assessment undertaken by another consultant recommended that the site can be made suitable for the then proposed child care centre subject to the management of soil impacted in the area of the previous UST and that a Remediation Action Plan (RAP) should be prepared for the site. Council records suggest that a RAP was prepared, however, Council did not have a record of a Validation Report following the proposed remediation, and thus it is unclear whether the proposed remediation was completed.

Though not known at the time of setting out our test locations, DP's Bore 4 was positioned in the vicinity of the previous UST. The results for the samples analysed from Bore 4 did not indicate any contamination likely sourced from a previous UST, although slightly higher lead was recorded in Sample 4 / 0.1 m at a concentration of 52 mg/kg, which was less than the SAC.

Given the above, it is recommended that a targeted investigation be completed in the area of the previous UST. The targeted investigation could include a ground penetrating radar scan to identify the previous tank pit followed by the drilling / excavation of several bores / pits to a depth of 4 m below current ground levels followed by analysis for potential contaminants associated with fuel storage. The need for further remediation and validation of the former UST area would depend on the results of the targeted investigation.

Overall, based on the above, it is considered that the site is generally compatible with the proposed Childhood Early Learning Centre, provided the area of the previous UST is managed / remediated / Validated and an unexpected finds protocol (UFP) is prepared as part of the Construction Management Plan for the proposed development. The UFP provides methods and strategies to manage unexpected finds of potential contamination during construction works.

Groundwater testing was not completed by DP, however, given that no significant groundwater contamination was found in JBS&G (2016) and no soil impacts (other than the UST area) were identified, groundwater is unlikely to be contaminated as a result of the known status of site soils. If extraction of groundwater is planned, then, further investigation will be necessary to determine its suitability for use.

Any soil which is to be removed from the site should be assessed for waste classification for off-site disposal to a licensed facility.

14. Limitations

Douglas Partners (DP) has prepared this report for this project at 2 High Valley Close, Wamberal in accordance with DP's proposal CCT190345 dated 20 September 2019 and acceptance received from Andrew Brand of Mistlake Investments Pty Ltd dated 26 September 2019. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Mistlake Investments Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of 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.

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.

Asbestos has not been detected by observation or by laboratory analysis, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, such as concrete and plastic were, however, located in the fill and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints or to parts of the site being inaccessible and not available for inspection / sampling, or to vegetation preventing visual inspection and reasonable access. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This

design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

Drawing 1

Proposed Development Plans

Site Photographs

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Aerial Image Plan

Drawing adapted from Nearmap Image, dated 20 October 2019

30 0 30 60 90 120 m

Locality Plan

Proposed Development Plan

Drawing adapted from Thrum Architects dwg, ref. 19008, dwg. SK-001, rev. B, dated 5 November 2019

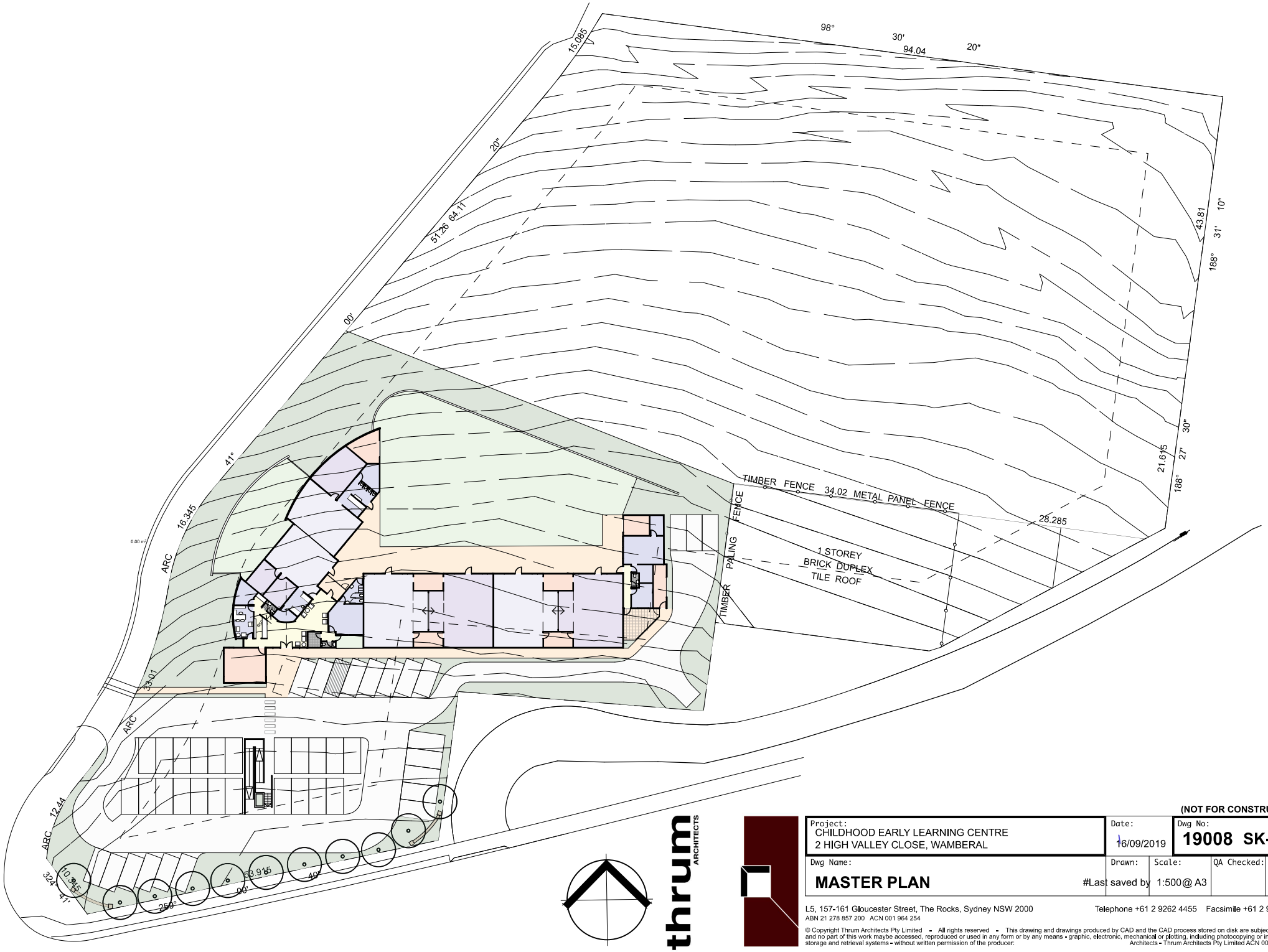
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Mistlake Investments Pty Ltd		
OFFICE:	Central Coast	DRAWN BY:	JBR
SCALE:	1:1,000 @ A3	DATE:	14.11.2019

TITLE: **Test Location Plan**
Proposed Childhood Early Learning Centre
2 High Valley Close, Wamberal

N

PROJECT No:	83717.00
DRAWING No:	1
REVISION:	0



(NOT FOR CONSTRUCTION)

Project:	Date:	Dwg No:
CHILDHOOD EARLY LEARNING CENTRE 2 HIGH VALLEY CLOSE, WAMBERAL	16/09/2019	19008 SK-001

Dwg Name:	Drawn:	Scale:	QA Checked:	Rev:
MASTER PLAN	#Last saved by	1:500@ A3		A

thrum ARCHITECTS

L5, 157-161 Gloucester Street, The Rocks, Sydney NSW 2000 Telephone +61 2 9262 4455 Facsimile +61 2 9299 1524
ABN 21 278 857 200 ACN 001 964 254

Photo 1 - South-western corner of the site, looking toward the north-west, 15 October 2019.

Photo 2 - Middle of the site, looking toward the north-west, 15 October 2019.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 1 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19

Photo 3 - Neighbouring Duplex, looking toward the east, 15 October 2019.

Photo 4 - Typical of the concrete fragments noted at the surface, 15 October 2019.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 2 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19

Appendix B

Site History Information

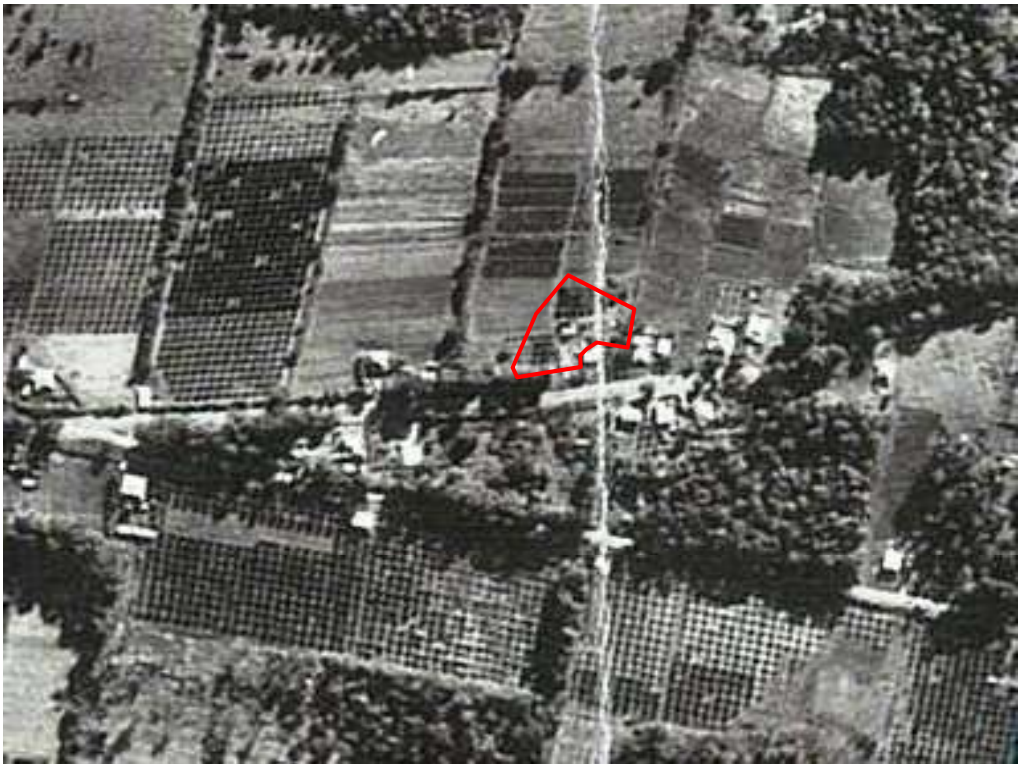


Photo 1 - 1954

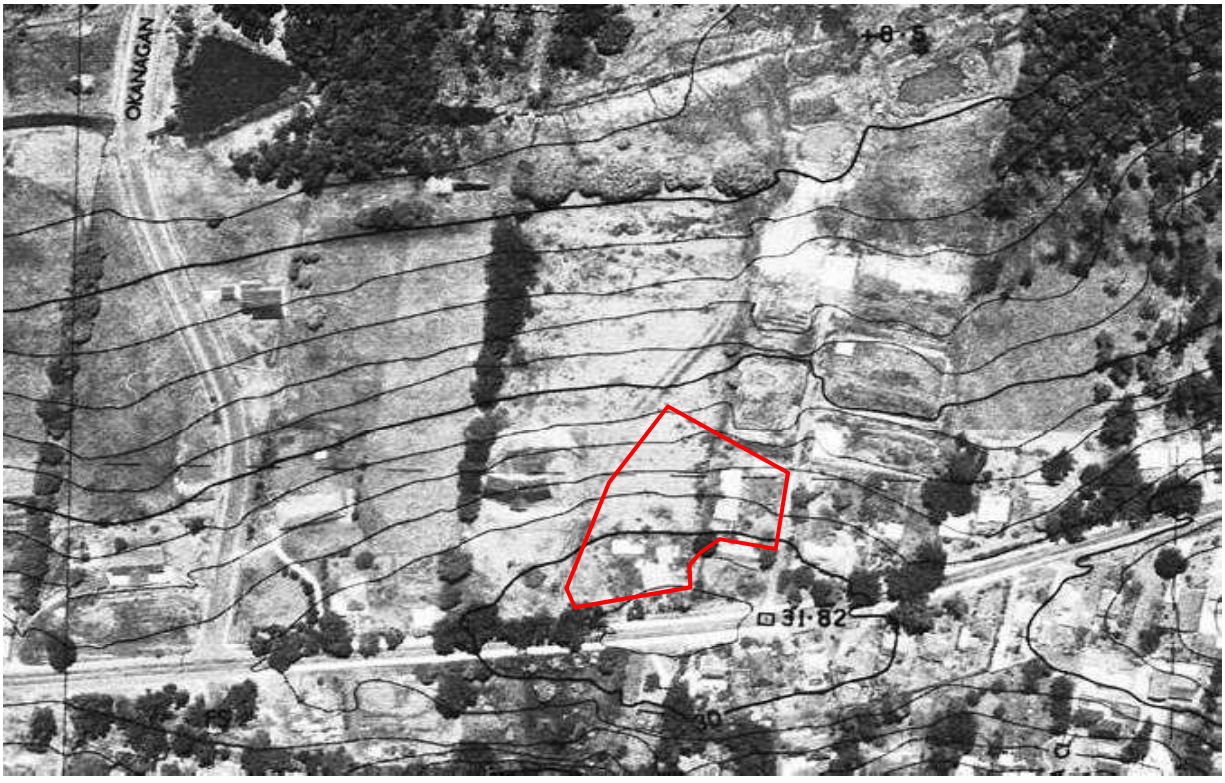


Photo 2 - 1975

Douglas Partners Geotechnics / Environment / Groundwater	**Aerial Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 1 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19

Photo 3 - 1991

Photo 4 - 2010, November

Douglas Partners Geotechnics / Environment / Groundwater	**Aerial Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 2 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19

Photo 5 - 2010, May

Photo 6 - 2011, Jan

Douglas Partners Geotechnics / Environment / Groundwater	**Aerial Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 3 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19

Photo 7 - 2011, June

Photo 8 - 2012, June

Douglas Partners Geotechnics / Environment / Groundwater	**Aerial Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 4 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19

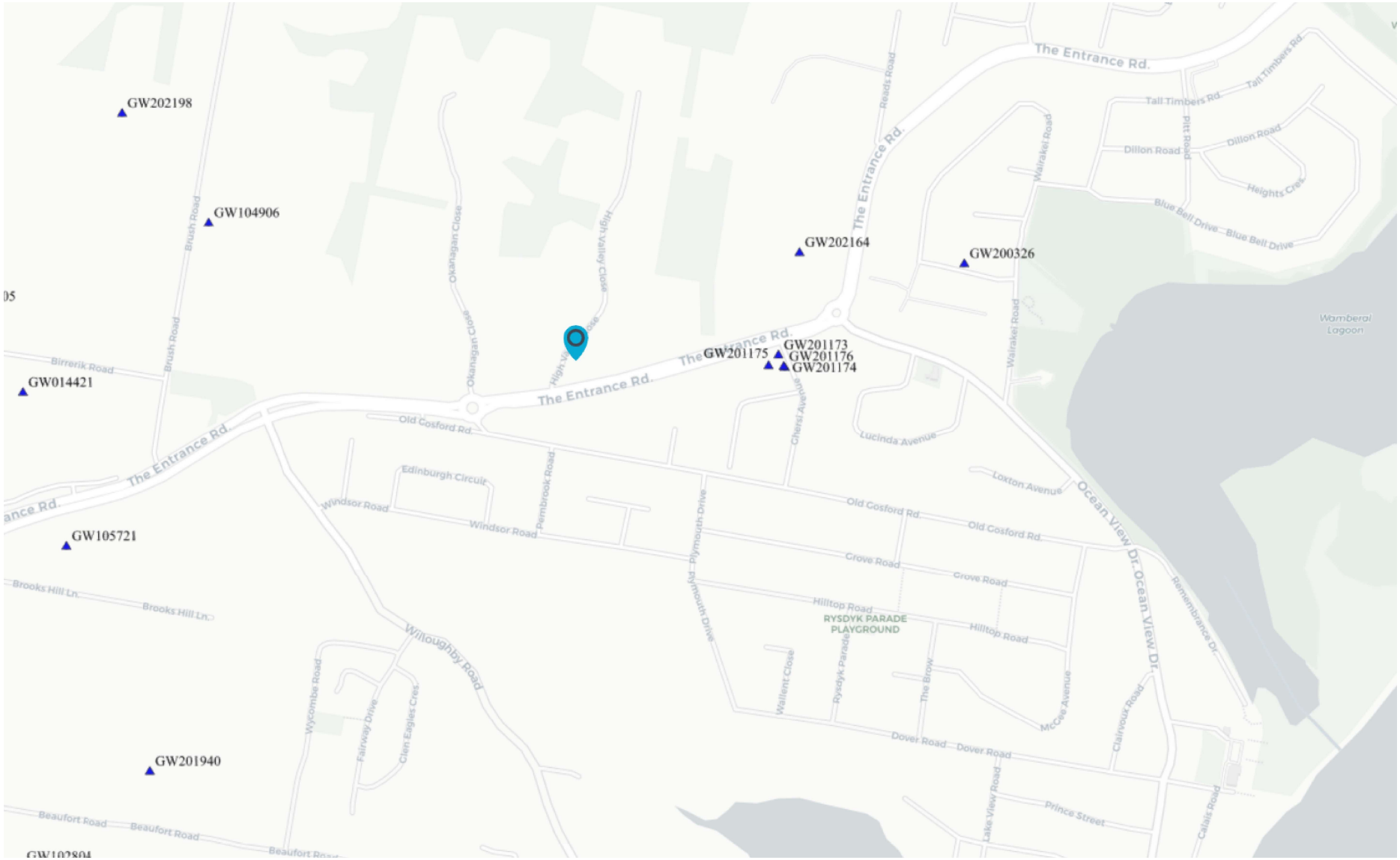
Photo 9 - 2013, April

Photo 10 - 2013, December

Douglas Partners Geotechnics / Environment / Groundwater	**Aerial Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 5 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19

Photo 11 - 2019, July

Douglas Partners Geotechnics / Environment / Groundwater	**Aerial Photographs** **2 High Valley Close** **Wamberal, NSW**	PROJECT: 83717.00 PLATE No: 6 REV: 0
	CLIENT: Mistlake Investments Pty Ltd	DATE: 18-Oct-19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Old Cosford Rd.
Windsor Road
Grove Road
Hilltop Road
Dover Road
Ocean View Dr.
Willoughby Road
Brush Road
Okanagan Close
High Valley Close
Reads Road
Wairakei Road
Tall Timbers Rd.
Dillon Road
Blue Bell Drive
Heights Crest
Wamberal Lagoon
Birrerik Road
Edinburgh Circuit
Pembrook Road
Plymouth Drive
Cherisi Avenue
Lucinda Avenue
Loxton Avenue
Brooks Hill Ln.
RYSDYK PARADE PLAYGROUND
Rysdyk Parade
Wallent Close
The Brow
McCue Avenue
Clairvoux Road
Remembrance Dr.
Wycombe Road
Fairway Drive
Glen Eagles Cres.
Beaufort Road
Lake View Road
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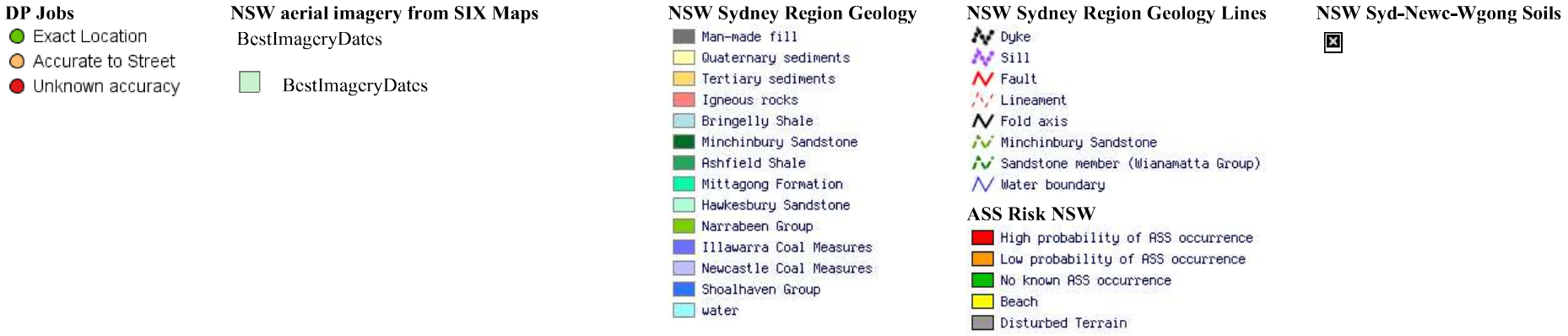
Calais Road

Legends



Open legend in a separate tab

Dataset Details

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Please contact the provider of this data for more information, including information about usage rights and constraints.

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Douglas Partners

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NSW aerial imagery from SIX Maps

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Copyright Text

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NSW Sydney Region Geology

Data Description

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NSW Sydney Region Geology Lines

Data Description

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Service Description

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Layer name: NSW_Sydney_Region_GeologyLines

NSW Syd-Newc-Wgong Soils

Data Description

Reference individual map sheets as follows: Hazelton, P.A., Bannerman, S.M. and Tille, P.J., 1989, Soil Landscapes Series - Penrith 1:100,000 Sheet, Soil Conservation Service of NSW. Chapman, G.A., Murphy, C.L., Tille, P.J., Atkinson, G. and Morse, R.J., 1989, Soil Landscapes Series - Sydney 1:100,000 Sheet, Soil Conservation Service of NSW. Hazelton, P.A. and Tille, P.J., 1990, Soil Landscapes Series - Wollongong-Port Hacking 1:100,000 Sheet, Soil Conservation Service of NSW. C.L. Murphy and P.J. Tille, 1993, Soil Landscape Series - Gosford - Lake Macquarie 1:100 000 Sheet, NSW Department of Land and Water Conservation (DLWC). L.E. Matthei, 1995, Soil Landscape Series - Newcastle 1:100 000 Sheet, NSW Department of Land and Water Conservation (DLWC). P.A. Hazelton, 1992, Soil Landscape Series - Kiama 1:100 000 Sheet, Soil Conservation Service of NSW.

Service Description

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Layer name: NSW_Syd-Newc-Wgong_Soils

ASS Risk NSW

Data Description

Data supplied by NSW Department of Environment and Climate Change based on published 1:25,000 Acid Sulfate Soil Risk Mapping, 1994-1998.

Service Description

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Layer name: ASS_Risk_NSW

NSW Groundwater Wells (March 2019)

Data Description

Construction details and driller logs for groundwater bores within NSW.

WaterNSW is making the information available on the understanding that it does not warrant that the information is suitable for any intended use. In using the information supplied, the user acknowledges that they are responsible for any deductions or conclusions arrived at from interpretation of the data.

GetCapabilities URL

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Service Contact

Douglas Partners

Web Map Service (WMS) URL

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Layer name: Douglas:NSW Groundwater wells

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NSW 2m Contours

Data Description

Data was purchased from the NSW Department of Lands in April 2009.

Service Description

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Web Map Service (WMS) URL

This is a WMS service, which generates map images on request. It can be used in GIS software with this URL:

```
http://dpsydgis01/cgi-bin/mapserv
```

Layer name: NSW_2m_Contours

NSW Hunter & Central Coast LiDAR

Data Description

Reference as: Smoothed Contours 0.5m Interval, NSW Department of Planning Central and Hunter Coasts LiDAR Project, 2007

Service Description

This WMS server was set up by Douglas Partners for internal use

GetCapabilities URL

http://dpsydgis01/cgi-bin/mapserv?MAP=/var/www/html/mapserver/dp_mapfiles/DouglasMap.map&service=WMS&version=1.1.0&REQUEST=GetCapabilities

Web Map Service (WMS) URL

This is a WMS service, which generates map images on request. It can be used in GIS software with this URL:

`http://dpsydgis01/cgi-bin/mapserv`

Layer name: NSW_Hunter_Central_Coasts_LiDAR_Contours

NSW Cadastral Lots

Service Description

Dynamic Map Service of Plan, Section and Lot extents designed primarily for display over raster data. Control of the display of symbology, labelling or both is available.

Copyright Text

Data Custodian

DFSI Spatial Services NSW

Esri ArcGIS MapServer URL

`https://maps.six.nsw.gov.au/arcgis/rest/services/public/NSW_Cadastre/MapServer`

Layer name: Lot

Metadata URL

https://maps.six.nsw.gov.au/arcgis/rest/services/public/NSW_Cadastre/MapServer

NSW Cadastral Labels

Please contact the provider of this data for more information, including information about usage rights and constraints.

Esri ArcGIS MapServer URL

`https://maps.six.nsw.gov.au/arcgis/rest/services/public/NSW_Cadastre/MapServer`

Layer name: Lot Labels

Metadata URL

https://maps.six.nsw.gov.au/arcgis/rest/services/public/NSW_Cadastre/MapServer

Map Credits

- Disclaimer: This map must not be used for navigation or precise spatial analysis
- Data61
- CESIUM
- © OpenStreetMap contributors ODbL, © CartoDB CC-BY 3.0
- © Department of Finance, Services & Innovation 2018

WaterNSW
Work Summary

GW202198

Licence: 20BL169386
Licence Status: ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s): TEST BORE, STOCK, DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Down Hole Hamm
Owner Type: Private

Commenced Date:
Completion Date: 25/10/2004
Final Depth: 90.00 m
Drilled Depth: 66.00 m

Contractor Name: Slade Drilling
Driller: Paul Edwin Slade
Assistant Driller: T carter

Property: N/A Lot 15 61 Brush Rd WAMBERAL 2260 NSW
GWMA: -
GW Zone: -
Standing Water Level (m): 34.000
Salinity Description:
Yield (L/s): 1.000

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTHUMBERLAND	KINCU	15/A/5728
Licensed:	NORTHUMBERLAND	KINCUMBER	Whole Lot 15/A/5728

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6301130.000
Easting: 353520.000
Latitude: 33°25'09.1"S
Longitude: 151°25'28.4"E

GS Map: -
MGA Zone: 56
Coordinate Source: Unidentified

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	90.00	150			Down Hole Hammer
1		Annulus	Waterworn/Rounded	0.00	90.00	150	110		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 9	0.00	90.00	110	98		Seated on Bottom, Glued
1	1	Opening	Slots - Diagonal	50.00	72.00	110		0	Casing - Hand Sawn Slot, PVC Class 9, Glued, SL: 100.0mm, A: 2.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
50.00	54.00	4.00	Unknown	34.00		0.33			
54.00	60.00	6.00	Unknown			0.33			
60.00	66.00	6.00	Unknown			0.10			
68.00	72.00	4.00	Unknown			0.24			2870.00

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	2.00	2.00	Soil, & Clays	Soil	
2.00	8.00	6.00	Sandstone, orange	Sandstone	
8.00	21.00	13.00	Sandstone, grey	Sandstone	
21.00	66.00	45.00	Shale & Sandstone mix, grey	Shale	

Remarks

25/10/2004: Form A Remarks:
Nat Carling, 1-June-2012; No location was provided, based in the centre of the authorised land.

***** End of GW202198 *****

WaterNSW
Work Summary

GW201940

Licence: 20WA216681 **Licence Status:** CURRENT

Authorised Purpose (s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Rotary Mud
Owner Type: Private

Commenced Date:
Completion Date: 08/05/2007
Final Depth: 38.00 m
Drilled Depth: 38.00 m

Contractor Name: (None)
Driller: Lloyd Norman Whitsed
Assistant Driller:

Property: N/A 119 Beaufort Rd TERRIGAL 2260 NSW
GWMA: -
GW Zone: -
Standing Water Level (m): 2.200
Salinity Description: Good
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTHUMBERLAND	KINCU	222//786431
Licensed:	NORTHUMBERLAND	KINCUMBER	Whole Lot 222//786431

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6299910.000
Easting: 353590.000
Latitude: 33°25'48.7"S
Longitude: 151°25'30.4"E

GS Map: -
MGA Zone: 56
Coordinate Source: GIS - Geogra

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	38.00	175			Rotary Mud
1		Annulus	Waterworn/Rounded	0.00	1.50	175	125		Graded
1		Annulus	Waterworn/Rounded	1.50	38.00	175	125		Graded, Q:0.600m3
1	1	Casing	Pvc Class 9	0.00	38.00	125	102		Seated on Bottom, Glued
1	1	Opening	Slots - Vertical	12.00	18.00	125		0	Mechanically Slotted, PVC Class 9, Glued, SL: 150.0mm, A: 1.50mm
1	1	Opening	Slots - Vertical	32.00	38.00	125		0	

									Mechanically Slotted, PVC Class 9, Glued, SL: 150.0mm, A: 1.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
12.00	18.00	6.00	Unknown						
32.00	38.00	6.00	Unknown	2.20				03:00:00	

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	12.00	12.00	Clay, brown & red	Clay	
12.00	12.50	0.50	Clay & Gravel	Clay	
12.50	19.00	6.50	Clay, white bands	Clay	
19.00	27.00	8.00	Clay, & coarse grit	Clay	
27.00	34.00	7.00	Shale, grey with bands of soft Sandstone	Shale	
34.00	38.00	4.00	Shale, hard	Shale	

Remarks

08/05/2007: Form A Remarks:
Nat Carling, 15-May-2012; Coordinates based on location map provided with the Form-A. No Aquifer depths were provided, taken from screen details.

***** End of GW201940 *****

WaterNSW
Work Summary

GW201176

Licence:
Licence Status:
Authorised Purpose (s):
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 12/05/2010
Final Depth: 9.00 m
Drilled Depth: 9.00 m

Contractor Name: (None)
Driller: Unkown Unknown
Assistant Driller:

Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:			
Licensed:	NORTHUMBERLAND	KINCU	10//816325

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6300679.000
Easting: 354755.000
Latitude: 33°25'24.4"S
Longitude: 151°26'15.9"E

GS Map: -
MGA Zone: 56
Coordinate Source: GIS - Geogra

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	9.00	150			(Unknown)
1		Annulus	Bentonite/Grout	2.30	3.10	150	60		PL:Poured/Shovelled
1		Annulus	Waterworn/Rounded	3.10	8.00	150	60		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	8.00	60	53		Seated, Screwed
1	1	Opening	Slots - Horizontal	5.00	8.00	60		0	Mechanically Slotted, PVC Class 18, Screwed, SL: 39.0mm, A: 6.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
5.20	8.00	2.80	Unknown						

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.15	0.15	Fill, Concrete Paving	Fill	
0.15	0.60	0.45	Clay, soft	Clay	
0.60	1.30	0.70	Sandstone, red brown & grey	Sandstone	
1.30	9.00	7.70	Siltstone, grey	Siltstone	

Remarks

12/05/2010: Form A Remarks:
Nat Carling, 6-Feb-2012; No Page 2 was provided, holes were drilled by an unlicensed driller. Coordinates based on location map provided with the Form-A's.

***** End of GW201176 *****

WaterNSW
Work Summary

GW104906

Licence: 20WA215766 **Licence Status:** CURRENT

Authorised Purpose (s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 11/11/2002
Final Depth: 36.00 m
Drilled Depth: 36.00 m

Contractor Name: Slade Drilling
Driller: Paul Edwin Slade
Assistant Driller:

Property: N/A NSW
GWMA: -
GW Zone: -
Standing Water Level (m): 6.000
Salinity Description: Good
Yield (L/s): 4.000

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTHUMBERLAND	KINCU	LT321 DP773394
Licensed:	NORTHUMBERLAND	KINCUMBER	Whole Lot 321//773394

Region: 10 - Sydney South Coast
River Basin: 212 - HAWKESBURY RIVER
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6300929.000
Easting: 353684.000
Latitude: 33°25'15.7"S
Longitude: 151°25'34.6"E

GS Map: -
MGA Zone: 56
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	36.00	215			Down Hole Hammer
1		Annulus	Waterworn/Rounded	2.50	3.50				Graded, Q:540.000m3
1	1	Casing	Pvc Class 9	0.00	36.00	150			Seated on Bottom
1	1	Opening	Slots - Diagonal	24.00	30.00	150		0	PVC Class 9, SL: 100.0mm, A: 2.00mm

Water Bearing Zones

			WBZ Type						

From (m)	To (m)	Thickness (m)		S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
27.00	29.00	2.00	Unknown	6.00		4.00		02:00:00	

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.40	0.40	SOIL	Soil	
0.40	11.00	10.60	CLAYS	Invalid Code	
11.00	18.00	7.00	SILTSTONE	Siltstone	
18.00	36.00	18.00	SANDSTONE/CLAY	Sandstone	

***** End of GW104906 *****

WaterNSW
Work Summary

GW014421

Licence: 20WA214820 **Licence Status:** CURRENT

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): IRRIGATION

Work Type: Excavation
Work Status:
Construct.Method: > 100 sq.m.
Owner Type: Private

Commenced Date:
Completion Date: 01/03/1958
Final Depth: 2.10 m
Drilled Depth: 2.10 m

Contractor Name: (None)
Driller:
Assistant Driller:

Property: N A 593a The Netrance Rd WAMBERAL 2260 NSW
GWMA: 603 - SYDNEY BASIN
GW Zone: -
Standing Water Level (m):
Salinity Description: invalid code
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTHUMBERLAND	KINCU	175
Licensed:	NORTHUMBERLAND	KINCUMBER	Whole Lot 172//883908

Region: 10 - Sydney South Coast
River Basin: 212 - HAWKESBURY RIVER
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6300610.000
Easting: 353344.000
Latitude: 33°25'25.9"S
Longitude: 151°25'21.3"E

GS Map: -
MGA Zone: 56
Coordinate Source: GD.,PR. MAP

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
0.30	2.10	1.80	Unconsolidated	0.30		6.32			

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.76	0.76	Soil Black	Soil	
0.76	2.13	1.37	Clay Red Hard Water Supply	Clay	

*** End of GW014421 ***

WaterNSW
Work Summary

GW105721

Licence: 20WA215785 **Licence Status:** CURRENT

Authorised Purpose (s): DOMESTIC
Intended Purpose(s):

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 13/04/2005
Final Depth:
Drilled Depth:

Contractor Name: (None)
Driller:
Assistant Driller:

Property: BAILEY 556 The Entrance Rd ERINA HEIGHTS 2260 NSW
GWMA: -
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTHUMBERLAND	KINCU	2 708594
Licensed:	NORTHUMBERLAND	KINCUMBER	Whole Lot 2//708594

Region: 10 - Sydney South Coast
River Basin: 212 - HAWKESBURY RIVER
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6300326.000
Easting: 353429.000
Latitude: 33°25'35.2"S
Longitude: 151°25'24.4"E

GS Map: -
MGA Zone: 56
Coordinate Source: Unknown

*** End of GW105721 ***

WaterNSW
Work Summary

GW202164

Licence:
Licence Status:
Authorised Purpose (s):
Intended Purpose(s): IRRIGATION

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Rotary Air
Owner Type: Private

Commenced Date:
Completion Date: 04/12/2007
Final Depth: 84.00 m
Drilled Depth: 84.00 m

Contractor Name: Slade Drilling
Driller: Tony John Carter
Assistant Driller: Shane Hill

Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s): 1.000

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:			
Licensed:	NORTHUMBERLAND	KINCU	15//1097150

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6300891.000
Easting: 354781.000
Latitude: 33°25'17.5"S
Longitude: 151°26'17.0"E

GS Map: -
MGA Zone: 56
Coordinate Source: GIS - Geogra

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	12.00	200			Rotary Air
1		Hole	Hole	12.00	84.00	150			Rotary Air
1		Casing	Casing Protector	0.00	12.00	168	158		Glued

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

15.00	18.00	3.00	Unknown			0.10			2700.00
35.00	36.00	1.00	Unknown			0.10			3000.00
50.00	60.00	10.00	Unknown			0.80		01:00:00	3300.00

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	3.00	3.00	Clay, mixed	Clay	
3.00	9.00	6.00	Sandstone, grey	Sandstone	
9.00	16.00	7.00	Sandstone, orange/cream	Sandstone	
16.00	36.00	20.00	Sandstone, light grey	Sandstone	
36.00	45.00	9.00	Sandstone, white	Sandstone	
45.00	48.00	3.00	Sandstone, orange/cream	Sandstone	
48.00	72.00	24.00	Shale, light & dark grey	Shale	
72.00	74.00	2.00	Sandstone, orange cream	Sandstone	
74.00	78.00	4.00	Shale, dark grey	Shale	
78.00	84.00	6.00	Shale, light brown	Shale	

Remarks

04/12/2007: Form A Remarks:
Nat Carling, 23-May-2012; Coordinates based on location map provided with the Form-A.

***** End of GW202164 *****

WaterNSW
Work Summary

GW200326

Licence: 20WA216541 **Licence Status:** CURRENT

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status:
Construct.Method: Rotary - Percu
Owner Type:

Commenced Date:
Completion Date: 10/11/2006
Final Depth: 18.00 m
Drilled Depth: 18.00 m

Contractor Name: Slade Drilling
Driller: Tony John Carter
Assistant Driller:

Property: NSW
GWMA: -
GW Zone: -
Standing Water Level (m): 2.500
Salinity Description:
Yield (L/s): 0.200

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTHUMBERLAND	KINCU	34/240473
Licensed:	NORTHUMBERLAND	KINCUMBER	Whole Lot 34//240473

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6300875.000
Easting: 355087.000
Latitude: 33°25'18.1"S
Longitude: 151°26'28.9"E

GS Map: -
MGA Zone: 56
Coordinate Source: Map Interpre

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	18.00	150			Rotary - Percussion (Down Hole H
1		Annulus	(Unknown)	0.00	18.00				Graded, Q:200.000m3
1	1	Casing	P.V.C.	0.00	12.00	40	30		
1	1	Opening	Screen - Gauze/Mesh	11.00	12.00	40		0	PVC

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
15.00	16.00	1.00	Unknown	2.50		0.20		01:00:00	2700.00

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	topsoil (sandy)	Topsoil	
1.00	12.00	11.00	clay (mixed)	Clay	
12.00	18.00	6.00	sandstone (weathered)	Sandstone	

Remarks

04/11/2009: Updated coordinates as per existing Eastings and Northings.

***** End of GW200326 *****

WaterNSW
Work Summary

GW201173

Licence:
Licence Status:
Authorised Purpose (s):
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 12/05/2010
Final Depth: 5.50 m
Drilled Depth: 5.50 m

Contractor Name: (None)
Driller: Unkown Unknown
Assistant Driller:

Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:			
Licensed:	NORTHUMBERLAND	KINCU	10//816325

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6300700.000
Easting: 354745.000
Latitude: 33°25'23.7"S
Longitude: 151°26'15.5"E

GS Map: -
MGA Zone: 56
Coordinate Source: GIS - Geogra

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.50	150			(Unknown)
1		Annulus	Bentonite/Grout	0.00	1.00	150	60		
1		Annulus	Waterworn/Rounded	1.00	4.00	150	60		Graded
1	1	Casing	Pvc Class 18	0.00	4.00	60	53		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	1.00	4.00	60		0	Mechanically Slotted, PVC Class 18, Screwed, SL: 39.0mm, A: 6.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
1.22	5.50	4.28	Unknown						

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Soil, brown, mediumg rained	Soil	
0.30	2.40	2.10	Fill, Sandy Gravel, yellow-brown, medium grained	Fill	
2.40	2.80	0.40	Clay, light grey, soft	Clay	
2.80	5.50	2.70	Shale/Siltstone, grey	Shale	

Remarks

12/05/2010: Form A Remarks:
Nat Carling, 6-Feb-2012; No Page 2 was provided, holes were drilled by an unlicensed driller. Coordinates based on location map provided with the Form-A's.

***** End of GW201173 *****

WaterNSW
Work Summary

GW201174

Licence:
Licence Status:
Authorised Purpose (s):
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 12/05/2010
Final Depth: 7.20 m
Drilled Depth: 7.20 m

Contractor Name: (None)
Driller: Unkown Unknown
Assistant Driller:

Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTHUMBERLAND	KINCU	10//816325
Licensed:			

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6300677.000
Easting: 354757.000
Latitude: 33°25'24.4"S
Longitude: 151°26'16.0"E

GS Map: -
MGA Zone: 56
Coordinate Source: GIS - Geogra

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	7.20	150			(Unknown)
1		Annulus	Bentonite/Grout	0.60	2.10	150	60		PL:Poured/Shovelled
1		Annulus	Waterworn/Rounded	2.10	6.50	150	60		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	6.50	60	53		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	3.50	6.50	60		0	Mechanically Slotted, PVC Class 18, Screwed, SL: 39.0mm, A: 6.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
4.56	6.50	1.94	Unknown						

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.15	0.15	Concrete Pavement	Fill	
0.15	0.60	0.45	Sandy Clay, grey & red brown, soft	Sandy Clay	
0.60	1.80	1.20	Sandstone, grey & red brown	Sandstone	
1.80	7.20	5.40	Siltstone	Siltstone	

Remarks

12/05/2010: Form A Remarks:
Nat Carling, 6-Feb-2012; No Page 2 was provided, holes were drilled by an unlicensed driller. Coordinates based on location map provided with the Form-A's.

***** End of GW201174 *****

WaterNSW
Work Summary

GW201175

Licence:
Licence Status:
Authorised Purpose (s):
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 12/05/2010
Final Depth: 9.10 m
Drilled Depth: 10.00 m

Contractor Name: (None)
Driller: Unkown Unknown
Assistant Driller:

Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:			
Licensed:	NORTHUMBERLAND	KINCU	10//816325

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9131-2S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6300680.000
Easting: 354727.000
Latitude: 33°25'24.3"S
Longitude: 151°26'14.8"E

GS Map: -
MGA Zone: 56
Coordinate Source: GIS - Geogra

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	9.10	150			(Unknown)
1		Annulus	Bentonite/Grout	2.70	3.50	150	60		PL:Poured/Shovelled
1		Annulus	Waterworn/Rounded	3.50	9.10	150	60		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	9.10	60	53		Seated, Screwed
1	1	Opening	Slots - Horizontal	6.10	9.10	60		0	Mechanically Slotted, PVC Class 18, Screwed, SL: 39.0mm, A: 6.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
6.60	9.10	2.50	Unknown						

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.15	0.15	Fill, Concrete Paving	Fill	
0.15	0.70	0.55	Fill, sandy Gravel, grey/green, medium-coarse grained	Fill	
0.70	2.50	1.80	Sandy Clay, light brown, soft	Sandy Clay	
2.50	10.00	7.50	Siltstone, grey & red-brown	Siltstone	

Remarks

12/05/2010: Form A Remarks:
Nat Carling, 6-Feb-2012; No Page 2 was provided, holes were drilled by an unlicensed driller. Coordinates based on location map provided with the Form-A's.

***** End of GW201175 *****

Property Report

2 HIGH VALLEY CLOSE WAMBERAL 2260

Property Details

Address:	2 HIGH VALLEY CLOSE WAMBERAL 2260
Lot/Section /Plan No:	70/-/DP1215036
Council:	CENTRAL COAST COUNCIL

Summary of planning controls

Planning controls held within the Planning Database are summarised below. The property may be affected by additional planning controls not outlined in this report. Please contact your council for more information.

Land Zoning	DM - Deferred Matter: (pub. 29-6-2018)
Height Of Building	NA
Floor Space Ratio	NA
Minimum Lot Size	NA
Heritage	NA
Land Reservation Acquisition	NA
Foreshore Building Line	NA

Detailed planning information

State Environmental Planning Policies which apply to this property

State Environmental Planning Policies can specify planning controls for certain areas and/or types of development. They can also identify the development assessment system that applies and the type of environmental assessment that is required.

- State Environmental Planning Policy (Affordable Rental Housing) 2009: Land Application (pub. 31-7-2009)
- State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004: Land Application (pub. 25-6-2004)
- State Environmental Planning Policy (Coastal Management) 2018: Land Application (pub. 17-12-2018)
- State Environmental Planning Policy (Coastal Management) 2018: Subject Land (pub. 23-3-2018)

- State Environmental Planning Policy (Concurrences) 2018: Land Application (pub. 21-12-2018)
- State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017: Land Application (pub. 1-9-2017)
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008: Land Application (pub. 12-12-2008)
- State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004: Land Application (pub. 31-3-2004)
- State Environmental Planning Policy (Infrastructure) 2007: Land Application (pub. 21-12-2007)
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007: Land Application (pub. 16-2-2007)
- State Environmental Planning Policy (Miscellaneous Consent Provisions) 2007: Land Application (pub. 28-9-2007)
- State Environmental Planning Policy (Primary Production and Rural Development) 2019: Land Application (pub. 28-2-2019)
- State Environmental Planning Policy No 19—Bushland in Urban Areas: Land Application (pub. 24-10-1986)
- State Environmental Planning Policy No 1—Development Standards: Land Application (pub. 17-10-1980)
- State Environmental Planning Policy No 21—Caravan Parks: Land Application (pub. 24-4-1992)
- State Environmental Planning Policy No 33—Hazardous and Offensive Development: Land Application (pub. 13-3-1992)
- State Environmental Planning Policy No 36—Manufactured Home Estates: Land Application (pub. 16-7-1993)
- State Environmental Planning Policy No 44—Koala Habitat Protection: Land Application (pub. 6-1-1995)
- State Environmental Planning Policy No 50—Canal Estate Development: Land Application (pub. 10-11-1997)
- State Environmental Planning Policy No 55—Remediation of Land: Land Application (pub. 28-8-1998)
- State Environmental Planning Policy No 64—Advertising and Signage: Land Application (pub. 16-3-2001)
- State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development: Land Application (pub. 26-7-2002)
- State Environmental Planning Policy No 70—Affordable Housing (Revised Schemes): Land Application (pub. 1-5-2002)

Other matters affecting the property

Information held in the Planning Database about other matters affecting the property appears below. The property may also be affected by additional planning controls not outlined in this report. Please speak to your council for more information

1.5 m Buffer around Classified Roads	Classified Road Adjacent
Local Aboriginal Land Council	DARKINJUNG

Appendix C

Descriptive Notes

Logs

Sampling Methods

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Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Description and Classification Methods

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

Soil Types

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

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

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

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

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

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

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

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

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

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

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

Soil Descriptions

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Origin

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

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

Moisture Condition – Coarse Grained Soils

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

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

Moisture Condition – Fine Grained Soils

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

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

Symbols & Abbreviations

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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

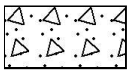
Symbols & Abbreviations

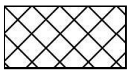
Graphic Symbols for Soil and Rock

General

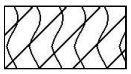

Asphalt

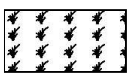

Road base

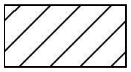

Concrete

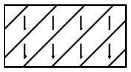

Filling

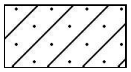
Soils


Topsoil

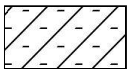

Peat

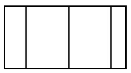

Clay

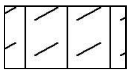

Silty clay

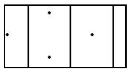

Sandy clay

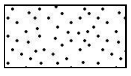

Gravelly clay

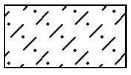

Shaly clay

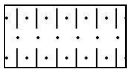

Silt


Clayey silt


Sandy silt

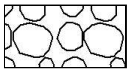

Sand

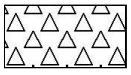

Clayey sand


Silty sand

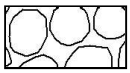

Gravel


Sandy gravel


Cobbles, boulders

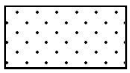

Talus

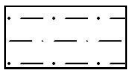
Sedimentary Rocks

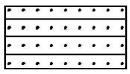

Boulder conglomerate

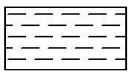

Conglomerate


Conglomeratic sandstone

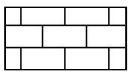

Sandstone


Siltstone

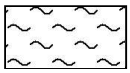

Laminite

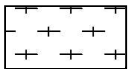

Mudstone, claystone, shale

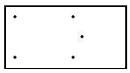

Coal


Limestone

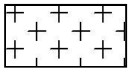
Metamorphic Rocks

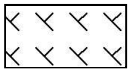

Slate, phyllite, schist

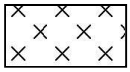

Gneiss

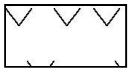

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Mistlake Investments Pty Ltd
PROJECT: Proposed Childhood Early Learning Cnt
LOCATION: 2 High Valley Close, Wamberal

SURFACE LEVEL: 31.7 AHD
EASTING: 354340.6
NORTHING: 6300642.1
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 83717.00
DATE: 15/10/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
31	0.1	FILL/Silty SAND SM: medium grained, brown; trace organics; moist; fill		E	0.05		PID<1 ppm		
		FILL/CLAY CL: low plasticity, orange-brown and red-brown; with sandstone, fragments; trace concrete; w<PL; fill			0.2				
				D/E B	0.3		pp = 340 PID<1 ppm PID<1 ppm		
	0.55				0.5				
		Silty CLAY CL: low plasticity, grey-brown; with ironstone, fragments; w<PL; stiff; residual		D/E	0.7		PID<1 ppm		
	0.95								
30	1	CLAY CL: low plasticity, brown and slightly yellow-brown; with organics; w<PL; stiff; residual			1.0				1
				U_{50}			PID<1 ppm		
					1.2				
				D	1.3		pp = 230 PID<1 ppm		
		- From 1.7m: very stiff		D	1.8		pp >400 PID<1 ppm		
29	2								2
				D	2.2		pp = 370-400 PID<1 ppm		
	2.7			D	2.7		pp = 250 PID<1 ppm		
		Sandy CLAY ??: low plasticity, yellow-brown and grey; trace organics; trace sandstone gravels; w<PL; very stiff; residual - From 2.8m: weathered sandstone like properties, with sandstone fragments							
28	3								3
	3.0	Bore discontinued at 3.0m- limit of investigation		D	3.0		PID<1 ppm		

RIG: TOYOTA 4WD **DRILLER:** MJH **LOGGED:** MJH **CASING:**

TYPE OF BORING: 60mm Ø Dynamic Continous Push Tube Sampling

WATER OBSERVATIONS: No free groundwater obseved

REMARKS: Location coordinates are in MGA94 Zone 56 H.

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Mistlake Investments Pty Ltd
PROJECT: Proposed Childhood Early Learning Cnt
LOCATION: 2 High Valley Close, Wamberal

SURFACE LEVEL: 30.9 AHD
EASTING: 354357.3
NORTHING: 6300660.7
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 83717.00
DATE: 15/10/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.0	FILL/CLAY CL: low plasticity, brown; trace gravels, subrounded, igneous; trace organics; w<PL; fill		D/E	0.1		PID<1 ppm		
	0.2	FILL/Sandy GRAVEL GP: poorly graded, grey-brown; with concrete, asphalt and decomposed/burnt organics; dry; fill		D/E	0.5		PID<1 ppm		
	0.7	CLAY CL: low plasticity, brown and slighty yellow-brown; with organics; w<PL; stiff; residual			0.9				
	1			U_{50} D/E	1.0 1.1		PID<1 ppm pp = 150 PID<1 ppm		1
		- From 1.3m: very stiff		D	1.5		PID<1 ppm		
29	2			D	1.8		pp = 280-340 PID<1 ppm		2
	2.15	Sandy CLAY ??: low plasticity, yellow-brown and grey; trace organics; trace sandstone gravels; w<PL; very stiff; residual		D	2.1		pp = 280-400 PID<1 ppm		
	2.4	- From 2.3m: weathered sandstone properties		D	2.4				
28	3	Bore discontinued at 2.4m- refusal on sandstone							3
27									

RIG: TOYOTA 4WD **DRILLER:** MJH **LOGGED:** MJH **CASING:**

TYPE OF BORING: 60mm Ø Dynamic Continous Push Tube Sampling

WATER OBSERVATIONS: No free groundwater obseved

REMARKS: Location coordinates are in MGA94 Zone 56 H.

☐ 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: Mistlake Investments Pty Ltd
PROJECT: Proposed Childhood Early Learning Cnt
LOCATION: 2 High Valley Close, Wamberal

SURFACE LEVEL: 27.3 AHD
EASTING: 354372.8
NORTHING: 6300688.4
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 83717.00
DATE: 15/10/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
27	0.15	FILL/Silty SAND SM: medium grained, brown; trace organics; moist; fill		D/E	0.1		PID<1 ppm		
	0.3	FILL/Sandy GRAVEL ??: poorly graded, grey and brown; roadbase gravels, subangular, igneous, with sand; dry; fill		D/E	0.2		PID<1 ppm		
	0.9	FILL/CLAY ??: low plasticity, orange-brown and red-brown; with sandstone; plastic and concrete; trace organics; w<PL; fill		D/E	0.5		pp >400 PID<1 ppm		
				U_{50}	0.7 0.85		PID<1 ppm		
	1	Silty CLAY CL: low plasticity, grey-brown; with ironstone, fragments; w<PL; stiff; residual		D/E	1.0		pp = 280 PID<1 ppm		1
26	1.2	CLAY CL: low plasticity, brown and slightly yellow-brown; with organics; w<PL; very stiff; residual		U_{50}	1.2 1.35		PID<1 ppm		
				D	1.5		pp = 380 PID<1 ppm		
				D	1.8		pp = 380-400 PID<1 ppm		
	1.9	Sandy CLAY ??: low plasticity, yellow-brown and grey; trace organics; trace sandstone gravels; w<PL; hard; residual							
	2								2
	2.25	- From 2.2m: sandstone fragments		D	2.2		pp >400		
25		Bore discontinued at 2.25m- refusal on sandstone							
	3								3
24									

RIG: TOYOTA 4WD **DRILLER:** MJH **LOGGED:** MJH **CASING:**

TYPE OF BORING: 60mm Ø Dynamic Continous Push Tube Sampling

WATER OBSERVATIONS: No free groundwater obseved

REMARKS: Location coordinates are in MGA94 Zone 56 H.

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

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Mistlake Investments Pty Ltd
PROJECT: Proposed Childhood Early Learning Cnt
LOCATION: 2 High Valley Close, Wamberal

SURFACE LEVEL: 27.0 AHD
EASTING: 354419.3
NORTHING: 6300686.3
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 83717.00
DATE: 15/10/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
27	0.12	FILL/Silty SAND SM: coarse grained, brown; with organics; trace gravels, subrounded, roadbase, <10mm; moist; fill		D/E	0.1		PID<1 ppm		
		FILL/CLAY CL: ??? plasticity, red-brown and brown; with organics and basalt/sandstone gravels; trace cobbles; w<PL; fill		D/E	0.2		PID<1 ppm		
	0.55			D/E	0.5		PID<1 ppm		
		Silty CLAY CL: low plasticity, grey-brown; with ironstone, frgaments; w<PL; stiff; residual							
	0.7	CLAY CL: low plasticity, brown and slightly yellow-brown; with organics; w<PL; very stiff; residual							
26	1			D/E	1.0		pp = 320-390 PID<1 ppm		1
	1.4	Sandy CLAY ??: low plasticity, yellow-brown and grey; trace organics; trace sandstone gravels; w<PL; very stiff; residual			1.5		pp <400 PID<1 ppm		
				D	1.7		PID<1 ppm		
		- From 1.8m: very difficult to drill							
	1.9	- From 1.85m: sandstone fragments		D	1.9		PID<1 ppm		
25	2	Bore discontinued at 1.9m- refusal on sandstone							2
24	3								3

RIG: TOYOTA 4WD **DRILLER:** MJH **LOGGED:** MJH **CASING:**

TYPE OF BORING: 60mm Ø Dynamic Continous Push Tube Sampling

WATER OBSERVATIONS: No free groundwater obseved

REMARKS: Location coordinates are in MGA94 Zone 56 H.

☐ 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,	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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Appendix D

Tables D1 & D2

Laboratory Test Report, Sample Receipt and Chain of Custody

Table QA1

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Table D1: Summary of Laboratory Results – Metals, TRH, BTEX, PAH

			Metals								TRH						BTEX				PAH			
			Arsenic	Cadmium	Chromium (VI)	Copper	Lead	Mercury (inorganic)	Nickel	Zinc	TRH C6 - C10	TRH >C10-C16	F1 ((C6-C10)-BTEX)	F2 (>C10-C16 less Naphthalene)	F3 (>C16-C34)	F4 (>C34-C40)	Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	Benzo(a)pyrene (BaP)	Benzo(a)pyrene TEQ	Total PAHs
		PQL	4.0	0.4	1.0	1.0	1.0	0.1	1.0	1.0	25.0	50.0	25.0	50.0	100.0	100.0	0.2	0.5	1.0	1.0	1.0	0.05	0.5	0.05
Sample ID	Depth	Sampled Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	0.3m	15/10/2019	**6** 100 100	<0.4 20 NC	**24** 100 410	**9** 6000 55	**13** 300 1100	<0.1 40 NC	**3** 400 35	**14** 7400 150	<25 NC NC	<50 NC NC	<25 45 180	<50 110 120	<100 NC 300	<100 NC 2800	<0.2 0.5 50	<0.5 160 85	<1 55 70	<1 40 105	<1 3 NC	<0.05 NC 0.7	<0.5 3 NC	<0.05 300 NC
2	0.5m	15/10/2019	**5** 100 100	<0.4 20 NC	**21** 100 410	**22** 6000 55	**19** 300 1100	<0.1 40 NC	**26** 400 35	**49** 7400 150	<25 NC NC	<50 NC NC	<25 45 180	<50 110 120	**110** NC 300	**110** NC 2800	<0.2 0.5 50	<0.5 160 85	<1 55 70	<1 40 105	<1 3 NC	**0.09** NC 0.7	<0.5 3 NC	**0.77** 300 NC
2	1m	15/10/2019	**4** 100 100	<0.4 20 NC	**16** 100 410	**6** 6000 55	**9** 300 1100	<0.1 40 NC	**2** 400 35	**7** 7400 150	NT NC NC	NT NC NC	NT 45 180	NT 110 120	NT NC 300	NT NC 2800	NT 0.5 50	NT 160 85	NT 55 70	NT 40 105	NT 3 NC	NT NC 0.7	NT 3 NC	NT 300 NC
3	0.1m	15/10/2019	<4 100 100	<0.4 20 NC	**10** 100 410	**11** 6000 55	**20** 300 1100	<0.1 40 NC	**7** 400 35	**40** 7400 150	<25 NC NC	<50 NC NC	<25 45 180	<50 110 120	**250** NC 300	**140** NC 2800	<0.2 0.5 50	<0.5 160 85	<1 55 70	<1 40 105	<1 3 NC	**0.06** NC 0.7	<0.5 3 NC	**0.5** 300 NC
3	1m	15/10/2019	**5** 100 100	<0.4 20 NC	**16** 100 410	**2** 6000 55	**17** 300 1100	<0.1 40 NC	**6** 400 35	**35** 7400 150	NT NC NC	NT NC NC	NT 45 180	NT 110 120	NT NC 300	NT NC 2800	NT 0.5 50	NT 160 85	NT 55 70	NT 40 105	NT 3 NC	NT NC 0.7	NT 3 NC	NT 300 NC
4	0.1m	15/10/2019	**6** 100 100	<0.4 20 NC	**16** 100 410	**19** 6000 55	**52** 300 1100	<0.1 40 NC	**8** 400 35	**88** 7400 150	NT NC NC	NT NC NC	NT 45 180	NT 110 120	NT NC 300	NT NC 2800	NT 0.5 50	NT 160 85	NT 55 70	NT 40 105	NT 3 NC	NT NC 0.7	NT 3 NC	NT 300 NC
4	1m	15/10/2019	**11** 100 100	<0.4 20 NC	**13** 100 410	**2** 6000 55	**9** 300 1100	<0.1 40 NC	**1** 400 35	**12** 7400 150	NT NC NC	NT NC NC	NT 45 180	NT 110 120	NT NC 300	NT NC 2800	NT 0.5 50	NT 160 85	NT 55 70	NT 40 105	NT 3 NC	NT NC 0.7	NT 3 NC	NT 300 NC
BD1/1510	Duplicate of 1/0.3m	15/10/2019	**6** 100 100	<0.4 20 NC	**22** 100 410	**9** 6000 55	**11** 300 1100	<0.1 40 NC	**2** 400 35	**13** 7400 150	<25 NC NC	<50 NC NC	<25 45 180	<50 110 120	<100 NC 300	<100 NC 2800	NT 0.5 50	NT 160 85	NT 55 70	NT 40 105	NT 3 NC	NT NC 0.7	NT 3 NC	NT 300 NC

HIL / HSL exceedance | EIL / ESL exceedance | ML exceedance | HIL/HSL and EIL/ESL exceedance | **Bold** = Lab detections | Key: Lab result (HIL/HSL value | EIL/ESL value)

ML and HIL/HSL/EIL/ESL exceedance | **red** = DC exceedance | NT = Not tested | NL = Non limiting | NC = No criteria | NAD = No asbestos detected

Indicates that asbestos has been detected by the lab below the PQL, refer to the lab report

Notes:

a QA/QC replicate of sample listed directly below the primary sample

HIL/HSL HIL A / HSL A/B - NEPC 2013, Schedule B1
EIL/ESL Urban Residential and Public Open Space - NEPC 2013, Schedule B1

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Table D2: Summary of Laboratory Results – OCP, OPP, PCB and Asbestos

			OCP								OPP	PCB	
			DDT+DDE+DDD	Aldrin & Dieldrin	Total Chlordane	Total Endosulfan	Endrin	Heptachlor	HCB	Methoxychlor	Chlorpyriphos	Total PCB	Asbestos Identification
		PQL	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sample ID	Depth	Sampled Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/kg
1	0.3m	15/10/2019	<0.1 240 NC	<0.1 6 NC	<0.1 50 NC	<0.1 270 NC	<0.1 10 NC	<0.1 6 NC	<0.1 10 NC	<0.1 300 NC	<0.1 160 NC	<0.1 1 NC	No asbestos detected No asbestos NC
2	0.5m	15/10/2019	<0.1 240 NC	<0.1 6 NC	<0.1 50 NC	<0.1 270 NC	<0.1 10 NC	<0.1 6 NC	<0.1 10 NC	<0.1 300 NC	<0.1 160 NC	<0.1 1 NC	No asbestos detected No asbestos NC
2	1m	15/10/2019	<0.1 240 NC	<0.1 6 NC	<0.1 50 NC	<0.1 270 NC	<0.1 10 NC	<0.1 6 NC	<0.1 10 NC	<0.1 300 NC	<0.1 160 NC	NT 1 NC	NT No asbestos NC
3	0.1m	15/10/2019	<0.1 240 NC	<0.1 6 NC	<0.1 50 NC	<0.1 270 NC	<0.1 10 NC	<0.1 6 NC	<0.1 10 NC	<0.1 300 NC	<0.1 160 NC	<0.1 1 NC	No asbestos detected No asbestos NC
3	1m	15/10/2019	<0.1 240 NC	<0.1 6 NC	<0.1 50 NC	<0.1 270 NC	<0.1 10 NC	<0.1 6 NC	<0.1 10 NC	<0.1 300 NC	<0.1 160 NC	NT 1 NC	NT No asbestos NC
4	0.1m	15/10/2019	<0.1 240 NC	<0.1 6 NC	<0.1 50 NC	<0.1 270 NC	<0.1 10 NC	<0.1 6 NC	<0.1 10 NC	<0.1 300 NC	<0.1 160 NC	NT 1 NC	No asbestos detected No asbestos NC
4	1m	15/10/2019	<0.1 240 NC	<0.1 6 NC	<0.1 50 NC	<0.1 270 NC	<0.1 10 NC	<0.1 6 NC	<0.1 10 NC	<0.1 300 NC	<0.1 160 NC	NT 1 NC	NT No asbestos NC
BD1/1510	Duplicate of 1/0.3m	15/10/2019	NT 240 NC	NT 6 NC	NT 50 NC	NT 270 NC	NT 10 NC	NT 6 NC	NT 10 NC	NT 300 NC	NT 160 NC	NT 1 NC	NT No asbestos NC

HIL / HSL exceedance EIL / ESL exceedance ML exceedance HIL/HSL and EIL/ESL exceedance **Bold** = Lab detections

Key: Lab result (HIL/HSL value | EIL/ESL value)

ML and HIL/HSL/EIL/ESL exceedance **red** = DC exceedance NT = Not tested NL = Non limiting NC = No criteria NAD = No asbestos detected

Indicates that asbestos has been detected by the lab below the PQL, refer to the lab report

Notes:

a QA/QC replicate of sample listed directly below the primary sample

HIL/HSL HIL A / HSL A/B - NEPC 2013, Schedule B1
EIL/ESL Urban Residential and Public Open Space - NEPC 2013, Schedule B1

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CERTIFICATE OF ANALYSIS 228921

Client Details

Client	Douglas Partners Tuggerah
Attention	Jessica Paulsen
Address	Unit 5, 3 Teamster Close, Tuggerah, NSW, 2259

Sample Details

Your Reference	**83717.00**
Number of Samples	8 Soil
Date samples received	22/10/2019
Date completed instructions received	22/10/2019

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	29/10/2019
Date of Issue	28/10/2019

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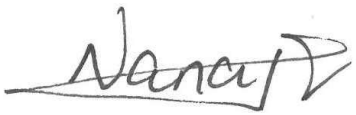
Asbestos Approved By
Analysed by Asbestos Approved Identifier: Panika Wongchanda
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
Josh Williams, Chemist
Loren Bardwell, Senior Chemist
Lucy Zhu, Senior Asbestos Analyst
Steven Luong, Organics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil					
Our Reference		228921-1	228921-2	228921-4	228921-8
Your Reference	UNITS	1	2	3	BD1/1510
Depth		0.3	0.5	0.1	.
Date Sampled		15/10/2019	15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	23/10/2019	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	26/10/2019	26/10/2019	26/10/2019	26/10/2019
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	[NA]
Toluene	mg/kg	<0.5	<0.5	<0.5	[NA]
Ethylbenzene	mg/kg	<1	<1	<1	[NA]
m+p-xylene	mg/kg	<2	<2	<2	[NA]
o-Xylene	mg/kg	<1	<1	<1	[NA]
naphthalene	mg/kg	<1	<1	<1	[NA]
Total +ve Xylenes	mg/kg	<3	<3	<3	[NA]
Surrogate aaa-Trifluorotoluene	%	77	80	80	[NA]

svTRH (C10-C40) in Soil					
Our Reference		228921-1	228921-2	228921-4	228921-8
Your Reference	UNITS	1	2	3	BD1/1510
Depth		0.3	0.5	0.1	.
Date Sampled		15/10/2019	15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	23/10/2019	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	150	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	150	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	110	250	<100
TRH >C_{34} -C_{40}	mg/kg	<100	110	140	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	230	400	<50
Surrogate o-Terphenyl	%	78	80	81	75

PAHs in Soil				
Our Reference		228921-1	228921-2	228921-4
Your Reference	UNITS	1	2	3
Depth		0.3	0.5	0.1
Date Sampled		15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil
Date extracted	-	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019
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	0.2	0.2
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	0.3	<0.2
Benzo(a)pyrene	mg/kg	<0.05	0.09	0.06
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	0.77	0.5
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	%	109	105	103

Organochlorine Pesticides in soil						
Our Reference		228921-1	228921-2	228921-3	228921-4	228921-5
Your Reference	UNITS	1	2	2	3	3
Depth		0.3	0.5	1.0	0.1	1.0
Date Sampled		15/10/2019	15/10/2019	15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/10/2019	23/10/2019	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
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	%	98	101	90	100	93

Organochlorine Pesticides in soil			
Our Reference		228921-6	228921-7
Your Reference	UNITS	4	4
Depth		0.1	1.0
Date Sampled		15/10/2019	15/10/2019
Type of sample		Soil	Soil
Date extracted	-	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019
alpha-BHC	mg/kg	<0.1	<0.1
HCB	mg/kg	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1
Surrogate TCMX	%	106	105

Organophosphorus Pesticides in Soil						
Our Reference		228921-1	228921-2	228921-3	228921-4	228921-5
Your Reference	UNITS	1	2	2	3	3
Depth		0.3	0.5	1.0	0.1	1.0
Date Sampled		15/10/2019	15/10/2019	15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/10/2019	23/10/2019	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
Azinphos-methyl (Guthion)	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
Chlorpyriphos	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
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
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
Ethion	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
Parathion	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
Surrogate TCMX	%	98	101	90	100	93

Organophosphorus Pesticides in Soil			
Our Reference		228921-6	228921-7
Your Reference	UNITS	4	4
Depth		0.1	1.0
Date Sampled		15/10/2019	15/10/2019
Type of sample		Soil	Soil
Date extracted	-	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1
Surrogate TCMX	%	106	105

PCBs in Soil				
Our Reference		228921-1	228921-2	228921-4
Your Reference	UNITS	1	2	3
Depth		0.3	0.5	0.1
Date Sampled		15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil
Date extracted	-	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019
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	%	98	101	100

Acid Extractable metals in soil						
Our Reference		228921-1	228921-2	228921-3	228921-4	228921-5
Your Reference	UNITS	1	2	2	3	3
Depth		0.3	0.5	1.0	0.1	1.0
Date Sampled		15/10/2019	15/10/2019	15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/10/2019	23/10/2019	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	23/10/2019	23/10/2019	23/10/2019	23/10/2019	23/10/2019
Arsenic	mg/kg	6	5	4	<4	5
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	24	21	16	10	16
Copper	mg/kg	9	22	6	11	2
Lead	mg/kg	13	19	9	20	17
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	26	2	7	6
Zinc	mg/kg	14	49	7	40	35

Acid Extractable metals in soil				
Our Reference		228921-6	228921-7	228921-8
Your Reference	UNITS	4	4	BD1/1510
Depth		0.1	1.0	.
Date Sampled		15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil
Date prepared	-	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	23/10/2019	23/10/2019	23/10/2019
Arsenic	mg/kg	6	11	6
Cadmium	mg/kg	<0.4	<0.4	<0.4
Chromium	mg/kg	16	13	22
Copper	mg/kg	19	2	9
Lead	mg/kg	52	9	11
Mercury	mg/kg	<0.1	<0.1	<0.1
Nickel	mg/kg	8	1	2
Zinc	mg/kg	88	12	13

Moisture						
Our Reference		228921-1	228921-2	228921-3	228921-4	228921-5
Your Reference	UNITS	1	2	2	3	3
Depth		0.3	0.5	1.0	0.1	1.0
Date Sampled		15/10/2019	15/10/2019	15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/10/2019	23/10/2019	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
Moisture	%	18	16	18	13	13

Moisture				
Our Reference		228921-6	228921-7	228921-8
Your Reference	UNITS	4	4	BD1/1510
Depth		0.1	1.0	.
Date Sampled		15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil
Date prepared	-	23/10/2019	23/10/2019	23/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019
Moisture	%	17	22	18

Asbestos ID - soils					
Our Reference		228921-1	228921-2	228921-4	228921-6
Your Reference	UNITS	1	2	3	4
Depth		0.3	0.5	0.1	0.1
Date Sampled		15/10/2019	15/10/2019	15/10/2019	15/10/2019
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019
Sample mass tested	g	Approx. 25g	Approx. 30g	Approx. 30g	Approx. 30g
Sample Description	-	Brown clayey soil & rocks	Brown sandy soil & rocks	Brown sandy soil & rocks	Brown sandy 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
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

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-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	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-003	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-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-006	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-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-012/017	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS.
Org-012/017	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-MS and/or GC-MS/MS. 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.

Method ID	Methodology Summary
Org-012/017	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-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	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-016	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-5	[NT]
Date extracted	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Date analysed	-			26/10/2019	[NT]	[NT]	[NT]	[NT]	26/10/2019	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	85	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	85	[NT]
Benzene	mg/kg	0.2	Org-016	<0.2	[NT]	[NT]	[NT]	[NT]	97	[NT]
Toluene	mg/kg	0.5	Org-016	<0.5	[NT]	[NT]	[NT]	[NT]	81	[NT]
Ethylbenzene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	81	[NT]
m+p-xylene	mg/kg	2	Org-016	<2	[NT]	[NT]	[NT]	[NT]	83	[NT]
o-Xylene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	81	[NT]
naphthalene	mg/kg	1	Org-014	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	88	[NT]	[NT]	[NT]	[NT]	77	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	228921-2
Date extracted	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	23/10/2019
Date analysed	-			24/10/2019	[NT]	[NT]	[NT]	[NT]	24/10/2019	24/10/2019
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	118	97
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	101	87
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	108	106
TRH >C_{10}-C_{16}	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	118	97
TRH >C_{16}-C_{34}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	101	87
TRH >C_{34}-C_{40}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	108	106
Surrogate o-Terphenyl	%		Org-003	76	[NT]	[NT]	[NT]	[NT]	98	85

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Date analysed	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Naphthalene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Acenaphthylene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Phenanthrene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Anthracene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	80	[NT]
Pyrene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012/017	<0.05	[NT]	[NT]	[NT]	[NT]	98	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012/017	113	[NT]	[NT]	[NT]	[NT]	85	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Date analysed	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
alpha-BHC	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	80	[NT]
HCB	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	92	[NT]
gamma-BHC	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	82	[NT]
delta-BHC	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	86	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	80	[NT]
gamma-Chlordane	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	84	[NT]
Dieldrin	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Endrin	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Endosulfan II	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	84	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	84	[NT]
Methoxychlor	mg/kg	0.1	Org-012/017	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-012/017	85	[NT]	[NT]	[NT]	[NT]	116	[NT]

QUALITY CONTROL: Organophosphorus Pesticides in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Date analysed	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	128	[NT]
Dimethoate	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
Fenitrothion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Malathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	125	[NT]
Parathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	114	[NT]
Ronnel	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Surrogate TCMX	%		Org-008	85	[NT]	[NT]	[NT]	[NT]	116	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Date analysed	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	69	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-006	85	[NT]	[NT]	[NT]	[NT]	116	[NT]

QUALITY CONTROL: Acid Extractable metals in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date prepared	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Date analysed	-			23/10/2019	[NT]	[NT]	[NT]	[NT]	23/10/2019	[NT]
Arsenic	mg/kg	4	Metals-020	<4	[NT]	[NT]	[NT]	[NT]	102	[NT]
Cadmium	mg/kg	0.4	Metals-020	<0.4	[NT]	[NT]	[NT]	[NT]	97	[NT]
Chromium	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Copper	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Lead	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	107	[NT]
Mercury	mg/kg	0.1	Metals-021	<0.1	[NT]	[NT]	[NT]	[NT]	91	[NT]
Nickel	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Zinc	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	105	[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.

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; 60-140% for organics (+/-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.

Report Comments

Asbestos: A portion of the supplied samples were sub-sampled for asbestos analysis according to Envirolab procedures.
We cannot guarantee that these sub-samples are indicative of the entire sample.
Envirolab recommends supplying 40-50g of sample in its own container.
Note: Samples requested for asbestos testing were sub-sampled from jars provided by the client.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics | Environment | Groundwater

Client: Douglas Partners	Project Number: 83717.00	To:	Envirolab Services
Contact Person: Jessica Paulsen	Project Name: Wamberal	Contact Person:	Aileen Hie
Project Mgr: Jessica Paulsen	PO No.: 83717.00	Address:	12 Ashley Street
	lab Quote No.: 2016-2017 List		Chatswood NSW 2068
Address: 5/3 Teanster Cl Tuggerah NSW 2259	Date results required: STANDARD *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	Phone:	02 9910 6200
		Fax:	02 9910 6201
Phone: 4351 1422 Mob:	Report format: Esdat/PDF / Excel	Email:	ahie@envirolab.com.au
Email: jessica.paulsen@douglaspartners.com.au	Comments:	Laboratory Report No:	
		Lab Comments:	

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	Combo 8A	COMBO 3	PH	CEC	HM8 & TRH	HM8	TRH, BTEX, PAH & PCB	OCP & OPP	Asbestos ID		Combo	Provide as much information about the sample as you can
1	1	0.3	15/10/2019	jar	soil						1	1	1	1			
2	2	0.5	15/10/2019	jar	soil						1	1	1	1			
3	2	1.0	15/10/2019	jar	soil						1		1				
4	3	0.1	15/10/2019	jar	soil						1	1	1	1			
5	3	1.0	15/10/2019	jar	soil						1		1				
6	4	0.1	15/10/2019	jar	soil						1		1	1			
7	4	1.0	15/10/2019	jar	soil						1		1				
8	BD1/1510		15/10/2019	jar	soil					1							

ENVIROLAB

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 228921
Date Received: 22.10.19
Time Received: 10:17
Received by: MO
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by: Douglas Partners		Sample Receipt	
Courier (by whom)	TNT	Received by (Company):	EL S
Condition of Sample at dispatch Cool or Ambient (circle)	Cold, on ice	Print Name:	Michael Ohie
Temperature (if Applicable):	Cold, on ice	Date & Time:	22-10-19 10:17
Print Name:	Jessica Paulsen	Signature:	
Date & Time:	21/10/2019 PM		
Signature:			

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: 17.2 (if applicable)
Transported by: Hand delivered / courier

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details

Client	Douglas Partners Tuggerah
Attention	Jessica Paulsen

Sample Login Details

Your reference	83717.00
Envirolab Reference	228921
Date Sample Received	22/10/2019
Date Instructions Received	22/10/2019
Date Results Expected to be Reported	29/10/2019

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	8 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	17.2
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

Sample ID	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticides in soil	Organophosphorus Pesticides in Soil	PCBsin Soil	Acid Extractable metalsin soil	Asbestos ID - soils
1-0.3	✓	✓	✓	✓	✓	✓	✓	✓
2-0.5	✓	✓	✓	✓	✓	✓	✓	✓
2-1.0				✓	✓		✓	
3-0.1	✓	✓	✓	✓	✓	✓	✓	✓
3-1.0				✓	✓		✓	
4-0.1				✓	✓		✓	✓
4-1.0				✓	✓		✓	
BD1/1510-.	✓	✓					✓	

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.

TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

DATA QUALITY ASSESSMENT

Q1. Data Quality Objectives

The PSI was prepared with reference to the seven step data quality objective (DQO) process which is provided in Appendix B, Schedule B2 of the *National Environment Protection (Assessment of Site Contamination) Measure* 1999 as amended 2013 (NEPC, 2013). The DQO process is outlined as follows:

- Stating the Problem;
- Identifying the Decision;
- Identifying Inputs to the Decision;
- Defining the Boundary of the Assessment;
- Developing a Decision Rule;
- Specifying Acceptable Limits on Decision Errors; and
- Optimising the Design for Obtaining Data.

The DQOs have been addressed within the report as shown in Table Q1.

Table Q1: Data Quality Objectives

Data Quality Objective	Report Section where Addressed
State the Problem	S1 Introduction
Identify the Decision	S1 Introduction (objective) S12 & S13 Discussion, Conclusions & Recommendations
Identify Inputs to the Decision	S1 Introduction S3 Site Information S2 Scope of Work S9 Assessment Criteria S10 to S12 Results of Investigation
Define the Boundary of the Assessment	S3 & S6 Site Identification and Description Site Drawings – Appendix A
Develop a Decision Rule	S9 Site Assessment Criteria
Specify Acceptable Limits on Decision Errors	S8 Fieldwork and Analysis S9 Site Assessment Criteria QA/QC Procedures and Results – Sections Q2, Q3
Optimise the Design for Obtaining Data	S2 Scope of Work S8.3 Sampling Locations and Rationale QA/QC Procedures and Results – Sections Q2, Q3

Q2. FIELD AND LABORATORY QUALITY CONTROL

The field and laboratory quality control (QC) procedures and results are summarised in Tables Q2 and Q3. Reference should be made to the field work and analysis procedures in Section 8 and the laboratory results certificates in Appendix D for further details.

Table Q2: Field QC

Item	Frequency	Acceptance Criteria	Achievement
Intra-laboratory replicates	14% primary samples	RPD <30% (inorganics), <50% (organics)	yes[1]

NOTES: 1 qualitative assessment of RPD results overall; refer Section Q2.1

Table Q3: Laboratory QC

Item	Frequency	Acceptance Criteria	Achievement
Analytical laboratories used		NATA accreditation	yes
Holding times		In accordance with NEPC (2013) which references various Australian and international standards	yes
Laboratory / Reagent Blanks	1 per lab batch	<PQL	yes
Laboratory duplicates	10% primary samples	Laboratory specific [1]	yes
Matrix Spikes	1 per lab batch	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes
Surrogate Spikes	organics by GC	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes
Control Samples	1 per lab batch	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes

NOTES: 1 ELS: <5xPQL – any RPD; >5xPQL – 0-50%RPD

In summary, the QC data is considered to be of sufficient quality to be acceptable for the assessment.

Q2.1 Intra-Laboratory Replicate

One intra-laboratory replicate was analysed as an internal check of the reproducibility within the primary laboratory ELS and as a measure of consistency of sampling techniques.

Note that, where both samples are below LOR / PQL the difference and RPD has been given as zero. Where one sample is reported below LOR / PQL, but a concentration is reported for the other, the LOR/PQL value has been used for calculation of the RPD for the less than LOR / PQL sample.

The calculated RPD values were generally within the acceptable range of +/-30% for inorganic analytes and +/-50% for organics. Overall, the intra-laboratory replicate comparisons indicate that the sampling techniques were generally consistent and repeatable.

Q3. Data Quality Indicators

The reliability of field procedures and analytical results was assessed against the following data quality indicators (DQIs):

- Completeness – a measure of the amount of usable data from a data collection activity;
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event;
- Representativeness – the confidence (qualitative) of data representativeness of media present on-site;
- Precision – a measure of variability or reproducibility of data; and
- Accuracy – a measure of closeness of the data to the 'true' value.

The DQIs were assessed as outlined in the following Table Q4.

Table Q4: Data Quality Indicators

Data Quality Indicator	Method(s) of Achievement
Completeness	Planned systematic and selected target locations sampled; Preparation of field logs, sample location plan and chain of custody (COC) records; Laboratory sample receipt information received confirming receipt of samples intact and appropriateness of the chain of custody; Samples analysed for contaminants of potential concern (COPC) identified in the Conceptual Site Model (CSM); Completion of COC documentation; NATA endorsed laboratory certificates provided by the laboratory; Satisfactory frequency and results for field and laboratory QC samples as discussed in Section Q2.
Comparability	Using appropriate techniques for sample recovery, storage and transportation, which were the same for the duration of the project; Works undertaken by appropriately experienced and trained DP environmental scientist / engineer / geologist; Use of a NATA registered laboratory; Satisfactory results for field and laboratory QC samples.
Representativeness	Target media sampled; Spatial and temporal distribution of sample locations; Sample numbers recovered and analysed are considered to be representative of the target media and complying with DQOs; Samples were extracted and analysed within holding times; Samples were analysed in accordance with the analysis request.
Precision	Acceptable RPD between the original sample and the replicate; Satisfactory results for all other field and laboratory QC samples.
Accuracy	Satisfactory results for all field and laboratory QC samples.

Based on the above, it is considered that the DQIs have been complied with. As such, it is concluded that the field and laboratory test data obtained are reliable and useable for this assessment.