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Report on
Preliminary Waste Classification

Proposed Grade Separated Interchange and Drainage
Channel
Kings Hill, North Raymond Terrace

Prepared for
PM No 1 Pty Ltd

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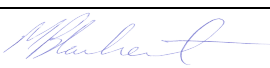
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Preliminary Waste Classification

Proposed Grade Separated Interchange and Drainage Channel

Kings Hill, North Raymond Terrace

1. Introduction

This report presents the results of a preliminary waste classification undertaken for a proposed grade separated interchange and drainage channel at Kings Hill, North Raymond Terrace. The investigation was commissioned in an email dated 12 August 2019 by APP Pty Ltd, acting on behalf of PM No 1 Pty Ltd and was undertaken with reference to Douglas Partners Pty Ltd (DP) proposal NCL190481 dated 5 August 2019.

The proposed development includes the construction of a stormwater drainage channel on the eastern side of the Pacific Highway, between the highway and Grahamstown Dam and a grade separated interchange located towards the lateral centre of the drainage channel which will allow vehicles to cross the highway. Excavation depths of up to 5.5 m will be required for the proposed drainage channel. Minor excavation will be required for embankment preparation as part of the interchange construction.

The purpose of the assessment is to provide a preliminary waste classification of the material expected to be excavated within the anticipated impact areas for the grade separated interchange and drainage channel (ie 'the site'), with a focus on areas likely to be suitable for classification as Virgin Excavated Natural Material (VENM). It is noted that a brief desktop assessment was undertaken prior to commencement of this preliminary waste classification and revealed that some areas of the anticipated impact areas have been subject to disturbance has occurred along the alignment, as follows:

- A fenced off former compound near the southern end of the channel alignment;
- A number of sealed pavements which cross the area;
- The existing Pacific Highway and associated embankments;
- A number of unsealed pavement throughout the site; and
- The raised Hunter Water access fill embankment within the northern part of the alignment and also towards the southern end of the alignment.

These areas have been excluded from this assessment and would require additional investigation to confirm the suitable waste classification and associated disposal/re-use options for materials.

The investigation included the drilling of eight boreholes, laboratory testing followed by preparation of this report. The details of the field work are presented in this report, together with preliminary waste classification comments.

For the purposes of the preliminary assessment the client provided shape files showing the impact areas for the drainage channel and grade separated interchange.

2. Background

Douglas Partners Pty Ltd (DP) has undertaken a number of geotechnical investigations in relation to the channel, which included:

- 21 test bores along the alignment to various depths;
- 16 test pits along the alignment to various depths.

The majority of these test locations encountered natural soils at the surface.

3. Site Description

3.1 General

The Figure 1, below, provides an aerial image of the proposed drainage alignment and grade separated interchange locations. The majority of the alignment lies within either cleared sections of forested areas or within undisturbed areas. Some parts of the alignment lie within close proximity to the existing Pacific Highway.



Figure 1: Aerial image showing impact area of the proposed Grade Separated Interchange (blue) and Drainage Channel (yellow)

3.2 Drainage Channel Alignment

The proposed stormwater drain alignment is located generally parallel and to the eastern side of the Pacific Highway, about 4 km north of Raymond Terrace. The drain will be positioned between the highway and a drowned valley associated with Grahamstown Dam.

Parts of the site are described below:

The northern end of the alignment (Ch 00) is located near the intersection of the Pacific Highway and Six Mile Road, on the eastern side of the highway.

Within this area, the alignment is through areas which contain mature trees and varying undergrowth (refer Figure 2).



Figure 2: View looking south-west along drainage channel alignment (existing unsealed access track)



Figure 3: Bushland in northern area of alignment

The alignment continues south through bushland situated between the Pacific Highway and Grahamstown Dam, which is generally about 200 m or more to the east of the alignment. The ground surface generally falls to the south and south-east at slopes of less than 5°.

From about Ch 1750, the alignment passes through a low lying section, which was covered with tall grass at the time of field work (refer Figures 3 and 4).



Figure 4: Tall grass in area between approximately Ch1750 and Ch 2050



Figure 5: Dry dam edge of alignment at about Ch 1850, looking south-west

Over an approximately 250 m length, from about Ch 1750 to Ch 2050, a Hunter Water Corporation (HWC) access road appeared to be constructed on ballast rock fill and was supported on a fill embankment up to about 2 m to 3 m high (refer Figure 6). The proposed drainage channel centreline is approximately 20 m to the east of this embankment.



Figure 6: View of start of existing access embankment, looking south-west

From about Ch 2050, the alignment returns to moderately dense bushland adjacent to the existing HWC access track.

At around Ch 2150, the alignment turns slightly to the east to pass around the proposed grade separated interchange. This area of the alignment is covered with dense bush and grass cover with some bare patches exposing residual clay soils (refer Figure 6).



Figure 7: Dense bushland at approximately Ch 2700

At approximately Ch 3120, the alignment passes an existing sealed access road and a former compound (refer Figure 8 and Figure 9).



Figure 8: Former compound at approximately Ch 3120, looking south



Figure 9: Sealed access road to existing spillway at approximately Ch 3120

The southern end of the drain alignment, from approximately Ch 3150 to its end, is located within a low lying area, which was covered with tall grass at the time of investigation (refer Figure 10).



Figure 10: Low lying grass covered area (photo taken during previous investigation)

3.3 Grade Separated Interchange

The proposed interchange is located on the Pacific Highway near the reservoir of Grahamstown Dam, about 4 km north of Raymond Terrace (refer Figure 1 which shows the anticipated impact area). The Pacific Highway (A1) near the site is a dual carriageway road of four traffic lanes and vegetated median strip.

The western approach to the interchange is predominantly within cleared paddocks. Topography within these areas generally falls to the south-west at slope of less than 10° (refer Figure 11 and Figure 12).



Figure 11: Typical view of area on western side of Pacific Highway

A vegetated strip of about 10 m wide was present adjacent to the Pacific Highway (refer Figure 4).



Figure 12: View along western side of Pacific Highway, looking north

Towards the northern end of the proposed northern entry ramp (near Pit 203 on Drawing 5) some ponded surface water was present at various stages during the present and previous investigations (refer Figure 13 taken during previous investigation).



Figure 13: Ponded water near Pit 203 excavated during previous investigation (December 2014)

The eastern side of the proposed interchange, which will include a bridge approach embankment together with entry/exit ramps is located primarily within bushland with a dense growth of trees or within an existing unsealed access track which runs parallel to the Pacific Highway.

Approximate photo locations and orientations are shown on Drawings 2 to 7 in Appendix D.

4. Scope of Work

The scope of work conducted for the preliminary waste classification assessment comprised the following:

- Review of previous investigations by DP in the area;
- Desktop review of the readily accessible information sources such as historical aerial photographs and mapping to provide an initial assessment of subsurface conditions and potential contamination sources;
- EPA records search;
- Drilling of eight bores within targeted areas of proposed impact areas;
- Laboratory testing of representative samples for potential contaminants;
- Provision of this report providing comments on preliminary waste classification and areas of the alignment requiring additional investigation/analysis required to assess the appropriate waste classification.

5. Desktop Review

The desktop assessment included review of the following available information:

- Geological mapping;

- Acid sulfate soil risk mapping;
- Soil landscape mapping;
- Previous DP investigations;
- Review of historical aerial photos; and
- Searches with the NSW Environmental Protection Authority (EPA).

Details are presented in Sections 5.1 to Section 5.6.

5.1 Regional Geology

Figure 14, below, is an extract from the 1:100,000 Newcastle Coalfield Regional Geology Sheet (9231).

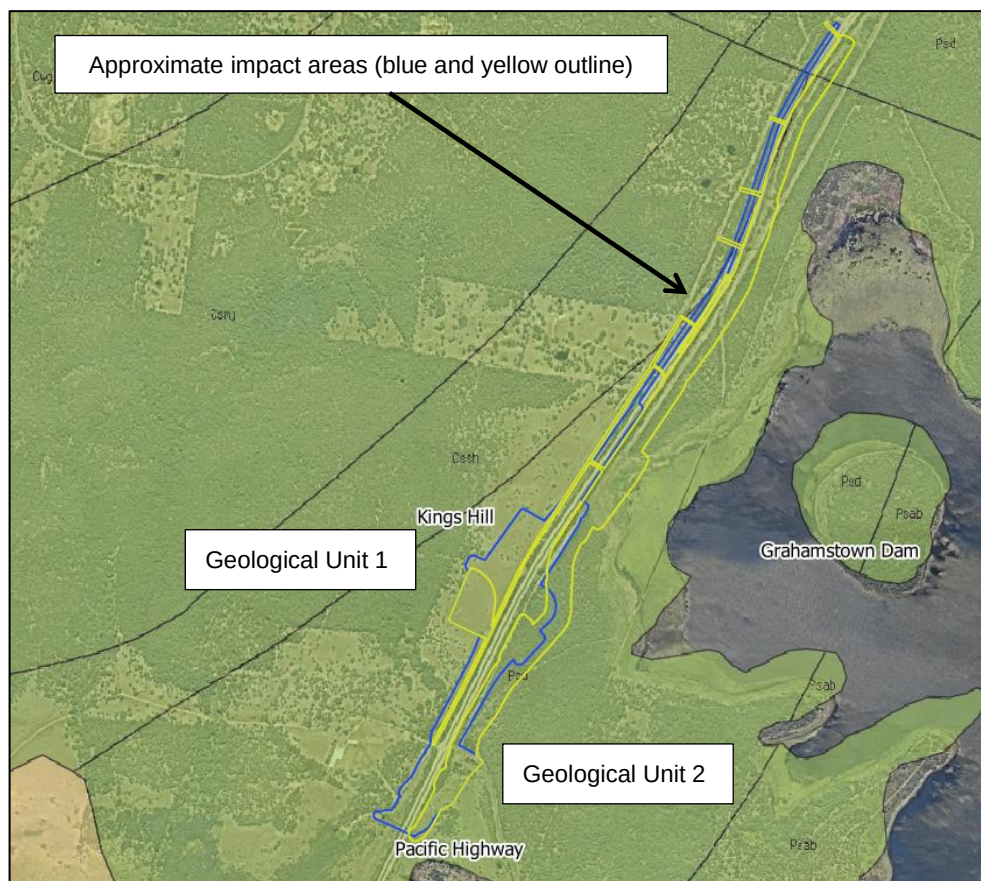


Figure 14: Extract from Geological Mapping

The mapping indicates that the site lies close to a boundary between two geological units, as follows:

- Geological Unit 1: Seaham Formation, comprising tillite, siltstones, tuff and mudstone with interbedded with conglomerate and sandstone; and

- Geological Unit 2: Dalwood Group (undifferentiated) of Permian age rocks, comprising sandstone, siltstone, conglomerate, marl and basalt.

The conditions encountered in the previous bores and pits were indicative of these two geological units.

5.2 Acid Sulfate Soil Risk Mapping

Reference to the local acid sulfate soil risk map indicates that the areas of impact for the grade separated interchange and the drainage channel are in an area with no known occurrence of acid sulfate soils. It is noted that an area mapped as having a high probability of acid sulfate soils is located to the south of the investigation area. Figure 15 below is an extract from the ASS risk mapping.



Figure 15: Extract from Acid Sulfate Soil Mapping

5.3 Soil Landscape Mapping

Figure 16, below, is an extract from the Soil Landscape Mapping for the area.

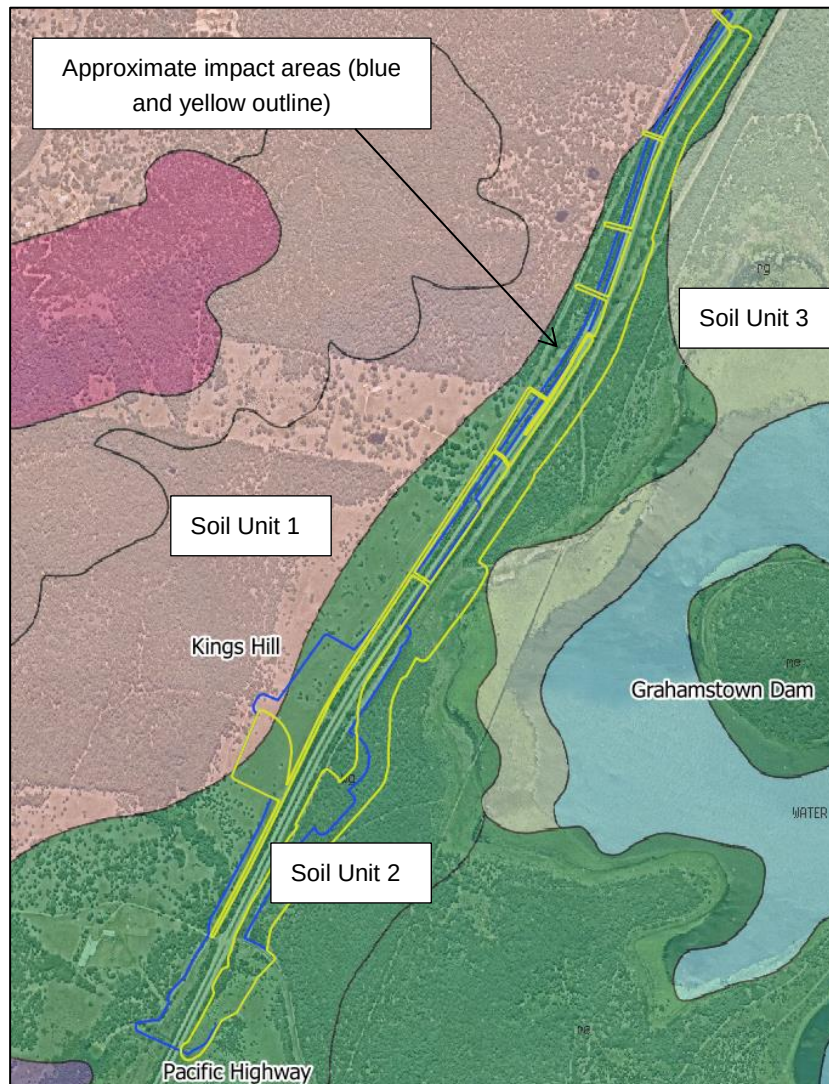


Figure 16: Extract from soil landscape mapping

The mapping indicates that the proposed interchange and drainage channel extends over soils belonging to two landscape groups, and is in close proximity to soils of a third landscape group, as follows:

- Soil Unit 1: Ten Mile Road Group (erosional). Limitations associated with this soil group include a high water erosion hazard, localised shallow soils, high run-on and seasonal waterlogging. These soils have been reported to be strongly to extremely acid;
- Soil Unit 2: Wallalong Group (residual). Limitations associated with this soil group include high water erosion hazard, localised seasonal waterlogging and shallow soils. These soils have also been reported to be very highly acidic; and
- Soil Unit 3: Nungra (transferal) of which no limitations are provided in the notes accompanying the plans.

5.4 Previous DP Investigations

DP has undertaken a number of previous investigations for the proposed grade separated interchange and drainage channel. These included the following:

- DP (2016), which was a geotechnical investigation for the proposed drainage channel.
 - This investigation included eleven bores (Bores 501 to 511, 501A), 601 to 604 along the drainage channel alignment. The pits and bores generally encountered slopewash (colluvium) and topsoil overlying residual clay and weathered bedrock (either sedimentary or volcanic). Alluvial soils, including saturated sand, were encountered where the drain alignment is closest to the dam and also at the southern end of the alignment;
 - ASS screening tests were undertaken on samples retrieved from the bores located within the southern end of the alignment (south of former compound). The results indicated an absence of ASS conditions. It was considered that ASS soils were not present within the proposed drainage alignment;
- DP (2015), which was a geotechnical investigation for the proposed grade separated interchange.
 - This investigation included the drilling a number of bores (Bores 601 to 604, 701) and pits (Pits 702 to 707) within the impact area for the interchange. The pits and bores generally encountered sandy silt topsoil or silt overlying residual clay to depths ranging from about 0.7 m to greater than 6 m, which in turn was underlain by basaltic bedrock.
- DP (2014), which was a geotechnical investigation for the stormwater options;
 - This investigation included the drilling of five bores (Bores 1 to 5), broadly spaced along the proposed drainage alignment. The bores encountered clay fill to 3.5 m depth (former compound area) and 0.55 m depth (Hunter Water Access embankment at approximately Ch1800) or topsoil overlying predominantly residual clay soils with bedrock encountered at depths ranging from about 0.7 m to greater than 5 m.

The location of the relevant pits and bores undertaken during these investigation are shown on Drawings 2 to 7 in Appendix D.

Relevant test pit logs and borehole logs from these pits/bores are also included in Appendix B.

5.5 Review of Historical Aerial Photos

A limited historical aerial photos review undertaken for the assessment indicated the following:

- 1966 image – the former Pacific Highway is visible in the photo with cleared farmland in the southern area of the impact areas; and
- 1998 Image – the existing Pacific Highway is visible, along with the former alignment of the highway. The majority of the impact area is covered with forested areas for the drainage channel (east of current Pacific Highway alignment) and cleared paddocks on the western side of the Pacific Highway. Several access tracks are visible in the photo.

It is noted that data obtained from aerial photos was limited due to the relatively small scale and poor resolutions.

5.6 EPA Public Register Search

A review of the NSW EPA public registers indicated the following:

- The site is not on the NSW EPA Contaminated Land Management Register;
- The site is not on the list of contaminated sites notified to NSW EPA; and
- The site is not on the Protection of the Environment Operations Act list for licences, notices etc.

6. Field Work Rationale and Methods

It is noted that the proposed channel and grade separated interchange alignment is in the order of 3 km in length and hence covers a large area. This preliminary investigation has included only limited subsurface investigation. There is a possibility that some isolated areas of the alignment may have been impacted by previous potentially contaminating activities. These areas (where identified by the site walkover and brief desktop review) have generally been excluded from the assessment. The test bore and sampling locations were nominated to confirm the presence of natural soils in areas where previous investigation and site observations have inferred natural soils and to provide laboratory testing of these natural soils to assess their suitability to be classified as VENM.

The field work was undertaken on 15 August 2019 and 12 September 2019 and comprised the following:

- Walkover assessment of the alignment by a senior engineer from DP (15 August 2019 and 12 September 2019);
- Drilling of eight (8) bores (designated Bores 2001 to 2008) on 12 September 2019 within the anticipated impact area for the proposed drainage channel and grade separated interchange; and
- The bores were drilled using a 4WD mounted push tube rig or hand tools to depths ranging from 0.5 m to 1.2 m.

Samples of the soils encountered in the bores were collected at regular depth intervals by a geo-environmental engineer, carefully removing and extraneous material, who also prepared engineering logs of the subsurface conditions.

All sampling data was recorded on the DP chain of custody sheets, and the general sampling procedure comprised:

- Decontamination of all sampling equipment using 3% solution of phosphate free detergent (Decon 90) and tap water prior to collecting each sample;
- The use of disposable gloves for each sampling event;
- Transfer of samples into laboratory-prepared glass jars, and capping immediately;

- Collection of replicate soil samples in zip-lock plastic bags at each depth for photo-ionisation detector (PID) screening;
- Labelling of sample containers with individual and unique identification, including project number, sample location and sample depth;
- Placement of the sample jars and replicate sample bags into a cooled, insulated and sealed container for transport into the laboratory;
- Use of chain-of-custody (C-O-C) documentation ensuring that sample tracking and custody could be cross-checked at any point in the transfer of samples from the field to the laboratory. Copies of completed forms are provided in Appendix C;
- All samples were stored on ice during transportation to the laboratory.

The test locations were recorded using a hand held GPS unit. The approximate locations of the bores are shown in the drawings provided in Appendix D.

7. Field Work Results

7.1 Site Walkover

The main observations relating to the preliminary waste assessment along the alignments are as follows:

- The majority of the drainage channel alignment is either within bushland or within the cleared area between Grahamstown Dam and the Pacific Highway;
- No obvious areas of fill was noted within the majority of the anticipated impact areas during the inspection with the exception of the following:
 - The existing Pacific Highway and associated fill embankments;
 - The former compound and adjacent sealed access road at approximately Ch1320 (refer Figure 8);
 - A former access embankment to the south of the compound area and extending to the southern end of the impact areas (refer Drawing 7);
 - Several unsealed access pavements crossing the alignment;
 - A sealed pavement for the Riding for the Disabled facility towards the southern end of the area; and
 - The sealed former Pacific Highway alignment towards the centre of the alignment (refer Figure 17);



Figure 17: Former Pacific Highway pavement (near Bore 2001)

- In the area to the west of the Pacific Highway and between the access to the Riding for the Disabled access road and the Balickera Spillway, some signs of fill were observed (refer Figure 18).



Figure 18: Buried metal sheet in ground surface south of Riding for the Disabled Access Road

- It is noted that shallow fill (appears to be a quarried natural gravel) has been placed along the main north-south HWC access track seemingly to assist with access during wet weather (refer Figure 19);



Figure 19: Typical gravel placed along access tracks

There were no obvious indications of gross contamination (e.g. staining or odours) or anthropogenic materials noted on the site's surface within the areas of inspection (with the exception of the areas excluded from this assessment).

7.2 Bores

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

The subsurface conditions encountered within the bores are summarised below:

- Possible sandy silt fill in Bore 2011 to 0.2 m depth associated with the existing access track;
- Topsoil – comprising sandy silt to depths ranging from 0.03 m to 0.15 m in several bores;
- Residual clay, sandy silt, sandy clay or silty clay soils in all bores;
- No anthropogenic inclusions were encountered in the bores.

No free groundwater was observed within the bores whilst they remained open. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

Replicate samples for each soil sample were screened for the presence of volatile organic compounds (VOCs), using a calibrated PID. The results of PID screening suggested the absence of gross volatile hydrocarbon impact (<1 ppm). Furthermore there were no obvious signs of potential acid sulfate soils (such as sulfidic odours or presence of jarosite (yellow mottling)).

8. Laboratory Testing

8.1 Chemical Testing

Ten soil samples (including one QA/QC sample) were analysed for the following suite of potential contaminants by Envirolab Services Pty Ltd (Envirolab) a NATA accredited laboratory:

- Total Recoverable Hydrocarbons (TRH);
- Polycyclic Aromatic Hydrocarbons (PAH);
- Polychlorinated Biphenyls (PCB);
- Organochlorine (OCP) and Organophosphate (OPP) Pesticides;
- Benzene, Toluene, Ethyl Benzene, Xylene (BTEX); and
- Metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn).

The results of laboratory testing of soil samples are presented in the laboratory report sheets in Appendix C and are summarised in Table 1 to Table 3 below. A review of laboratory quality control test results was undertaken and, in summary, indicated that the accuracy and precision of the soil testing procedures, as inferred by the QA/QC data, is considered to be of sufficient standard to allow the data reported to be used to interpret contamination conditions.

Table 1: Laboratory Results for Metals in Soil

Sample Location	Depth (m)	PID (ppm)	Metals							
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
2001	0.05-0.15	<1	<4	<0.4	17	5	15	<0.1	4	31
2001	0.4-0.5	<1	<4	<0.4	49	21	5	<0.1	20	28
2002	0.1-0.2	<1	<4	<0.4	17	5	14	<0.1	4	10
2003	0.2	<1	<4	<0.4	10	<1	8	<0.1	2	3
2004	0.1-0.2	<1	<4	<0.4	18	11	5	<0.1	5	11
2005	0.05-0.1	<1	<4	<0.4	11	3	9	<0.1	3	7
D1 (2005)	0.05-0.1	<1	<4	<0.4	21	3	4	<0.1	3	3
2006	0.05-0.15	<1	<4	<0.4	17	11	6	<0.1	3	13
2007	0.05-0.1	<1	<4	<0.4	15	<1	9	<0.1	2	3
2008	0.05-0.15	<1	<4	<0.4	63	21	11	<0.1	28	21
Laboratory PQL			1	0.4	1	1	1	0.1	0.1	1
General Solid Waste (CT1)			100	20	100⁽¹⁾	NC	100	4	40	NC
Restricted Solid Waste (CT2)			400	80	400⁽¹⁾	NC	400	16	160	NC
Excavated Natural Material Maximum Average Concentration (adopted for VENM assessment)			20	0.5	75	100	50	0.5	30	150

Notes to Table 1:

All results in mg/kg on a dry weight basis unless otherwise shown

NC - No Criteria CT - Concentration Threshold

PID - Photoionisation Detector PQL - Practical Quantitation Limits

1 - Chromium (VI) (Conservative)

Table 2: Laboratory Results for TRH, BTEX in Soil

Sample location	Depth (m)	PID (ppm)	TRH				BTEX			
			C ₆ - C ₉	C ₁₀ - C ₁₄	C ₁₅ - C ₂₈	C ₂₉ - C ₃₆	Benzene	Toluene	Ethyl Benzene	Xylene
2001	0.05-0.15	<1	<25	<50	100	140	<0.2	<0.5	<1	<3
2001	0.4-0.5	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
2002	0.1-0.2	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
2003	0.2	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
2004	0.1-0.2	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
2005	0.05-0.1	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
2006	0.05-0.15	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
2007	0.05-0.1	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
2008	0.05-0.15	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
D1 (2005)	0.05-0.1	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<3
Laboratory PQL			25	50	100	100	0.2	0.5	1	3
General Solid Waste (CT1)			650	10000 total			10	288	600	80
Restricted Solid Waste (CT2)			2600	40000 total			40	1152	2400	200
Excavated Natural Material Absolute Maximum Concentration			NC	500 total			0.5	65	25	15
VENM Criteria			<PQL	<PQL			<PQL	<PQL	<PQL	<PQL

Notes to Table 2:

All results in mg/kg on a dry weight basis unless otherwise shown

CT - Concentration Threshold

PID - Photoionisation Detector

PQL - Practical Quantitation Limits

NA – Not applicable

Table 3: Results of Chemical Testing – PAH, OCP, OPP and PCB in Soil

Pit	Depth (m)	Total Positive PAH	B(a)P	Total PCB	Total OPP	Total OCP	Aldrin + Dieldrin	Chlor dane	DDT	Heptachlor
2001	0.05-0.15	80	<u>5.8</u>	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2001	0.4-0.5	0.05	0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2002	0.1-0.2	2.7	0.3	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2003	0.2	<0.05	<0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2004	0.1-0.2	<0.05	<0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2005	0.05-0.1	<0.05	<0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2006	0.05-0.15	0.05	0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2007	0.05-0.1	<0.05	<0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
2008	0.05-0.15	<0.05	<0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
D1 (2005)	0.05-0.1	<0.05	<0.05	<0.7	<1.2	<2	<0.2	<0.1	<0.1	<0.1
Laboratory PQL		0.05	0.05	0.1 ea	0.1 ea	0.1 ea	0.1 ea	0.1	0.1	0.1
General Solid Waste (CT1)		200	0.8	50	250	250	NC	NC	NC	NC
Restricted Solid Waste (CT2)		800	3.2	50	1000	1000	NC	NC	NC	NC
<i>Excavated Natural Material</i>		<i>20</i>	<i>0.5</i>	<i>NC</i>	<i>NC</i>	<i>NC</i>	<i>NC</i>	<i>NC</i>	<i>NC</i>	<i>NC</i>
VENM Criteria		<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Notes to Table 3:

All results in mg/kg on a dry weight basis

CT - Concentration Threshold

NA - Not Applicable

NC - No Criteria

NT - Not Tested

PID - Photoionisation Detector

PQL - Practical Quantitation Limits

SCC - Specific Contaminant Concentration

156
156

Italicised results exceed NSW EPA (2014) General Solid Waste criteria without leachability (TCLP) testing

Bold, italicised and underlined results exceed NSW EPA (2014) Restricted Solid Waste criteria without leachability (TCLP) testing

9. Assessment Criteria

It is understood that the majority of the material excavated as part of the development may be re-used within the construction of the Grade Separated Interchange. Some excess material may be transported off site for re-use/disposal subject to waste classification.

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

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

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

(b) that does not contain any sulfidic ores or soils or any other waste

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

Virgin excavated natural material (VENM) is a waste that has been pre-classified (EPA, 2014a) as general solid waste (non-putrescible).

Additional advice is provided on the EPA web site entitled 'Virgin Excavated Natural Material'. This advice states:

- Generators of VENM must assess the past and present activities on the site. The possibility that a previous land use has caused contamination of a site must be considered when assessing whether an excavated material is VENM. Land uses that could result in contaminants being present in an excavated material are listed on the web site. The list is not exhaustive and an excavated material may still be contaminated even where none of these activities have previously occurred on a site. Activities not directly related to a site may also lead to contamination, including diffuse sources of pollution such as contaminated groundwater that migrates under a site, or dust settling out from industrial emissions. Generators of VENM must consider these factors;
- Generators of excavated material should review the applicable Acid Sulfate Soil Risk Maps to determine the probability of acid sulfate soils being present at the site at which VENM excavation is proposed. The waste cannot be classified as VENM if the Acid Sulfate Soil Risk Maps identify a high probability of occurrence of acid sulfate soils or potential acid sulfate soils, unless it has undergone chemical assessment in accordance with the *Acid Sulfate Soils Assessment Guidelines* and the updated *Acid Sulfate Soils Laboratory Method Guidelines Version 4.0* - September 2014;
- By definition, VENM cannot contain any other waste, or be 'made' from processed soils. Excavated material that has been processed in any way cannot be classified as VENM; and
- Classification of excavated material as VENM requires certainty that all aspects of the definition are met. Chemical testing may be required to ascertain whether an excavated material is contaminated with manufactured chemicals or process residues, or whether it contains sulfidic ores or soils.

For assessment of the suitability of the natural soils to be classified as Virgin Excavated Natural Materials (VENM) in term of inorganic analytes (heavy metal) concentrations, the NSW EPA, Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 "The Excavated Natural Material Order 2014" (EPA, 2014b) was adopted.

For all other organic analytes, where no published background levels were available, the respective practical laboratory quantitation limits were used as the assessment basis.

Topsoils cannot be classified as VENM and must be segregated from underlying VENM material, where present.

For materials that cannot be classified as ENM or VENM, the *Waste Classification Guidelines, Part 1: Classification of Waste* EPA (EPA, 2014a) contains a six-step procedure for determining the type of waste and the waste classification. Part of the procedure, for materials not classified as special waste or pre-classified waste, is a comparison of analytical data initially against contaminant threshold (CT) values specific to a waste category.

10. VENM Assessment

The following Table 4 presents the results of the assessment of natural soils and underlying bedrock at the site with reference to the VENM definition.

Table 4: VENM Classification Procedure

Item	Comments	Rationale
1. Is the material natural?	Yes - mostly	Natural materials (excluding topsoils) observed comprised sandy silt overlying residual clay and underlain by bedrock. Some areas of fill observed which have been excluded from this assessment (refer Drawing 2).
2. Is the material impacted by manufactured chemicals or process residues?	No	There were no visual indicators of chemical contamination of the materials observed.
3. Are the materials acid sulfate soils?	No	Based on the risk mapping, elevation and previous laboratory screening tests, it is considered that acid sulfate soils are not likely to be present within the anticipated impact areas.
4. Are there current or previous land uses that have (or may have) contaminated the materials?	No - mostly	Generally, the impacted areas are within either cleared areas or forested areas. A number of areas have been identified as having the potential for previous contaminating activities, which have been excluded from this assessment (refer Drawing 2).

11. Preliminary Waste Classification Assessment

11.1 Discussion

A number of areas of the anticipated impact areas either exposed filling on the ground surface or the results of the preliminary assessment indicated that possible fill / past contaminating activities may have occurred. These are shown on Drawings 2 to 7 in Appendix D. Owing to the limited number of intrusive investigation locations and chemical tests undertaken, combined with the presence of such filling, the comments provided below in relation to waste classification should be treated as preliminary only. Further assessment of the material to be excavated will be required to confirm the suitability of the preliminary waste classifications provided in this report.

Regular inspections during construction are recommended to ensure that the excavated materials are appropriately handled and that if materials different to those expected from this investigation are encountered, they are assessed and appropriately managed. It is also recommended that an unexpected finds protocol be developed for the project, which outlines procedures for appropriate segregation, handling and classification of materials other than those encountered during this investigation.

The previous acid sulfate soil test results and mapping indicates that acid sulfate soil conditions are not present throughout the anticipated impact areas.

Predominantly natural soils were encountered in the bores with the exception of sandy silt fill encountered in Bore 2001, located where the drainage channel alignment crosses the former Pacific Highway alignment.

The majority of natural soil sample results were below the absolute maximum ENM concentration values. In addition, no detectable concentrations of TRH, PAHs, PCB and pesticides were found in the majority of the natural soil samples tested.

On this basis, the natural residual clay soils tested (excluding topsoils) are classified as VENM for re-use on another site or VENM (GSW) for direct disposal to a licensed landfill (if required), subject to stripping of the overlying filling and further inspection and possibly testing at the time of excavation.

It is noted, however, that the filling encountered within Bore 2001, located where the drainage channel alignment crosses the former Pacific Highway alignment, returned PAH concentrations above detection limits together with a concentration based on total concentration (CT1) for benzo (a) pyrene (5.8 mg/kg) above the maximum criteria for "Restricted Solid Waste" of 3.2 mg/kg. It is noted that Bore 2001 is located within close proximity to the spray seal wearing course of the former Pacific Highway. Examination of the sample taken from Bore 2001 indicated that it included some asphalt pieces. It is noted that the underlying natural sandy silt sample (2001/0.4 to 0.5) had detected concentrations of PAH, which would preclude classification as VENM. This material would be classified as GSW based on the total contaminant concentrations, however may be suitable for classification as ENM subject to additional testing in accordance with RRO (EPA, 2014b). It is recommended that this area be treated as a *Hot Spot* and additional investigation is undertaken to determine the extent of the elevated contamination levels and options for disposal / reuse.

Similarly, the sample of near surface soils in Bore 2002 returned PAH and B(a)P concentrations above laboratory detection limits. Hence this material is not considered suitable for a VENM classification and should be disposed of to a licensed landfill as "General Solid Waste" or re-assessed against the NSW EPA, Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 "The Excavated Natural Material Order 2014". RRO (EPA NSW, 2014b) as per natural soils at Bore 2001. Additional assessment would be required in this area of the alignment. It is anticipated that following removal of the surficial soils, say 0.3 m depth and appropriate validation, the underlying natural material in this area would be suitable for classification as VENM.

11.2 Summary

In summary, based on the results of the investigation the majority of the material to be excavated within the anticipated impacted areas are anticipated to be residual soils and underlying bedrock. The residual soils are described as clay, sandy silt, sandy clay or silty clay with the underlying bedrock comprising either basalt within the southern end of the impact areas or sandstone or conglomerate in the northern end of the impact areas.

Based on the results of the history review, subsurface investigation and laboratory testing, it is anticipated that the majority of the soils (excluding topsoils) and bedrock, as described above, to be excavated within the anticipated impact area would be suitable for classification as virgin excavated natural material (VENM).

The materials classified as VENM are pre-classified as General Solid Waste (non-putrescible) under EPA (2014a). Furthermore, VENM imported to the site may be applied to the site without the requirement of a licence under the POEO Act, subject to local planning consents.

A number of areas of the alignment were assessed as having a risk of containing fill, having a potentially contaminating activity in the past or returned chemical contaminant concentrations precluding a VENM classification. Therefore, these areas have been excluded from the assessment and would require additional specific investigation and assessment (including laboratory testing for chemical contaminants) for waste classification to define the extent of filling/chemical impact and options for disposal/reuse. These general areas are shown on Drawings 2 to 7 in Appendix D.

The use of the natural residual clays and underlying bedrock as Virgin Excavated Natural Material (VENM) would be contingent on prior acceptance by the receptor site/relevant authority to receive the material and the receiver site having the necessary consent requirement in place. The natural soils and bedrock should not be mixed/cross contaminated with non-VENM materials (e.g. overlying filling, topsoil or anthropogenic inclusions). During construction an inspection regime should include the following:

- Stripping of the overlying filling over the excavation area;
- Inspection of the exposed soils by a geo-environmental engineer to assess for the presence of material which may affect the VENM classification;
- Supplementary laboratory testing of soil in the event that differing conditions are encountered;
- Regular inspections and testing during construction to ensure that the excavated materials are appropriately handled and that material different to those encountered during the investigation are assessed, if encountered. It is envisaged that a site instruction would be issued to the contractor at the completion of each inspection (or following receipt of laboratory testing (where required) that would identify the classification of the material encountered in the exposed section of excavation and any treatment or handling procedures required.

If during excavation the natural *in situ* soil is found to contain possible signs of contamination or is cross-contaminated with non-VENM materials the excavated natural soil cannot be classified as VENM. In this regard, it is also recommended that care should be taken during the bulk excavation of the VENM to prevent cross contamination between the VENM and non-VENM materials.

Note that appropriate prior arrangement with the receiving site / relevant authorities should be obtained prior to the disposal of any material off site. The receiving site should check to ensure that the material received is suitable for the proposed use, matches the description provided in this report and contains no cross contamination. The receiving site should also check any acceptability restrictions specific to the receiving site such as salinity, ecological requirements (ie confirm material is fit for purpose).

It is noted however that the findings are preliminary due to the limited number of samples tested to date. It is therefore recommended that additional assessment (including subsurface sampling and testing) is undertaken during the detailed design phase or during construction (both within the areas identified as being preliminarily classified as VENM and within areas excluded from this assessment) to confirm the appropriate waste classification and re-use / disposal options.

It is noted that the conditions set out in the relevant general RRO are designed to minimise the risk of potential harm to human health or the environment, however, they do not guarantee that human health or the environment will not be harmed. The suitability of any exempted material should be confirmed with respect to the particular use proposed (i.e. areas fit for purpose), as stated in the relevant exemptions.

12. Recommended Additional Investigation

The preliminary investigation comprised limited intrusive investigation over the length of the grade separated interchange and drainage channel alignment. Therefore the waste classification assessment should be considered preliminary only.

A number of areas of the alignment were assessed as having a risk of containing fill or having a potentially contaminating activity in the past. Therefore, these areas have been excluded from the assessment and would require additional specific investigation and assessment (including laboratory testing for chemical contaminants) for waste classification to define the extent of filling/chemical impact and options for disposal/reuse.

During construction, it is recommended that soils of similar type within each segment of the alignment are stockpiled separately for further assessment to confirm the suitability of the preliminary waste classifications provided in this report.

As discussed in Section 11, regular inspections during construction are recommended to ensure that the excavated materials are appropriately handled and that materials different to those encountered during this investigation are appropriately segregated and assessed, if encountered. It is also recommended that an unexpected finds protocol be developed for the project, which outlines procedures for appropriate segregation, handling and classification of materials other than those encountered during this investigation. The handling, transport and disposal / re-use of the materials should be conducted in accordance with regulatory and statutory requirements

13. References

ASSMAC (1998), New South Wales Acid Sulfate Soil Management Advisory Committee Acid Sulfate Soil Manual.

DP (2016), *Report on Geotechnical Investigation, Proposed Drainage Channel, Kings Hill Development, Pacific Highway, North Raymond Terrace*, Douglas Partners Pty Ltd, Project 81502.03.

DP (2015), *Report on Geotechnical Investigation, Proposed Grade Separated Interchange, Kings Hill Development, Pacific Highway, North Raymond Terrace*, Douglas Partners Pty Ltd, Project 81502.02.

DP (2014), *Report on Preliminary Geotechnical Investigation, Proposed Stormwater Option, Kings Hill Development, Pacific Highway, North Raymond Terrace*, Douglas Partners Pty Ltd, Project 81502 dated June 2014.

NSW EPA (2014a), NSW EPA, *Waste Classification Guidelines – Part 1: Classifying Waste*, November 2014.

NSW EPA (2014b), NSW EPA, Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 *The Excavated Natural Material Order 2014*.

QASSIT (2014), *Soil Management Guidelines v4.0 in Queensland Acid Sulfate Soil Technical Manual* Queensland Department of Science, Information Technology, Innovation and The Arts.

14. Limitations

Douglas Partners (DP) has prepared this report for this project associated with the proposed grade separated interchange and drainage channel at Kings Hill with reference to DP's proposal NCL190481 dated 5 August 2019 and acceptance received from APP Pty Ltd, acting on behalf of PM No 1 Pty Ltd dated 12 August 2019. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of APP Pty Ltd and PM No 1 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, either on the surface of the site, or in filling materials at the test locations sampled. 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/or 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. 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.

Please note that Part 5.6, Section 143 of the Protection of the Environment Operations (POEO) Act 1997 states that it is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that the waste is disposed of appropriately. DP accepts no liability for the unlawful disposal of waste materials from any site.

Douglas Partners Pty Ltd

Appendix A

About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations

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

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

Borehole and Test Pit Logs

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

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

Groundwater

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

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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



Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:
4,6,7
N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:
15, 30/40 mm

Sampling Methods

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

Douglas Partners



Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

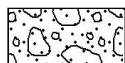
Symbols & Abbreviations

Graphic Symbols for Soil and Rock

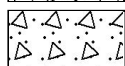
General



Asphalt



Road base



Concrete



Filling

Soils



Topsoil



Peat



Clay



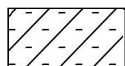
Silty clay



Sandy clay



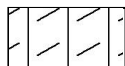
Gravelly clay



Shaly clay



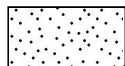
Silt



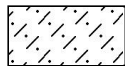
Clayey silt



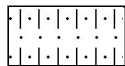
Sandy silt



Sand



Clayey sand



Silty sand



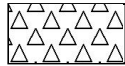
Gravel



Sandy gravel



Cobbles, boulders



Talus

Sedimentary Rocks



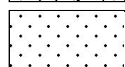
Boulder conglomerate



Conglomerate



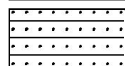
Conglomeratic sandstone



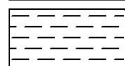
Sandstone



Siltstone



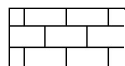
Laminite



Mudstone, claystone, shale

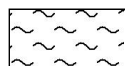


Coal

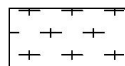


Limestone

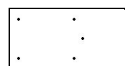
Metamorphic Rocks



Slate, phyllite, schist

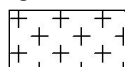


Gneiss

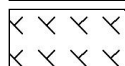


Quartzite

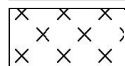
Igneous Rocks



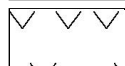
Granite



Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry

Appendix B

Borehole Logs – Bores 2001 to 2008
Relevant Logs from Previous Investigations

BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2001
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.2	FILL / SANDY SILT (SM) - Low plasticity, brown, fine to medium sand with fine to medium sub angular gravel. trace rootlets m<pl		E	0.05		PID <1			
					0.15					
		SANDY SILT (CI) - Medium plasticity, dark grey, mottled red, m<pl hard trace rootlets residual			0.3		pp >450			
					0.4					
				E	0.5		PID <1			
					0.6		pp = 400			
	0.7	SANDY SILT (ML) - low plasticity, pale yellow, mottled red, m<pl still residual			0.8					
				E	0.9		PID <1			
					1.1		pp = 250			
	1.2	Bore discontinued at 1.2m, limit of investigation								

RIG: Hand tools **DRILLER:** Pankhurst **LOGGED:** Gawn **CASING:**
TYPE OF BORING: 70mm diameter hand auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS: side of old highway

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)	

BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2002
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SANDY SILT (SM) - Low plasticity, brown, fine grain sand. m<pl very stiff to hard, trace roots and rootlets			0.1		PID <1 Ants nest at 0.2m			
				E	0.2		pp = 400			
	0.4	CLAY (CI) - Medium plasticity, brown. m<pl very stiff to hard residual			0.5		PID <1			
				E	0.6					
					0.8		pp = 380			
1	1.0	Bore discontinued at 1.0m, limit of investigation								

RIG: Push tube rig

DRILLER: Pankhurst

LOGGED: Pankhurst

CASING:

TYPE OF BORING: 63mm push tube to 1.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2003
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SILTY SAND (SM) - Grey fine to medium grained, dry, residual								
	0.15	CLAY (CI) - Brown, trace silt, M<wp (residual)		E	0.2		PID <1			
				A	0.7					
	0.75	Bore discontinued at 0.75m								
	1									

RIG: Hand tools **DRILLER:** Pankhurst **LOGGED:** Gawn **CASING:**
TYPE OF BORING: 70mm diameter hand auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

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

BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2004
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details		
				Type	Depth	Sample		Results & Comments		
		SILTY CLAY (CH) - Dark brown trace to fine subrounded gravel, m<wp					PID <1			
				E	0.1					
					0.2					
				E	0.5	ASS				PID <1
					0.6					
	0.75	SANDY CLAY (CT) - Trace sub rounded gravel, brown mottled orange, m>wp residual			0.75	ASS				
	0.8	Bore discontinued at 0.8m, limit of investigation								
	-1							-1		

RIG: Hand tools

DRILLER: Pankhurst

LOGGED: Gawn

CASING:

TYPE OF BORING: 70mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: tall grass at location

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U _i	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W _{seep}	Water seep
E	Environmental sample	W _{level}	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s(50) (MPa)
		PL(D)	Point load diametral test (s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2005
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.1	TOPSOIL / SANDY SILT (ML) - Low plasticity brown, m<pl, very stiff to hard trace rootlets		E	0.05		PID <1			
		CLAY (CI) - Medium plasticity, brown trace fine to medium grain sand. m<pl, very stiff residual		D1	0.1					
					0.4		pp = 400			
				E	0.6		PID <1			
					0.7		pp = 300			
1	1.0	Bore discontinued at 1.0m, limit of investigation								

RIG: Push tube rig
DRILLER: Pankhurst
TYPE OF BORING: 63mm push tube to 1.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

LOGGED: Pankhurst **CASING:**

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)

BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2006
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.03	TOPSOIL / SILTY SAND (SM) - Fine to medium grain sand, brown m<pl								
		CLAY (CI) - Medium plasticity, brown trace fine gravels, m<pl, very stiff to hard residual		E	0.05		PID <1			
					0.15					
				E	0.4		pp = 350 PID <1			
					0.5					
		From 0.6m, iron stone bands			0.7		pp = 450			
1	1.0	Bore discontinued at 1.0m, limit of investigation								

RIG: Push tube rig
DRILLER: Pankhurst
TYPE OF BORING: 63mm push tube to 1.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

LOGGED: Pankhurst
CASING:

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

BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2007
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SILTY SAND / SANDY SILT (SM) - Grey mottled light brown fine grained silty sand / sandy silt, residual m<pl		E	0.05 0.1		PID <1			
	0.35	CLAY (CI/CH) - Dark brown clay, trace silt, m<wp residual		E	0.4 0.5		PID <1			
	0.6	SANDY CLAY (CL) - Dark grey to black fine to medium grained sandy clay, m<wp		E	0.6 0.7		PID <1			
	0.75	CLAY (CI/CH) - Grey mottled orange, trace fine to medium grained sand, m<wp residual								
	0.9	Bore discontinued at 0.9m								
	1									

RIG: Hand tools

DRILLER: Pankhurst

LOGGED: Gawn

CASING:

TYPE OF BORING: 70mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

BOREHOLE LOG

CLIENT: PM No 1 Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Kings Hill, North Raymond Terrace

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

BORE No: 2008
PROJECT No: 81502.10
DATE: 12/9/2019
SHEET 1 OF 1

[illegible]

RIG: Hand tools

DRILLER: Gawn

LOGGED: Pankhurst

CASING:

TYPE OF BORING: 70mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U _i	Tube sample (x mm dia.)
C	Core drilling	W _i	Water sample
D	Disturbed sample	W _s	Water seep
E	Environmental sample	W _v	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s(50) (MPa)
		PL(D)	Point load diametral test (s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 10.1 AHD*
EASTING: 386195
NORTHING: 6378240
DIP/AZIMUTH: 90°/--

BORE No: 501
PROJECT No: 81502.03
DATE: 11/8/2015
SHEET 1 OF 1

[illegible]

RIG: Geoprobe 7822 DT

DRILLER: Campbell (T.T)

LOGGED: West

CASING: Nil

TYPE OF BORING: V-bit solid flight auger to 1.8m, TC-bit solid flight auger to 2.6m

WATER OBSERVATIONS: Free groundwater observed at the surface

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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



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BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd

PROJECT: Proposed Overpass Interchange and drainage ch

LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 10.1 AHD

EASTING: 386195

NORTHING: 6378240

DIP/AZIMUTH: 90°/--

BORE No: 501A

PROJECT No: 81502.03

DATE: 11/8/2015

SHEET 1 OF 1

[illegible]

RIG: Geoprobe 7822 DT

DRILLER: Campbell (T.T)

LOGGED: West

CASING: Nil

TYPE OF BORING: Solid flight auger to 1.7, then NMLC coring

WATER OBSERVATIONS: Free groundwater observed at the surface

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _i	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: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 11m AHD*
EASTING: 386258
NORTHING: 6378334
DIP/AZIMUTH: 90°/--

BORE No: 502
PROJECT No: 81502.03
DATE: 12/8/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details		
				Type	Depth	Sample	Results & Comments				
		CLAY - Firm, dark grey clay with some silt and trace fine grained sand, M>Wp From 0.0m to 0.2m, with abundant rootlets							From 0 to 0.25m, concrete		
									From 0.25m to 0.9m, bentonite		
	1				1.0						
				S	1.2		pp = 70-110 0,0,1 N = 1			50mm diamter class 18 blank PVC	
					1.45						
	2										
	2.3	CLAY - Stiff, light grey, clay with some silt, M>Wp From 2.5m, very stiff			2.5						
				S	2.7		pp = 250-350 3,4,8 N = 12				
					2.95						
	3	From 3.0m, dark brown								From 0.9m to 5.0m, gravel	
					4.0						
	4	From 4.0m, with some subrounded to subangular gravel up to 10mm in size			4.2		pp = 450 7,10,18 N = 28			From 2.0m to 5.0m, class 18, 50mm diamter machine slotted PVC	
				S	4.45						
	4.7	AMYGDALOIDAL BASALT - Extremely low strength, extremely weathered, dark brown amygdaloidal basalt (soil like properties)									

RIG: Geoprobe 7822 DT

DRILLER: Campbell (T.T)

LOGGED: West

CASING: Nil

TYPE OF BORING: V-Bit solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: * Surface levels provided by project surveyor

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)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 11m AHD*
EASTING: 386258
NORTHING: 6378334
DIP/AZIMUTH: 90°/--

BORE No: 502
PROJECT No: 81502.03
DATE: 12/8/2015
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		At 5.0m, V-bit refusal	✕ ✕	S	5.0		8,25/80 refusal		End Cap	
	5.23	Bore discontinued at 5.23m, limit of investigation	✕ ✕		5.23					
	6									
	7									
	8									
	9									

RIG: Geoprobe 7822 DT

DRILLER: Campbell (T.T)

LOGGED: West

CASING: Nil

TYPE OF BORING: V-Bit solid flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: * Surface levels provided by project surveyor

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 _s	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	≡	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 13.9m AHD* **BORE No:** 503
EASTING: 386364 **PROJECT No:** 81502.03
NORTHING: 6378553 **DATE:** 13/7/2015
DIP/AZIMUTH: 90°/-- **SHEET 1 OF 1**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.1	TOPSOIL - Generally comprising dark grey silty clay topsoil, some rootlets		D	0.1					
		SILTY CLAY - Dark grey silty clay, trace fine gravel, M>Wp		D	0.5					
	0.9	SANDSTONE - Extremely low strength, extremely weathered brown fine to medium grained sandstone, trace fine gravel (soil like properties)			1.0		26,21/110 refusal			
				S	1.21					
	1.4	BASALT - (High strength), grey-brown basalt			1.5					
	1.5	At 1.50m, start coring		C	1.55		PL (I) = 2.6			
		BASALT - High strength, slightly weathered to moderately weathered grey-brown fractured basalt			1.6					
					2.05		PL(A) = 2.4			
					2.45		PL(A) = 2.1			
					2.95		PL(A) = 3			
					3.05		PL(A) = 4.6			
					3.5		PL(A) = 3.9 PL(D) = 1.1			
					3.8					
					4.35		PL(A) = 4.1 PL(D) = 3.6			
					4.65					
	4.65	Bore discontinued at 4.65m, limit of investigation			4.65					

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Parkinson **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger TC-bit to 1.50m, NMLC Core from 1.50m to 4.65m

WATER OBSERVATIONS: No free groundwater observed in top 1.5m, observations obscured below due to drilling fluids

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.0m AHD* **BORE No:** 504
EASTING: 386434 **PROJECT No:** 81502.03
NORTHING: 6378632 **DATE:** 13/7/2015
DIP/AZIMUTH: 90°/-- **SHEET 1 OF 2**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.05	TOPSOIL - Generally comprising brown clay topsoil, some rootlets								
		CLAY - Stiff, brown clay, trace fine gravel, M>Wp		D	0.5					
	0.75	SANDY CLAY - Hard, orange-brown fine grained sandy clay, trace fine subrounded gravel, M<Wp		S	1.0		pp = 500 5,15,30/120 refusal			From 0 to 1.5m, grout
	1.5	BASALT - (High strength), grey-brown basalt			1.42					
	2.05	At 2.05m, start coring			2.05					
		BASALT - Very high strength, moderately weathered, grey-brown, highly fractured basalt			2.25		PL(D) = 4.4			
		2.40m to 2.70m, medium to high strength		C	2.65		PL (I) = 0.93			
					2.75		PL(D) = 7.1			
	3.3	CORE LOSS - 0.18m			3.3					
	3.48	BASALT - Extremely low strength, highly weathered, brown basalt								From 1.95m to 2.55m, specialised sand 2mm
	3.61	BASALT - Low strength, moderately weathered brown basalt			3.75		PL (I) = 0.35			
	4.0	BASALT - High strength, moderately weathered, grey-brown, highly fractured basalt		C	4.35		PL (I) = 2.9			From 2.55m to 5.05, 50mm machine slotted PVC
					4.6					

RIG: Geoprobe **DRILLER:** Terratec **LOGGED:** Parkinson **CASING:** HW to 2.05m

TYPE OF BORING: Solid flight auger TC-bit to 2.05m, NMLC Core from 2.05m to 5.05m

WATER OBSERVATIONS: No free groundwater observed in top 1.5m, observations obscured below due to drilling fluids

REMARKS: * Surface levels provided by project surveyor

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 _t 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	W Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.0m AHD* **BORE No:** 504
EASTING: 386434 **PROJECT No:** 81502.03
NORTHING: 6378632 **DATE:** 13/7/2015
DIP/AZIMUTH: 90°/-- **SHEET 2 OF 2**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	5.05	Bore discontinued at 5.05m, limit of investigation	✓		5.05				End Cap	
	6									
	7									
	8									
	9									

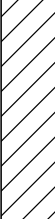
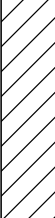
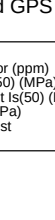
RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Parkinson **CASING:** HW to 2.05m
TYPE OF BORING: Solid flight auger TC-bit to 2.05m, NMLC Core from 2.05m to 5.05m
WATER OBSERVATIONS: No free groundwater observed in top 1.5m, observations obscured below due to drilling fluids
REMARKS: * Surface levels provided by project surveyor

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 _s	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	≡	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.5m AHD* **BORE No:** 505
EASTING: 386490 **PROJECT No:** 81502.03
NORTHING: 6378743 **DATE:** 13/7/2015
DIP/AZIMUTH: 90°/-- **SHEET 1 OF 2**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.1	TOPSOIL - Generally comprising brown silty clay topsoil, some rootlets								
		CLAY - Firm, brown clay, M>Wp								
				D	0.5					
										
	1	From 0.9m, stiff			1.0				1	
				S			2,2,4 N = 6 pp = 140-190			
					1.45					
										
	2								2	
										

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.5m AHD* **BORE No:** 505
EASTING: 386490 **PROJECT No:** 81502.03
NORTHING: 6378743 **DATE:** 13/7/2015
DIP/AZIMUTH: 90°/-- **SHEET 2 OF 2**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SANDSTONE - Extremely low strength, extremely weathered brown fine to medium grained sandstone, friable (soil like properties) <i>(continued)</i>			5.5		18,30/130,bouncing refusal			
	5.78	Bore discontinued at 5.78m, limit of investigation		S	5.78					
	6									
	7									
	8									
	9									

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Parkinson **CASING:** Nil
TYPE OF BORING: Solid flight auger TC-bit to 5.5m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.7m AHD* **BORE No:** 506
EASTING: 386565 **PROJECT No:** 81502.03
NORTHING: 6378819 **DATE:** 13/7/2015
DIP/AZIMUTH: 90°/-- **SHEET 1 OF 2**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.1	TOPSOIL - Generally comprising brown silty clay topsoil with some fine rootlets								
		CLAY - Stiff, brown clay, trace fine rootlets in parts, M>Wp		D	0.5					From 0.0m to 0.4m, Bentonite
	1				1.0					
	1.35	SANDY CLAY - Very stiff, grey mottled orange in parts, fine grained sandy clay, M>Wp		S	1.35		3.5.8 N = 13 pp = 150-170			From 0.4m to 2.3m, Clay backfill
					1.45		pp = 450			
					1.5					
	2			D	2.0					
	2.5	CLAY - Very stiff, red-pink speckled grey-white clay, M>Wp		S	2.5		pp = 370-400 5,7,10 N = 17			From 2.3m to 2.8m, Bentonite
	3				2.95					
				D	3.5					
	4	From 4.0m, hard, trace, fine to medium grained sand			4.0		pp = 550 7,12,16 N = 28			From 2.8m to 6.0m, Specialised Sand From 3.0m to 6.0m, 50mm machine slotted PVC
				S	4.45					
				D	5.0					

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Parkinson **CASING:** Nil
TYPE OF BORING: Solid flight auger TC-bit to 6.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface levels provided by project surveyor

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 _t	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W _L	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.7m AHD* **BORE No:** 506
EASTING: 386565 **PROJECT No:** 81502.03
NORTHING: 6378819 **DATE:** 13/7/2015
DIP/AZIMUTH: 90°/-- **SHEET 2 OF 2**

[illegible]

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Parkinson **CASING:** Nil
TYPE OF BORING: Solid flight auger TC-bit to 6.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface levels provided by project surveyor

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 _i	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 14.8m AHD* **BORE No:** 507
EASTING: 386686 **PROJECT No:** 81502.03
NORTHING: 6378928 **DATE:** 18/6/2015
DIP/AZIMUTH: 90°/-- **SHEET 1 OF 2**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SANDY SILT - (Soft to firm), grey, fine to medium grained sandy silt, moist								
	0.7	SANDY CLAY - Very stiff, grey fine to medium grained sandy clay, with trace subrounded to subangular gravel, up to 20mm in size, M>Wp			1.0					
				S	1.3		4,8,14 N = 22 pp = 500			
					1.45					
	1.7	SANDY CLAY - Hard, light grey, fine to medium grained sandy clay, M<Wp			2.5		14,25/13 refusal			
				S	2.78					
	3.0	BOULDER - High strength, highly weathered, light grey, possible basalt boulder								
	3.3	CLAY - Very stiff, orange-brown clay, with some fine to medium grained sand, with some silt, trace gravel, with subrounded to subangular gravel up to 20mm in size, M>Wp			4.0					
		From 4.0m to 5.0m, light grey		S	4.2		pp = 350-450 6,8,11 N = 19			
					4.45					

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: Nil

TYPE OF BORING: Solid flight auger to 6.45m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

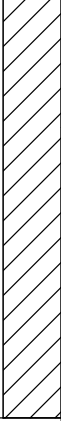
SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 14.8m AHD* **BORE No:** 507
EASTING: 386686 **PROJECT No:** 81502.03
NORTHING: 6378928 **DATE:** 18/6/2015
DIP/AZIMUTH: 90°/-- **SHEET 2 OF 2**

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		CLAY - Very stiff, orange-brown clay, with some fine to medium grained sand, with some silt, trace gravel, with subrounded to subangular gravel up to 20mm in size, M>Wp (continued)		S	5.0		12,15,15 N = 30 pp = 400			
					5.3					
					5.45					
	6				6.0					
				S	6.3		10,6,25 N = 31 pp = 350			
	6.45	Bore discontinued at 6.45m, limit of investigation			6.45					
	7									
	8									
	9									

RIG: Bobcat mounted DT250 **DRILLER:** S.Younan (GT) **LOGGED:** West **CASING:** Nil
TYPE OF BORING: Solid flight auger to 6.45m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd

PROJECT: Proposed Overpass Interchange and drainage ch

LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.0m AHD*

EASTING: 386667

NORTHING: 6379076

DIP/AZIMUTH: 90°/--

BORE No: 508

PROJECT No: 81502.03

DATE: 18/6/2015

SHEET 1 OF 2

[illegible]

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: Nil

TYPE OF BORING: Solid flight auger to 4.10m then NMLC coring

WATER OBSERVATIONS: No free groundwater observed whilst augering, then obscured by drilling fluids

REMARKS: * Surface levels provided by project surveyor

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 _s	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)



5945

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd

PROJECT: Proposed Overpass Interchange and drainage ch

LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.0m AHD*

EASTING: 386667

NORTHING: 6379076

DIP/AZIMUTH: 90°/--

BORE No: 508

PROJECT No: 81502.03

DATE: 18/6/2015

SHEET 2 OF 2

[illegible]

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: Nil

TYPE OF BORING: Solid flight auger to 4.10m then NMLC coring

WATER OBSERVATIONS: No free groundwater observed whilst augering, then obscured by drilling fluids

REMARKS: * Surface levels provided by project surveyor

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 _s	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)



5946

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 12.3m AHD*
EASTING: 386802
NORTHING: 6379370
DIP/AZIMUTH: 90°/--

BORE No: 509
PROJECT No: 81502.03
DATE: 1/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)
				Type	Depth	Sample	Results & Comments		
		SILTY CLAY - Firm, grey-brown silty clay, trace fine to medium grained sand and rootlets, M>Wp							
		From 0.3m, stiff		D	0.5				
		From 0.75m, very stiff		D	1.0				
		From 1.3m, trace medium sized gravel		D	1.8				
-2	2.0	Bore discontinued at 2.0m, slow progress							
-3									
-4									

RIG: Hand Tools

DRILLER: Parkinson/West

LOGGED: Parkinson

CASING: Nil

TYPE OF BORING: 75mm diameter hand auger

WATER OBSERVATIONS: Free groundwater observed at 400mm above surface

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 12.9m AHD*
EASTING: 386952
NORTHING: 6379594
DIP/AZIMUTH: 90°/--

BORE No: 510
PROJECT No: 81502.03
DATE: 26/8/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.3	SANDY SILT - Firm, brown fine grained sandy silt, trace rootlets and clay, M<Wp								
		SANDY CLAY - Stiff, brown mottled orange in parts, sandy clay, trace silt, M>Wp		D	0.5					From 0.0m to 0.8m, bentonite 50mm diameter blank PVC
	1				1.0					
				S	1.45		pp = 180 2,3,4 N = 7			
	2									From 0.8m to 3.0m, 5mm specialised sand From 1.0m to 3.0m, 50mm diameter machine slotted PVC
		From 2.55m, very stiff, grey mottled orange-red			2.55		pp = 270-300 3,4,5 N = 9			
	3			S						
	3.0	Bore discontinued at 3.0m, limit of investigation			3.0					End Cap at 3.0m
	4									

RIG: Geoprobe

DRILLER: Campbell (T.T)

LOGGED: Parkinson

CASING: Nil

TYPE OF BORING: Solid flight auger Vbit to 3.00m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	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	W _s	Water seep	S	Standard penetration test
E	Environmental sample	W _L	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 14.6m AHD* **BORE No:** 511
EASTING: 387071 **PROJECT No:** 81502.03
NORTHING: 6379754 **DATE:** 26/8/2015
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

[illegible]

RIG: Geoprobe **DRILLER:** Campbell (T.T) **LOGGED:** Parkinson **CASING:** Nil
TYPE OF BORING: Solid flight auger Vbit to 3.00m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface levels provided by project surveyor

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



BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.9 AHD
EASTING: 386514
NORTHING: 6379071
DIP/AZIMUTH: 90°/--

BORE No: 601
PROJECT No: 81502.02
DATE: 13/8/2015
SHEET 1 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %	RQD %	Test Results & Comments																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
	0.3	SILTY SAND - (Medium dense), light grey fine to medium grained silty fine to medium grained sand, humid																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		</

RIG: Geoprobe 7822 DT

DRILLER: Campbell (TT)

LOGGED: West

CASING: HW to 2.8m

TYPE OF BORING: Solid flight auger to 11.50m, then NMLC coring

WATER OBSERVATIONS: Free groundwater observed at 8.7m whilst augering

REMARKS: 50% water loss from 13.3m, 70% water loss from 15.6m * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.9 AHD
EASTING: 386514
NORTHING: 6379071
DIP/AZIMUTH: 90°/-

BORE No: 601
PROJECT No: 81502.02
DATE: 13/8/2015
SHEET 2 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %	RQD %	Test Results & Comments																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
		CLAY - Very stiff grey mottled brown clay with some silt (continued)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</

RIG: Geoprobe 7822 DT

DRILLER: Campbell (TT)

LOGGED: West

CASING: HW to 2.8m

TYPE OF BORING: Solid flight auger to 11.50m, then NMLC coring

WATER OBSERVATIONS: Free groundwater observed at 8.7m whilst augering

REMARKS: 50% water loss from 13.3m, 70% water loss from 15.6m * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.9 AHD
EASTING: 386514
NORTHING: 6379071
DIP/AZIMUTH: 90°/--

BORE No: 601
PROJECT No: 81502.02
DATE: 13/8/2015
SHEET 3 OF 5

[illegible]

RIG: Geoprobe 7822 DT

DRILLER: Campbell (TT)

LOGGED: West

CASING: HW to 2.8m

TYPE OF BORING: Solid flight auger to 11.50m, then NMLC coring

WATER OBSERVATIONS: Free groundwater observed at 8.7m whilst augering

REMARKS: 50% water loss from 13.3m, 70% water loss from 15.6m * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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



BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.9 AHD
EASTING: 386514
NORTHING: 6379071
DIP/AZIMUTH: 90°/--

BORE No: 601
PROJECT No: 81502.02
DATE: 13/8/2015
SHEET 4 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)			Discontinuities		Sampling & In Situ Testing					
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type
		AMYGDALOIDAL BASALT - Medium strength, highly weathered brown amygdaloidal basalt with healed joints and microfracturing (continued)																							
		From 15.02m to 15.09, very low strength																							
		From 15.14m to 15.25m, very low strength																							
		From 15.25m, medium strength																							
		From 15.40 to 15.98m, extremely low strength, extremely weathered																							
		From 15.98m to 16.03m, very low strength, highly weathered																							
		From 16.03m to 16.07m, extremely low strength, extremely weathered																							
		From 16.07m to 16.10m, very high strength																							
		From 16.10m to 16.63m, very low to low strength																							
		From 16.63m, medium strength																							
		CORE LOSS - 0.32m																							
													</												

RIG: Geoprobe 7822 DT

DRILLER: Campbell (TT)

LOGGED: West

CASING: HW to 2.8m

TYPE OF BORING: Solid flight auger to 11.50m, then NMLC coring

WATER OBSERVATIONS: Free groundwater observed at 8.7m whilst augering

REMARKS: 50% water loss from 13.3m, 70% water loss from 15.6m * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.9 AHD
EASTING: 386514
NORTHING: 6379071
DIP/AZIMUTH: 90°/--

BORE No: 601
PROJECT No: 81502.02
DATE: 13/8/2015
SHEET 5 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
			EW	HW	MW	SW		FS	FR	Ex Low	Very Low	Low			Medium	High	Very High	Ex High	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %	RQD %	Test Results & Comments																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
		AMYGDALOIDAL BASALT - Medium strength, highly weathered brown amygdaloidal basalt (continued) At 20.05m, 20mm thick quartz vein At 20.15m, 20mm thick quartz vein																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					

RIG: Geoprobe 7822 DT

DRILLER: Campbell (TT)

LOGGED: West

CASING: HW to 2.8m

TYPE OF BORING: Solid flight auger to 11.50m, then NMLC coring

WATER OBSERVATIONS: Free groundwater observed at 8.7m whilst augering

REMARKS: 50% water loss from 13.3m, 70% water loss from 15.6m * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 17.0 AHD
EASTING: 386544
NORTHING: 6379056
DIP/AZIMUTH: 90°/--

BORE No: 602
PROJECT No: 81502.02
DATE: 25 - 26/8/2015
SHEET 1 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing						
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %	RQD %
17	0.2	FILLING - Generally comprising dark grey fine grained sandy silt filling, some rootlets, wet																									
		SANDY CLAY - Very stiff, grey mottled orange-brown fine to coarse grained sandy clay, trace fine subrounded gravel, M>Wp																									
16	1																					S					pp = 250-300 4,6,7 N = 13
15	2																										
	2.5	SANDY CLAY - Hard, grey-brown medium to coarse grained sandy clay, trace to some fine to medium sized gravel, M<Wp (weathered rock like properties)																				S					pp = 400 12,14,20 N = 34
14	3																										
13	4	SANDY CLAY - Very stiff, brown mottled orange fine grained sandy clay, trace coarse gravel, M<Wp																				S					pp = 300 8,7,9 N = 16

RIG: Geoprobe **DRILLER:** Campbell (T.T) **LOGGED:** Parkinson **CASING:** HQ to 8.4m
TYPE OF BORING: Solid flight auger TC-bit 0m to 11.50m, solid flight auger V-bit 11.50m to 12.1m refusal, TC-bit 12.1m to 13.0m, NMLC core
WATER OBSERVATIONS: Seepage from surface (Dish drain)
REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 17.0 AHD
EASTING: 386544
NORTHING: 6379056
DIP/AZIMUTH: 90°/--

BORE No: 602
PROJECT No: 81502.02
DATE: 25 - 26/8/2015
SHEET 2 OF 5

[illegible]

RIG: Geoprobe

DRILLER: Campbell (T.T)

LOGGED: Parkinson

CASING: HQ to 8.4m

TYPE OF BORING: Solid flight auger TC-bit 0m to 11.50m, solid flight auger V-bit 11.50m to 12.1m refusal, TC-bit 12.1m to 13.0m, NMLC core

WATER OBSERVATIONS: Seepage from surface (Dish drain)

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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



BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 17.0 AHD
EASTING: 386544
NORTHING: 6379056
DIP/AZIMUTH: 90°/--

BORE No: 602
PROJECT No: 81502.02
DATE: 25 - 26/8/2015
SHEET 3 **OF** 5

[illegible]

RIG: Geoprobe

DRILLER: Campbell (T.T)

LOGGED: Parkinson

CASING: HQ to 8.4m

TYPE OF BORING: Solid flight auger TC-bit 0m to 11.50m, solid flight auger V-bit 11.50m to 12.1m refusal, TC-bit 12.1m to 13.0m, NMLC core

WATER OBSERVATIONS: Seepage from surface (Dish drain)

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

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



BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 17.0 AHD
EASTING: 386544
NORTHING: 6379056
DIP/AZIMUTH: 90°/--

BORE No: 602
PROJECT No: 81502.02
DATE: 25 - 26/8/2015
SHEET 4 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing					
			EW	HW	MW	SW		FS	FR	Ex Low	Very Low	Low			Medium	High	Very High	Ex High	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %
		AMYGDALOIDAL BASALT - Medium strength, slightly weathered brown fractured amygdaloidal basalt, tight healed micro-fracturing in parts <i>(continued)</i> From 15.12, slightly fractured																				PL(A) = 0.36
																						PL(A) = 1.2
	16																	C	100	83	PL(I)= 0.40 PL(A) = 0.42 PL(D) = 0.18	
		From 16.72m, fractured																				PL(A) = 0.89 PL(D) = 0.27
	17																					
		From 17.35m, grey																C	100	83	PL(A) = 0.83	
	18																					
		From 17.84m, slightly fractured																				
		From 18.0m to 18.5m, low to medium strength																				PL(A) = 0.62
	19																					
		From 19.65m, low strength																				
		From 19.81m to 19.85m, clay seam																				
	20.0																					19.7m: J, 40°, pl, un clay 19.81m to 19.85m, Cs, 10°, pl, inf,

RIG: Geoprobe **DRILLER:** Campbell (T.T) **LOGGED:** Parkinson **CASING:** HQ to 8.4m
TYPE OF BORING: Solid flight auger TC-bit 0m to 11.50m, solid flight auger V-bit 11.50m to 12.1m refusal, TC-bit 12.1m to 13.0m, NMLC core
WATER OBSERVATIONS: Seepage from surface (Dish drain)
REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 17.0 AHD
EASTING: 386544
NORTHING: 6379056
DIP/AZIMUTH: 90°/-

BORE No: 602
PROJECT No: 81502.02
DATE: 25 - 26/8/2015
SHEET 5 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing			
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	B - Bedding S - Shear	J - Joint D - Drill Break	Type
20.25	20.25	From 19.9m, very low strength, highly weathered						X	X												PL(A) = 0.21
		AMYGDALOIDAL BASALT - Low strength, slightly weathered grey amygdaloidal basalt						X	X												PL(A) = 0.37
		AMYGDALOIDAL BASALT - Medium strength, slightly weathered grey slightly fractured grey amygdaloidal basalt with some calcite veins 1mm in width generally bedded 0 - 10°																C	100	95	
21	21	BASALT - Very high strength, fresh, grey fractured basalt						X	X												PL(D) = 3.1
		From 21.75m, slightly fractured						X	X												PL(D) = 3.7
22	22							X	X									C	100	78	PL(D) = 3.4
	22.55	AMYGDALOIDAL BASALT - High strength, fresh, grey amygdaloidal basalt						X	X												PL(A) = 3
	22.8	Bore discontinued at 22.8m, limit of investigation						X	X												PL(A) = 1.6
23	23																				
24	24																				

RIG: Geoprobe **DRILLER:** Campbell (T.T) **LOGGED:** Parkinson **CASING:** HQ to 8.4m
TYPE OF BORING: Solid flight auger TC-bit 0m to 11.50m, solid flight auger V-bit 11.50m to 12.1m refusal, TC-bit 12.1m to 13.0m, NMLC core
WATER OBSERVATIONS: Seepage from surface (Dish drain)
REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.2 AHD
EASTING: 386570
NORTHING: 6379044
DIP/AZIMUTH: 90°/--

BORE No: 603
PROJECT No: 81502.02
DATE: 15/6/2015
SHEET 1 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing					
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %
16		CLAY - Very stiff, light grey clay, with some silt and trace fine grained sand, M>Wp																								
1		From 1.15m, hard sandy, with fine grained sand																				S				pp >530 4.25,- refusal
1.7		SANDSTONE - Dark grey, fine to coarse grained sandstone																								
2																										
2.1		SANDSTONE - Medium strength, slightly weathered, dark grey, fine to coarse grained sandstone																								PL(D) = 0.49
2.38		CONGLOMERATE - Extremely low strength, extremely weathered, yellow-brown conglomerate (soil like properties)																								
2.52		CORE LOSS - 1.28m																								
3																						C	25	0		
3.8		CLAYSTONE / CLAY - Extremely low strength, extremely weathered, orange-brown claystone / clay (soil like properties)																								pp = 350-400
4																						C	100	0		pp = 350-400

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: HW to 2.0m

TYPE OF BORING: Solid flight auger to 2.0m, then wash boring to 2.1m, then NMLC coring

WATER OBSERVATIONS: No free groundwater observed whilst augering, then obscured by drilling fluids

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.2 AHD
EASTING: 386570
NORTHING: 6379044
DIP/AZIMUTH: 90°/--

BORE No: 603
PROJECT No: 81502.02
DATE: 15/6/2015
SHEET 2 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing						
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %	RQD %
11	5.3	BASALT - Extremely low strength, extremely weathered, brown mottled orange brown basalt																								pp = 350-400	
6																											
10																											
	6.63	CORE LOSS - 0.17m																									
	6.8	BASALT - Extremely low to very low strength, highly weathered, orange-brown basalt with iron stained healed joints and microfracturing																								PL(D) = 0.04	
7																											
9																											
	8	From 8.25m to 8.50m, low strength																								PL(A) = 0.28	
8																											
	9																										
	7																										

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: HW to 2.0m

TYPE OF BORING: Solid flight auger to 2.0m, then wash boring to 2.1m, then NMLC coring

WATER OBSERVATIONS: No free groundwater observed whilst augering, then obscured by drilling fluids

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.2 AHD
EASTING: 386570
NORTHING: 6379044
DIP/AZIMUTH: 90°/-

BORE No: 603
PROJECT No: 81502.02
DATE: 15/6/2015
SHEET 3 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing			
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	B - Bedding S - Shear	J - Joint D - Drill Break	Type
	6	BASALT - Extremely low to very low strength, highly weathered, orange-brown basalt with iron stained healed joints and microfracturing <i>(continued)</i>															10.17m: J, 10°, pl, ro From 10.24m to 10.37m, fg				PL(D) = 0.02
	10.57	CORE LOSS - 0.28m															10.42m: P, 5°, pl, ro From 10.50m to 10.52m, fg 10.57m: CORE LOSS: 280mm	C	100	0	pp = 400
	10.85	BASALT - Low strength, highly weathered, dark brown basalt															From 10.91m to 11.10m, fg				PL(A) = 0.1
	11	From 11.18m to 11.37m, extremely low strength, extremely weathered From 11.37m, low to medium strength															11.18m: P, sh, un, ro, fe From 11.30m to 12.35m, fg	C	200	0	
	12	From 11.80m to 11.91m, extremely low strength, extremely weathered to highly weathered From 11.91m to 12.15m, low to medium strength From 12.15m to 12.35m, medium to high strength, highly weathered From 12.35m to 12.62m, extremely low strength, extremely weathered From 12.62m to 13.0m, medium to high strength, highly weathered																			
	13	From 13.00m to 13.14m, low strength, highly weathered From 13.14m, extremely low strength, extremely weathered From 13.25m to 13.66m, medium to high strength, highly weathered															13.04m: J, 70°, pl, ro 13.1m: J, 10°, pl, ro From 13.14m to 13.25m, fg From 13.25m to 13.77m, fg				PL(A) = 0.22
	14	From 13.78m to 14.0m, extremely low strength, extremely weathered From 14.00m to 14.20m, low to medium strength From 14.20m to 14.48m, medium strength From 14.40m to 14.60m, very low strength From 14.60m to 15.10m, low strength															From 13.87m to 14.20m, fg From 14.23m to 14.30m, fg From 14.36m to 14.82m, fg	C	100	0	PL(A) = 0.43
																	14.83m: J, 30°, pl, ro, fe 14.89m: J, 35°, pl, ro, fe				

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: HW to 2.0m

TYPE OF BORING: Solid flight auger to 2.0m, then wash boring to 2.1m, then NMLC coring

WATER OBSERVATIONS: No free groundwater observed whilst augering, then obscured by drilling fluids

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.2 AHD
EASTING: 386570
NORTHING: 6379044
DIP/AZIMUTH: 90°/--

BORE No: 603
PROJECT No: 81502.02
DATE: 15/6/2015
SHEET 4 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing				
			EW	HW	MW	SW		FS	FR	Ex Low	Very Low	Low			Medium	High	Very High	Ex High	B - Bedding S - Shear	J - Joint D - Drill Break	Type
		BASALT - Low strength, highly weathered, dark brown basalt (continued) From 15.10m to 15.35m, extremely low strength, extremely weathered From 15.35m to 15.42m, very low strength															14.95m: J, 10°, pl, ro, fe From 15.0m to 15.10m, fg	C	100	0	PL(A) = 0.16
	15.61	AMYGDALOIDAL BASALT - Low strength, highly weathered, dark grey-brown amygdaloidal basalt, with subangular mineral pebbles up to 20mm in size From 15.94m, extremely low strength, extremely weathered															From 15.60m to 15.76m, fg From 15.94m to 16.96m, fg	C	1.25	14	
	16.06	AMYGDALOIDAL BASALT - Very low strength, highly weathered, dark grey amygdaloidal basalt, with subangular mineral pebbles up to 20mm in size From 16.52m to 16.62m, medium strength From 16.62m, very low strength															From 16.36m to 16.42m, fg 16.42m: J, 60°, pl, ro, fe From 16.42m to 16.35m, fg	C	100	23	
	16.95	AMYGDALOIDAL BASALT - High strength, fresh, blue-grey basalt, amygdaloidal basalt															From 16.85m to 16.95, fg 16.95m: J, 10°, pl, ro 17.06m: J, 20°, pl, ro 17.07m: J, 80°, pl, ro 17.14m: J, 60°, pl, ro From 17.23m to 17.29m, fg 17.29m: J, 30°, pl, ro, fe From 17.41m to 17.48m, fg 17.48m: J, 30°, pl, ro 17.54m: J, 20°, pl, ro 17.56m: J, 30°, pl, ro 17.64m: J, 40°, pl, ro 17.71m: J, 20°, pl 17.77m: J, 80°, pl, ro 17.8m: J, 20°, pl, ro 17.82m: J, 30°, pl, ro 17.85m: J, 80°, pl, ro 17.92m: J, 40°, pl, ro From 17.95m to 18.06m, fg 18.09m: J, 80°, pl, ro From 18.17m to 18.35m, fg From 18.35m to 18.61m, fg 18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	18.26	COAL - Medium strength, fresh, black coal From 18.26m to 18.27m, extremely low strength, extremely weathered, mudstone															From 18.35m to 18.61m, fg	C	100	0	
	18.52	MUDSTONE - Medium strength, highly weathered, brown mudstone															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	18.72	MUDSTONE - Medium strength, highly weathered, brown mudstone															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	18.8	From 18.61m, extremely low strength, extremely weathered															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	18.89	From 18.61m, extremely low strength, extremely weathered															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	19.0	COAL - Medium, fresh, black coal From 18.74m to 18.76m, mudstone band															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	19.51	MUDSTONE - Extremely low strength, extremely weathered, brown mudstone															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	19.78	COAL - Medium strength, fresh, black coal															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	19.78	CORE LOSS - 0.51m															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	
	19.78	COAL - Medium strength, fresh, black coal															18.74m: J, 40°, pl, ro 18.76m: J, 30°, pl, ro 18.8m: J, 30°, pl, ro From 18.80m to 19.00m, fg 19m: CORE LOSS: 510mm	C	100	0	

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: HW to 2.0m

TYPE OF BORING: Solid flight auger to 2.0m, then wash boring to 2.1m, then NMLC coring

WATER OBSERVATIONS: No free groundwater observed whilst augering, then obscured by drilling fluids

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)
BLK Block sample	U 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	W Water seep	S Standard penetration test
E Environmental sample	W Water level	V Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.2 AHD
EASTING: 386570
NORTHING: 6379044
DIP/AZIMUTH: 90°/--

BORE No: 603
PROJECT No: 81502.02
DATE: 15/6/2015
SHEET 5 OF 5

[illegible]

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: HW to 2.0m

TYPE OF BORING: Solid flight auger to 2.0m, then wash boring to 2.1m, then NMLC coring

WATER OBSERVATIONS: No free groundwater observed whilst augering, then obscured by drilling fluids

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PI	Photo ionisation detector (ppm)
		AI	Alpha Point load test (ISO) (MPa)
		PL	Point load diametral test (ISO) (MPa)
		PP	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.4 AHD
EASTING: 386628
NORTHING: 6379007
DIP/AZIMUTH: 90°/--

BORE No: 604
PROJECT No: 81502.02
DATE: 18/6/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing												
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %	RQD %	Test Results & Comments					
15	0.7 1 14 2 13 2.75 3 3.0	SANDY SILT - (Firm), grey-brown, fine to coarse grained sandy silt, M>Wp																															
		CLAY - Stiff, grey-brown clay, with some silt and trace fine grained sand, M>Wp																															
		From 1.0m, very stiff																					S										3,6,12 N = 18 pp = 250-350
		From 1.7m, hard sandy, with fine to medium grained sand and trace subrounded to subangular gravel up to 10mm in size, M<Wp																															
		From 2.5m, grading to rock																					S										13,25/90,- refusal
		BASALT - (High strength, highly weathered) grey basalt																															
		Bore discontinued at 3.0m, TC-Bit refusal																															
12																																	
4																																	
11																																	

RIG: Bobcat mounted DT250

DRILLER: S.Younan (GT)

LOGGED: West

CASING: Nil

TYPE OF BORING: Solid flight auger to 3m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	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	W _s	Water seep	S	Standard penetration test
E	Environmental sample	W _L	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 13.1 AHD
EASTING: 386806
NORTHING: 6379426
DIP/AZIMUTH: 90°/--

BORE No: 701
PROJECT No: 81502.02
DATE: 1/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)
				Type	Depth	Sample	Results & Comments		
13	0.15	CLAYEY SILT - Soft, grey-brown clayey silt with abundant rootlets, M>Wp		D	0.5				
		SILTY CLAY - Firm, grey-brown silty clay, trace fine to medium grained sand and rootlets, M>Wp From 0.3m, stiff							
	0.7	CLAY - Very stiff, grey-brown clay, some silt, M>Wp							
1									
12	1.3	SANDY CLAY - Very stiff to hard, grey-brown fine to coarse grained sandy clay, trace silt and fine gravel, M>Wp		D	1.4				
	1.5	From 1.4m, slightly gravelly Bore discontinued at 1.5m, slow progress							
2									
11									
3									
10									
4									
5									

RIG: Hand Tools

DRILLER: Parkinson/West

LOGGED: Parkinson

CASING: Nil

TYPE OF BORING: 75mm diameter hand auger

WATER OBSERVATIONS: Free groundwater observed at 250mm above surface

REMARKS: * Surface levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

SAMPLING & IN SITU TESTING LEGEND

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

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 14.4 AHD
EASTING: 386617
NORTHING: 6379264

PIT No: 702
PROJECT No: 81502.02
DATE: 30/7/2015
SHEET 1 **OF** 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)					
				Type	Depth	Sample	Results & Comments		5	10	15	20		
14	0.1	TOPSOIL - Generally comprising grey fine to medium grained sandy clay topsoil, some rootlets		B										
		SANDY CLAY - Stiff to very stiff, grey fine to medium grained sandy clay with trace rootlets and roots up to 0.7m depth, M>Wp			0.3		pp = 330							
					0.5		pp = 280							
	1	1.0	SANDY CLAY - Very stiff pale grey mottled red, fine to medium grained sandy clay, M>Wp			1.0		pp = 280		1				
13					1.3		pp = 280							
2	2.0	Pit discontinued at 2.0m, limit of investigation			1.9		pp = 320		2					

RIG: Backhoe, 450mm bucket with teeth

LOGGED: Parkinson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _x	Tube sample (x mm dia.)	PL(P)	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)



TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 17.7 AHD
EASTING: 386455
NORTHING: 6379045

PIT No: 703
PROJECT No: 81502.02
DATE: 30/7/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	TOPSOIL - Generally comprising grey fine grained sandy silt topsoil, some rootlets										
		SILTY SAND - Loose, grey mottled orange fine to medium grained silty sand, trace fine gravel, moist										
	0.4			D	0.3		pp = 180					
		SANDY CLAY - Stiff to very stiff, grey mottled orange fine to medium grained sandy clay, M>Wp										
				B	0.5		pp = 220					
					0.6							
17												
					1.0		pp = 220					
1												
		From 1.4m, hard			1.4		pp = 450					
	1.6											
16		SANDSTONE - Extremely low strength, extremely weathered grey sandstone, friable (soil like properties in parts)										
	1.8	Pit discontinued at 1.8m, limit of investigation										
2												
15												

RIG: Backhoe, 450mm bucket with teeth

LOGGED: Parkinson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	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)

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 16.2 AHD
EASTING: 386533
NORTHING: 6378867

PIT No: 704
PROJECT No: 81502.02
DATE: 30/7/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
16	0.2	TOPSOIL - Generally comprising brown sandy silt topsoil, some rootlets, moist										
		CLAY - Stiff, grey mottled red clay, trace fine to medium grained sand, M>Wp			0.2		pp = 120					
				D	0.5		pp = 150					
				D	0.9		pp = 200					
15	1.4	SANDY CLAY - Hard, grey mottled orange-red medium grained sandy clay with trace cobbles, M<Wp (rock like properties in parts)										
				D	1.8		pp = 400-500					
14	2.0	Pit discontinued at 2.0m, limit of investigation										

RIG: Backhoe, 450mm bucket with teeth

LOGGED: Parkinson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

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

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 15.1 AHD
EASTING: 386378
NORTHING: 6378798

PIT No: 705
PROJECT No: 81502.02
DATE: 30/7/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
15	0.15	TOPSOIL - Generally comprising brown clay topsoil with some fine grained sand and rootlets										
		CLAY - Stiff to very stiff, brown clay with trace to some fine grained sand and silt, trace rootlets, M>Wp			0.3		pp = 260-310					
		From 0.5m, stiff			0.5		pp = 190-210					
				B	0.8							
					0.9		pp = 180-250					
1	1.1	SANDY CLAY - Very stiff, pale grey-brown fine grained sandy clay trace medium sized gravel, M>Wp			1.4		pp = 280-350					
				D	1.5							
		From 1.8m, hard grey, M<Wp (rock like properties)		D	1.8		pp = 450					
2	2.0	Pit discontinued at 2.0m, limit of investigation										

RIG: Backhoe, 450mm bucket with teeth

LOGGED: Parkinson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

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

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 12.7 AHD
EASTING: 386302
NORTHING: 6378644

PIT No: 706
PROJECT No: 81502.02
DATE: 30/7/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.15	TOPSOIL - Generally comprising grey clay topsoil with some roots and rootlets, wet										
		CLAY - Firm to stiff, grey clay with trace rootlets, fine grained sand and silt, M>Wp			0.3		pp = 100-120					
		From 0.5m, stiff		B	0.5		pp = 150					
					0.9		pp = 130					
1	1.0	GRAVELLY CLAY - Very stiff pale grey mottled orange gravelly clay, gravel subrounded generally medium to coarse sized with some fine grained sand, M<Wp		D	1.2		pp = 220-240					
2	2.0	Pit discontinued at 2.0m, limit of investigation										

RIG: Backhoe, 450mm bucket with teeth

LOGGED: Parkinson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Drain from the highway approximately 8m to the east, * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

SAMPLING & IN SITU TESTING LEGEND

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

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Grade Separated Interchange
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: 13.2 AHD
EASTING: 386337
NORTHING: 6378558

PIT No: 707
PROJECT No: 81502.02
DATE: 30/7/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
13		FILLING - Generally comprising grey-brown fine to medium grained sandy gravelly clay filling, gravel generally medium sized, fine to medium grained sand, some rootlets		D	0.2							
	0.35	CLAY - Stiff brown clay, some silt, M>Wp			0.35		pp = 150					
		At 0.45m, tree root		B	0.5		pp = 250					
		From 0.5m, stiff to very stiff										
1	1.0	CLAY - Very stiff, grey mottled orange-red clay, some fine to medium grained sand, M>Wp			1.0		pp = 280	1				
12				D	1.5		pp = 280-300					
2	2.0	Pit discontinued at 2.0m, limit of investigation			2.0		pp = 250	2				
11												

RIG: Backhoe, 450mm bucket with teeth

LOGGED: Parkinson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Surface Levels provided by Hyder based on hand held GPS coordinates and interpolation of detailed survey

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

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

BOREHOLE LOG

CLIENT: Northrop Consulting Engineers Pty Ltd
PROJECT: Proposed Stormwater Option
LOCATION: Kings Hill Development, North Raymond Terrace

SURFACE LEVEL: --
EASTING: 386280
NORTHING: 6378450
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 81502
DATE: 15/4/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.4	FILLING - Generally comprising brown sandy gravel filling, fine to medium grained sand, fine to medium subangular gravel		D	0.5					
	1	FILLING - Generally comprising brown-grey, fine to medium grained sandy clay filling, trace fine to medium subangular gravel		S	1.0					
		At 1.3m, gravel layer, 100mm thick		S	1.3		3,10/150mm			
	2			D	2.0					
				S	2.5		pp = 150 4,4,4 N = 8			
	3			S	2.95					
	3.5	SILTY CLAY - (Stiff), brown silty clay, some fine grained sand, M>Wp								
	4	SANDY CLAY - Very stiff, brown mottled orange-red fine grained sandy clay, M<Wp		S	4.0		pp = 300-400 4,7,9 N = 16			
	4.0				4.45					
	5	Bore discontinued at 5.0m, limit of investigation								
	5.0									
	6									
	7									
	8									
	9									

RIG: Scout Hydropower **DRILLER:** Ground Test (Kearney-Edwards) **LOGGED:** Parkinson **CASING:** Nil

TYPE OF BORING: Solid flight auger vbit to 1.3m, solid flight auger TC Bit to 2.0m, solid flight auger vbit to 5.0m

WATER OBSERVATIONS: No free groundwater observed whilst bore remained open

REMARKS:

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U 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	W Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	

BOREHOLE LOG

CLIENT: Northrop Consulting Engineers Pty Ltd
PROJECT: Proposed Stormwater Option
LOCATION: Kings Hill Development, North Raymond Terrace

SURFACE LEVEL: --
EASTING: 386497
NORTHING: 6379131
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 81502
DATE: 15/4/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)
				Type	Depth	Sample	Results & Comments		
	0.1	TOPSOIL - Generally comprising brown, fine to medium grained sandy silt topsoil		D	0.1				
	0.7	SANDY CLAY - Stiff, brown, fine to medium grained sandy clay, some silt, M>Wp From 0.5m, very stiff		D	0.5				
1		SANDY CLAY - Hard, brown mottled orange, fine to medium grained sandy clay, trace fine gravel, M<Wp, (sandstone like properties in parts)		S	1.0		pp = 450 7,16,20 N = 36		
					1.45				
2									
	2.5	CLAY - Very stiff to hard, pale yellow-brown clay, trace organic rootlet veins, M<Wp		S	2.5		pp = 300 6,10,15 N = 25		
3					2.95				
		From 3.5m, grey-brown, trace silt and sand, (rock like properties) start coring at 4.0m							
4	4.0	BASALT - Very high strength, moderately weathered, grey mottled orange in parts lithic siltstone, veins of calcite, fragmented, (possibly pyro clastic to 4.25m)		C	4.0				
	4.52	CORE LOSS - 0.52m							
5	5.0	BASALT - Very low to low strength, highly weathered, grey-brown, fine grained basalt with iron staining, fragmented		C	5.0				
	5.37	CORE LOSS - 0.90m							
6									
	6.27	BASALT - Medium strength, highly weathered basalt		C	6.25				
	6.54	CORE LOSS - 0.30m							
7	6.84	BASALT - Extremely weathered, extremely low strength, grey basalt							
	7.0	From 6.97m, high strength, (possible siltstone?) Bore discontinued at 7.0m, limit of investigation			7.0				
8									
9									

RIG: Scout Hydropower

DRILLER: Ground Test (Kearney-Ennis)

LOGGED: Parkinson

CASING: HQ to 4.0m

TYPE OF BORING: Solid flight auger vbit to 4.0m, NMLC Core to 7.0m

WATER OBSERVATIONS: No free groundwater observed during augering to 4.0m. Groundwater obscured below 4.0m due to introduction of drilling fluids.

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: Northrop Consulting Engineers Pty Ltd
PROJECT: Proposed Stormwater Option
LOCATION: Kings Hill Development, North Raymond Terrace

SURFACE LEVEL: --
EASTING: 386876
NORTHING: 6379482
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 81502
DATE: 15/4/2014
SHEET 1 OF 1

[illegible]

RIG: 80mm diameter hand auger **DRILLER:** Parkinson
TYPE OF BORING: 80mm diameter hand auger
WATER OBSERVATIONS: Free groundwater observed at 0.8m
REMARKS:

LOGGED: Parkinson

CASING: Nil

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

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



BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386592.86
NORTHING: 6379035.62
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 81502.01
DATE: 10 - 11/12/2014
SHEET 1 **OF** 4

[illegible]

RIG: Ute mounted 4WD rig **DRILLER:** FICO (Lynch) **LOGGED:** Benson **CASING:** HQ to to 2.1m

TYPE OF BORING: Solid flight auger with v-bit to 2.1m, NMLC to 16.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS:

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	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)



5976

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386592.86
NORTHING: 6379035.62
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 81502.01
DATE: 10 - 11/12/2014
SHEET 2 OF 4

[illegible]

RIG: Ute mounted 4WD rig **DRILLER:** FICO (Lynch) **LOGGED:** Benson **CASING:** HQ to to 2.1m

TYPE OF BORING: Solid flight auger with v-bit to 2.1m, NMLC to 16.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS:

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



BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386592.86
NORTHING: 6379035.62
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 81502.01
DATE: 10 - 11/12/2014
SHEET 3 **OF** 4

[illegible]

RIG: Ute mounted 4WD rig **DRILLER:** FICO (Lynch) **LOGGED:** Benson **CASING:** HQ to to 2.1m

TYPE OF BORING: Solid flight auger with v-bit to 2.1m, NMLC to 16.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS:

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	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)



5978

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386592.86
NORTHING: 6379035.62
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 81502.01
DATE: 10 - 11/12/2014
SHEET 4 **OF** 4

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing								
			EW	HW	MW	SW		FS	FR	Ex	Low	Very Low			Low	Medium	High	Very High	Ex	High	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %	RQD %
	16	PORPHYRY - Very low to low strength, highly weathered, red-brown porphyry with quartz gravels <i>(continued)</i>						P	P															PL(A) = 0.38 PL(D) = 0.37 PL(A) = 1 PL(D) = 1.4 PL(D) = 0.1	
								P	P											C	100	47			
								P	P																
								P	P																
								P	P																
								P	P																
								P	P																
								P	P																
								P	P																
								P	P																
	16.7	Bore discontinued at 16.7m																							
	17																								
	18																								
	19																								

RIG: Ute mounted 4WD rig **DRILLER:** FICO (Lynch) **LOGGED:** Benson **CASING:** HQ to to 2.1m

TYPE OF BORING: Solid flight auger with v-bit to 2.1m, NMLC to 16.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS:

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	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)



5979

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386512.9
NORTHING: 6379076.02
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 81502.01
DATE: 16/12/2014
SHEET 1 **OF** 5

[illegible]

RIG: Explore 140 **DRILLER:** Groundtest (J.Simon) **LOGGED:** Cairnes **CASING:** HW to 1.6m, HQ to 6m

TYPE OF BORING: Solid flight auger with v-bit to 1m, then rotary with mud to 15.75m, then NMLC coring to 18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS: 50%-80% water loss during drilling to 9m depth

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(P)	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)



5980

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386512.9
NORTHING: 6379076.02
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 81502.01
DATE: 16/12/2014
SHEET 2 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing						
			EW	HW	MW	SW		FS	FR	Ex Low	Very Low	Low		Medium	High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %
		BASALT - Extremely low strength, extremely weathered orange-brown basalt (with soil like properties) <i>(continued)</i>																								
	6																									
	7	From 7m, grey - brown mottled orange - brown minor extremely low strength, extremely weathered basalt lenses up to 50mm thick, grading to rock																				S				10,20,28 N = 48 pp = 340 - >400
	8																									
	9																									

RIG: Explore 140 **DRILLER:** Groundtest (J.Simon) **LOGGED:** Cairnes **CASING:** HW to 1.6m, HQ to 6m

TYPE OF BORING: Solid flight auger with v-bit to 1m, then rotary with mud to 15.75m, then NMLC coring to 18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS: 50%-80% water loss during drilling to 9m depth

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 _s Tube sample (x mm dia.)	PL(D) Point load diametral test Is(50) (MPa)		
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)		
D Disturbed sample	≻ Water seep	S Standard penetration test		
E Environmental sample	≻ Water level	V Shear vane (kPa)		

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386512.9
NORTHING: 6379076.02
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 81502.01
DATE: 16/12/2014
SHEET 3 **OF** 5

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log		Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing								
			EW	HW	MW	SW	FS	FR	Ex	Low	Very Low	Low	Medium		High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec.	%	RQD %	Test Results & Comments
11		BASALT - Extremely low strength, extremely weathered orange-brown basalt (with soil like properties) <i>(continued)</i>						X															S					pp >400 5.29 refusal	
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
12		From 11.25m, extremely low to very low strength, grey mottled pale brown						X															S					18.25/100mm refusal	
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
13		From 12.75m, brown mottled orange-brown						X															S					24.25/100mm refusal	
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
14		From 13.5m, increased resistance to drilling						X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
								X																					
							X															S				pp = 430-550 25/120mm,-,- refusal			

RIG: Explore 140 **DRILLER:** Groundtest (J.Simon) **LOGGED:** Cairnes **CASING:** HW to 1.6m, HQ to 6m

TYPE OF BORING: Solid flight auger with v-bit to 1m, then rotary with mud to 15.75m, then NMLC coring to 18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS: 50%-80% water loss during drilling to 9m depth

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 _s	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)



5982

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386512.9
NORTHING: 6379076.02
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 81502.01
DATE: 16/12/2014
SHEET 4 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)				Discontinuities		Sampling & In Situ Testing						
			EW	HW	MW	SW		FS	FR	Ex Low	Low	Very Low		Medium	High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding S - Shear	J - Joint D - Drill Break	Type	Core Rec. %
	15.75	BASALT - Extremely low strength, extremely weathered orange-brown basalt (with soil like properties) (continued)																								
	16	BASALT - High strength, moderately weathered, highly fractured to fragmented brown - grey and orange brown basalt																								12/20mm,-,- refusal (bouncing) PL(A) = 2
		From 16.15m to 16.3m, extremely low strength, extremely weathered																								
		From 16.30m, low strength																								
		From 16.55m to 16.58m, extremely low strength, extremely weathered																								PL(A) = 0.35 PL(D) = 0.3
	17	From 17.0m, high strength, slightly weathered																								PL(A) = 1.6
		From 17.73m to 17.79m, extremely low strength, extremely weathered																								PL(A) = 1.2
	18	From 17.79m, very high strength, fresh, grey																								PL(A) = 4.9
	18.1	Bore discontinued at 18.1m, limit of investigation																								
	19																									

RIG: Explore 140 **DRILLER:** Groundtest (J.Simon) **LOGGED:** Cairnes **CASING:** HW to 1.6m, HQ to 6m

TYPE OF BORING: Solid flight auger with v-bit to 1m, then rotary with mud to 15.75m, then NMLC coring to 18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS: 50%-80% water loss during drilling to 9m depth

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	W Water seep	S Standard penetration test		
E Environmental sample	W Water level	V Shear vane (kPa)		

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386512.9
NORTHING: 6379076.02
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 81502.01
DATE: 16/12/2014
SHEET 5 **OF** 5

[illegible]

RIG: Explore 140 **DRILLER:** Groundtest (J.Simon) **LOGGED:** Cairnes **CASING:** HW to 1.6m, HQ to 6m

TYPE OF BORING: Solid flight auger with v-bit to 1m, then rotary with mud to 15.75m, then NMLC coring to 18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering, otherwise obscured by drilling fluids

REMARKS: 50%-80% water loss during drilling to 9m depth

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 _s	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)



5984

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386612.04
NORTHING: 6378870.14
DIP/AZIMUTH: 90°/--

BORE No: 303
PROJECT No: 81502.01
DATE: 13/1/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)
				Type	Depth	Sample	Results & Comments		
	0.3	CLAYEY SANDY SILT - Grey fine grained clayey sandy silt							
		SILTY CLAY - Very stiff grey-brown silty clay, M<Wp							
	1								
	1.55	From 1.35m, slightly gravelly, brown							
		Bore discontinued at 1.55m, auger refusal on possible weathered bedrock							
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								

RIG: Hand Tools

DRILLER: Gawn/Benson

LOGGED: Gawn/Benson

CASING: Nil

TYPE OF BORING: 70mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386744
NORTHING: 6379457
DIP/AZIMUTH: 90°/--

BORE No: 401
PROJECT No: 81502.01
DATE: 13/1/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.05	TOPSOIL - Brown clayey silt								
	0.4	CLAYEY SILT - (Stiff) grey-brown clayey silt, trace fine grained sand, M>Wp								
		CLAY - Very stiff brown to pale brown clay, trace silt, M>Wp		D	0.5		pp = 200-240		From 0.0m to 0.5m, bentonite	
	1				1.0		2,4,5 N = 9			
				S	1.45		pp = 230-270		From 0.5m to 2.5m, 5mm gravel	
	2									
	2.6	At 2.55m, 50mm thick green clayey silt, sulfuric odour		S	2.5		7,15/40 refusal			
		PORPHYRY - extremely low strength, extremely weathered red-brown porphyry	P		2.67					
	3	At 2.7m, v-bit refusal, very low strength, highly weathered	P							
			P							
			P							
		From 3.66m, extremely low strength, extremely weathered	P						From 2.5m to 4.0m, Class 18 black	
	4	From 3.9m, very low strength, highly weathered	P						From 4.0m to 2.5m, Class 18 machine slotted	
	4.04	Bore discontinued at 4.04m, limit of investigation	P	S	4.0		15/45 refusal			
	5									
	6									
	7									
	8									
	9									

RIG: 4WD truck mounted drill rig **DRILLER:** D.Dudley (FICO) **LOGGED:** Benson/Gawn **CASING:** Nil

TYPE OF BORING: V-bit, solid flight auger to 2.7m TC- solid flight auger to 4.0m

WATER OBSERVATIONS: No free groundwater observed during drilling, groundwater measured at 2.8m depth 3 hours after completion of drilling

REMARKS:

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386423.9
NORTHING: 6378906.42

PIT No: 201
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.25	TOPSOIL - Brown sandy silt with some clay and rootlets			0.2		pp = 200-370					
		CLAY - Very stiff, grey-brown clay, trace silt, trace gravel in parts, M>Wp		B	0.5							
1	1.2	SANDY CLAY - Very stiff to hard, fine to medium grained sandy clay, orange-brown, M>Wp			1.3		pp = 250 - >400					
	1.4	BASALT - Extremely low strength, extremely weathered, orange-brown basalt with some siltstone and pebbles in parts, some high strength bands/cobbles										
	1.65	Pit discontinued at 1.65m, slow progress/practical refusal										
2												

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

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

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386361.08
NORTHING: 6379153.03

PIT No: 202
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	TOPSOIL - Dark brown clayey silt with rootlets										
		SILT - Very stiff to hard, pale grey, silty, trace fine grained sand and fine sized gravel, M<Wp/humid			0.3		pp = 200-400					
	0.5	SILTY CLAY - Very stiff, grey-brown silty clay, trace fine grained sand, M>Wp			0.6		pp = 200-250					
	0.7	BASALT - Extremely low strength, extremely weathered, dark grey-brown mottled orange-brown basalt with some sand in parts										
	1											
		From 1.5m, soil like properties										
		From 1.7m, extremely low to very low strength, extremely weathered										
	2	Pit discontinued at 2.0m, limit of investigation										
	2.0											

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	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)

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386697.04
NORTHING: 6379371.48

PIT No: 203
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	TOPSOIL - Brown silty clay with rootlets										
	0.25	SILTY CLAY - Firm to stiff, brown silty clay, M>Wp			0.2		pp = 80-150					
		SILTY CLAY - Very stiff to hard, grey brown/brown silty clay, trace to some fine to medium grained sand in parts, M>Wp			0.3		pp = 200-400					
					0.5		pp = 200-400					
		From 0.7m, stiff to very stiff			0.9		pp = 110-250					
	1.2	SANDY CLAY - Stiff to very stiff, grey-brown mottled orange-brown, fine to medium grained sandy clay, M>Wp			1.5		pp = 150-300					
		From 1.6m, clayey sand in parts			1.8		pp = 200-300					
-2	2.0	Pit discontinued at 2.0m, limit of investigation										

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed due to surface water inflow

REMARKS:

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

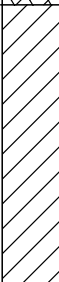
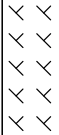
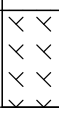
SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U _s Tube sample (x mm dia.)	PL(D) Point load diametral test Is(50) (MPa)	
C Core drilling	W Water sample	pp Pocket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

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386661.95
NORTHING: 6379177.08

PIT No: 204
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
		TOPSOIL - Brown silty clay, M>Wp										
	0.2	CLAY - Hard, brown/grey-brown clay, trace silt, M>Wp		B	0.4		pp >400					
	0.8	GRAVELLY CLAY - Hard, brown, fine to coarse sized subangular gravelly clay, M>Wp			0.9		pp >400					
1	1.0	BASALT - Extremely low strength, extremely weathered, brown/yellow-brown basalt with some high strength bands/cobbles										
	1.3	BASALT - High strength, moderately weathered, yellow-brown, highly fractured basalt										
	1.5	Pit discontinued at 1.5m, limit of investigation										
2												

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	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)

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386442.5
NORTHING: 6378766.58

PIT No: 205
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	TOPSOIL - Brown silty clay										
	0.2	CLAYEY SILT - Firm to stiff, brown clayey silt, M>Wp			0.2		pp = 80-200					
	0.4	GRAVELLY CLAY - Hard, brown, fine to coarse sized subangular gravelly clay, M>Wp			0.6		pp >400					
	1.1	BASALT - Medium strength, highly weathered, brown highly fractured basalt with clay infill on fractures and very low strength rock in parts										
2	2.0	Pit discontinued at 2.0m, limit of investigation										

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

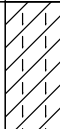
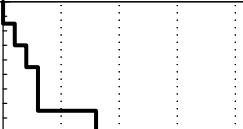
SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U _s	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket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

BOREHOLE LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386166.27
NORTHING: 6378202.99
DIP/AZIMUTH: 90°/--

BORE No: 301
PROJECT No: 81502.01
DATE: 13/1/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample		Results & Comments	5	10	15	20
1	0.9	SILTY CLAY - Firm, grey-brown mottled orange-brown silty clay, M>Wp			0.2 0.5 0.8		pp = 70-90 pp = 50-70 pp = 100-110					
		Bore discontinued at 0.9m, refusal on possible bedrock (possible cobbles from embankment)						1				
								2				
								3				
								4				
								5				
								6				
								7				
								8				
								9				

RIG: Hand Tools

DRILLER: Gawn

LOGGED: Gawn

CASING: Nil

TYPE OF BORING: 75mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed but surface water present with 5m of bore

REMARKS:

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

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

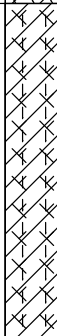


TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 386341.65
NORTHING: 6378512.32

PIT No: 302
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 **OF** 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.1	TOPSOIL - Red-brown clayey silt		D	0.3		pp = 80-150						
		SILTY CLAY and BASALT - Firm to stiff, red-brown and orange-brown silty clay and basalt (gravels, cobbles and boulders), M>Wp											
	0.8	BASALT - Medium to high strength, highly weathered, brown and blue-grey, highly fractured basalt											
	1.0	Pit discontinued at 1.0m, limit of investigation							1				
	2								2				

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

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



TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 387170.04
NORTHING: 6379890.61

PIT No: 304
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
		TOPSOIL - Brown clayey silt with some rootlets										
	0.25	SANDY CLAY - Hard, orange-brown, fine to medium grained sandy clay, some silt, M>Wp		D	0.3		pp >400					
	0.5	CLAY - Hard, grey mottled red-brown clay, trace silt and sand, M>Wp		D	0.6		pp >400					
	1											
					1.4		pp >400					
	1.7	SILTY CLAY - Hard, red-brown mottled grey silty clay, M>Wp			1.8		pp >400					
	1.9	BASALT - Extremely low strength, extremely weathered, brown basalt										
2	2.0	Pit discontinued at 2.0m, slow progress										

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U _s 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	W Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	

TEST PIT LOG

CLIENT: APP Corporation Pty Ltd
PROJECT: Proposed Interchange and Drainage Channel
LOCATION: Pacific Highway, Raymond Terrace

SURFACE LEVEL: --
EASTING: 387385.74
NORTHING: 6380234.65

PIT No: 305
PROJECT No: 81502.01
DATE: 11/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)
				Type	Depth	Sample	Results & Comments		
	0.1	TOPSOIL - Brown clayey silt with some rootlets							
	0.4	SILT - Stiff, grey-brown silt with some gravel, sand and clay, humid/M<Wp		D	0.25				
		CLAY - Hard, orange-brown mottled grey-brown clay, trace silt, M>Wp							
				D	0.6		pp >400		
					0.7				
					1.0		pp >400		
		From 1.2m, very stiff to hard			1.4		pp = 250-400		
	2.2	SILTY CLAY - Very stiff to hard, orange-brown mottled grey silty clay, M>Wp			2.3		pp = 350 - >400		
	2.5	CLAYEY SILT - (Hard), yellow-brown clayey silt with some fine grained sand, M>Wp		D	2.5				
	2.8	BASALT - Extremely low strength, extremely weathered, brown basalt		D	2.8				
-3	3.0	Pit discontinued at 3.0m, limit of investigation							

RIG: CAT305C excavator with 450mm wide bucket teeth

LOGGED: Benson

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U _s 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	W _s Water seep	S Standard penetration test	
E Environmental sample	W _L Water level	V Shear vane (kPa)	

Appendix C

Results of Laboratory Testing
Chain of Custody Sheets
Sample Receipts

CERTIFICATE OF ANALYSIS 226081

Client Details	
Client	Douglas Partners Pty Ltd
Attention	Michael Gawn
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details	
Your Reference	81502.10, Kings Hill
Number of Samples	10 soil
Date samples received	13/09/2019
Date completed instructions received	13/09/2019

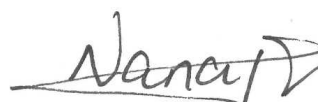
Analysis Details	
Please refer to the following pages for results, methodology summary and quality control data.	
Samples were analysed as received from the client. Results relate specifically to the samples as received.	
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.	

Report Details	
Date results requested by	20/09/2019
Date of Issue	18/09/2019
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *	

Results Approved By

Josh Williams, Chemist
 Loren Bardwell, Senior Chemist
 Steven Luong, Organics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

Client Reference: 81502.10, Kings Hill

VTRH(C6-C10)/BTEXN in Soil						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
TRH C ₆ - C ₉	mg/kg	<25	<25	<25	<25	<25
TRH C ₆ - C ₁₀	mg/kg	<25	<25	<25	<25	<25
vTPH C ₆ - C ₁₀ less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	87	89	102	94	86

VTRH(C6-C10)/BTEXN in Soil						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
TRH C ₆ - C ₉	mg/kg	<25	<25	<25	<25	<25
TRH C ₆ - C ₁₀	mg/kg	<25	<25	<25	<25	<25
vTPH C ₆ - C ₁₀ less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	113	91	98	90	104

Client Reference: 81502.10, Kings Hill

svTRH (C10-C40) in Soil						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
TRH C ₁₀ - C ₁₄	mg/kg	<50	<50	<50	<50	<50
TRH C ₁₅ - C ₂₈	mg/kg	100	<100	<100	<100	<100
TRH C ₂₉ - C ₃₆	mg/kg	140	<100	<100	<100	<100
TRH >C ₁₀ -C ₁₆	mg/kg	<50	<50	<50	<50	<50
TRH >C ₁₀ - C ₁₆ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C ₁₆ -C ₃₄	mg/kg	190	<100	<100	<100	<100
TRH >C ₃₄ -C ₄₀	mg/kg	110	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	300	<50	<50	<50	<50
Surrogate o-Terphenyl	%	78	77	76	74	75

svTRH (C10-C40) in Soil						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
TRH C ₁₀ - C ₁₄	mg/kg	<50	<50	<50	<50	<50
TRH C ₁₅ - C ₂₈	mg/kg	<100	<100	<100	<100	<100
TRH C ₂₉ - C ₃₆	mg/kg	<100	<100	<100	<100	<100
TRH >C ₁₀ -C ₁₆	mg/kg	<50	<50	<50	<50	<50
TRH >C ₁₀ - C ₁₆ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C ₁₆ -C ₃₄	mg/kg	<100	<100	<100	<100	<100
TRH >C ₃₄ -C ₄₀	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	73	76	75	77	76

Client Reference: 81502.10, Kings Hill

PAHs in Soil						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.4	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	4.8	<0.1	0.2	<0.1	<0.1
Anthracene	mg/kg	0.6	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	13	<0.1	0.5	<0.1	<0.1
Pyrene	mg/kg	14	<0.1	0.5	<0.1	<0.1
Benzo(a)anthracene	mg/kg	4.7	<0.1	0.2	<0.1	<0.1
Chrysene	mg/kg	5.0	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	21	<0.2	0.7	<0.2	<0.2
Benzo(a)pyrene	mg/kg	5.8	0.05	0.3	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	4.1	<0.1	0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	5.8	<0.1	0.2	<0.1	<0.1
Total +ve PAH's	mg/kg	80	0.05	2.7	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	9.2	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	9.2	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	9.2	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	96	102	103	124	90

Client Reference: 81502.10, Kings Hill

PAHs in Soil						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	95	102	103	103	100

Client Reference: 81502.10, Kings Hill

Organochlorine Pesticides in soil						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-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
beta-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
pp-DDD	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-DDT	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
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	%	91	92	95	109	78

Client Reference: 81502.10, Kings Hill

Organochlorine Pesticides in soil						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-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
beta-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
pp-DDD	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-DDT	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
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	%	88	92	92	93	90

Client Reference: 81502.10, Kings Hill

Organophosphorus Pesticides						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
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
Chlorpyrifos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyrifos-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	%	91	92	95	109	78

Client Reference: 81502.10, Kings Hill

Organophosphorus Pesticides						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
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
Chlorpyrifos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyrifos-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	%	88	92	92	93	90

Client Reference: 81502.10, Kings Hill

PCBs in Soil						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	91	92	95	109	78

PCBs in Soil						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date extracted	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	88	92	92	93	90

Client Reference: 81502.10, Kings Hill

Acid Extractable metals in soil						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Arsenic	mg/kg	<4	<4	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	17	49	17	10	18
Copper	mg/kg	5	21	5	<1	11
Lead	mg/kg	15	5	14	8	5
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	4	20	4	2	5
Zinc	mg/kg	31	28	10	3	11

Acid Extractable metals in soil						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Arsenic	mg/kg	<4	<4	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	11	17	15	63	21
Copper	mg/kg	3	11	<1	21	3
Lead	mg/kg	9	6	9	11	4
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	3	2	28	3
Zinc	mg/kg	7	13	3	21	3

Client Reference: 81502.10, Kings Hill

Moisture						
Our Reference		226081-1	226081-2	226081-3	226081-4	226081-5
Your Reference	UNITS	2001	2001	2002	2003	2004
Depth		0.05-0.15	0.4-0.5	0.1-0.2	0.2	0.1-0.2
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
Moisture	%	3.0	23	10	20	23

Moisture						
Our Reference		226081-6	226081-7	226081-8	226081-9	226081-10
Your Reference	UNITS	2005	2006	2007	2008	D1
Depth		0.05-0.1	0.05-0.15	0.05-0.1	0.05-0.15	-
Date Sampled		12/09/2019	12/09/2019	12/09/2019	12/09/2019	12/09/2019
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	16/09/2019	16/09/2019	16/09/2019	16/09/2019	16/09/2019
Date analysed	-	17/09/2019	17/09/2019	17/09/2019	17/09/2019	17/09/2019
Moisture	%	11	25	24	20	14

Client Reference: 81502.10, Kings Hill

Method ID	Methodology Summary
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-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-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.

Method ID	Methodology Summary
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-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)-BTX 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)-BTX 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.

Client Reference: 81502.10, Kings Hill

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	226081-2
Date extracted	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	16/09/2019
Date analysed	-			17/09/2019	1	17/09/2019	17/09/2019		17/09/2019	17/09/2019
TRH C ₆ - C ₉	mg/kg	25	Org-016	<25	1	<25	<25	0	101	89
TRH C ₆ - C ₁₀	mg/kg	25	Org-016	<25	1	<25	<25	0	101	89
Benzene	mg/kg	0.2	Org-016	<0.2	1	<0.2	<0.2	0	97	81
Toluene	mg/kg	0.5	Org-016	<0.5	1	<0.5	<0.5	0	98	89
Ethylbenzene	mg/kg	1	Org-016	<1	1	<1	<1	0	103	93
m+p-xylene	mg/kg	2	Org-016	<2	1	<2	<2	0	104	92
o-Xylene	mg/kg	1	Org-016	<1	1	<1	<1	0	100	90
naphthalene	mg/kg	1	Org-014	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	109	1	87	113	26	109	84

Client Reference: 81502.10, Kings Hill

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	226081-2
Date extracted	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	16/09/2019
Date analysed	-			17/09/2019	1	17/09/2019	17/09/2019		17/09/2019	17/09/2019
TRH C ₁₀ - C ₁₄	mg/kg	50	Org-003	<50	1	<50	<50	0	91	90
TRH C ₁₅ - C ₂₈	mg/kg	100	Org-003	<100	1	100	<100	0	85	86
TRH C ₂₉ - C ₃₆	mg/kg	100	Org-003	<100	1	140	110	24	108	104
TRH >C ₁₀ -C ₁₆	mg/kg	50	Org-003	<50	1	<50	<50	0	91	90
TRH >C ₁₆ -C ₃₄	mg/kg	100	Org-003	<100	1	190	160	17	85	86
TRH >C ₃₄ -C ₄₀	mg/kg	100	Org-003	<100	1	110	<100	10	108	104
Surrogate o-Terphenyl	%		Org-003	74	1	78	76	3	85	97

Client Reference: 81502.10, Kings Hill

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	[NT]
Date extracted	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	[NT]
Date analysed	-			17/09/2019	1	17/09/2019	17/09/2019		17/09/2019	[NT]
Naphthalene	mg/kg	0.1	Org-012	<0.1	1	0.1	0.2	67	116	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	1	0.4	0.4	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	1	0.2	0.1	67	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	1	0.2	0.2	0	126	[NT]
Phenanthrene	mg/kg	0.1	Org-012	<0.1	1	4.8	3.5	31	118	[NT]
Anthracene	mg/kg	0.1	Org-012	<0.1	1	0.6	0.3	67	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	1	13	10	26	106	[NT]
Pyrene	mg/kg	0.1	Org-012	<0.1	1	14	10	33	110	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	1	4.7	3.5	29	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	1	5.0	4.0	22	112	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	1	21	15	33	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	1	5.8	3.8	42	108	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	1	4.1	2.8	38	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	1	0.3	0.2	40	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	1	5.8	4.0	37	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	105	1	96	101	5	92	[NT]

Client Reference: 81502.10, Kings Hill

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	[NT]
Date extracted	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	[NT]
Date analysed	-			17/09/2019	1	17/09/2019	17/09/2019		17/09/2019	[NT]
HCB	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	114	[NT]
gamma-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	126	[NT]
Heptachlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	98	[NT]
delta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	106	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	94	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	122	[NT]
Dieldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	78	[NT]
Endrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	122	[NT]
pp-DDD	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	106	[NT]
Endosulfan II	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	120	[NT]
Methoxychlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	93	1	91	92	1	87	[NT]

Client Reference: 81502.10, Kings Hill

QUALITY CONTROL: Organophosphorus Pesticides						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	[NT]
Date extracted	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	[NT]
Date analysed	-			17/09/2019	1	17/09/2019	17/09/2019		17/09/2019	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyrifos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	86	[NT]
Chlorpyrifos-methyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	96	[NT]
Dimethoate	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	90	[NT]
Fenitrothion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	74	[NT]
Malathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	122	[NT]
Parathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	114	[NT]
Ronnel	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	94	[NT]
Surrogate TCMX	%		Org-008	93	1	91	92	1	87	[NT]

Client Reference: 81502.10, Kings Hill

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	[NT]
Date extracted	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	[NT]
Date analysed	-			17/09/2019	1	17/09/2019	17/09/2019		17/09/2019	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	100	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-006	93	1	91	92	1	87	[NT]

Client Reference: 81502.10, Kings Hill

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	[NT]
Date prepared	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	[NT]
Date analysed	-			16/09/2019	1	16/09/2019	16/09/2019		16/09/2019	[NT]
Arsenic	mg/kg	4	Metals-020	<4	1	<4	<4	0	107	[NT]
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	103	[NT]
Chromium	mg/kg	1	Metals-020	<1	1	17	22	26	113	[NT]
Copper	mg/kg	1	Metals-020	<1	1	5	4	22	110	[NT]
Lead	mg/kg	1	Metals-020	<1	1	15	11	31	113	[NT]
Mercury	mg/kg	0.1	Metals-021	<0.1	1	<0.1	<0.1	0	92	[NT]
Nickel	mg/kg	1	Metals-020	<1	1	4	3	29	103	[NT]
Zinc	mg/kg	1	Metals-020	<1	1	31	22	34	109	[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.

Rev4/October2016

SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	Michael Gawn

Sample Login Details	
Your reference	81502.10, Kings Hill
Envirolab Reference	226081
Date Sample Received	13/09/2019
Date Instructions Received	13/09/2019
Date Results Expected to be Reported	20/09/2019

Sample Condition	
Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	10 soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	4.2
Cooling Method	Ice
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:

Sample ID	VTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticides in soil	Organophosphorus Pesticides	PCBs in Soil	Acid Extractable metals in soil
2001-0.05-0.15	✓	✓	✓	✓	✓	✓	✓
2001-0.4-0.5	✓	✓	✓	✓	✓	✓	✓
2002-0.1-0.2	✓	✓	✓	✓	✓	✓	✓
2003-0.2	✓	✓	✓	✓	✓	✓	✓
2004-0.1-0.2	✓	✓	✓	✓	✓	✓	✓
2005-0.05-0.1	✓	✓	✓	✓	✓	✓	✓
2006-0.05-0.15	✓	✓	✓	✓	✓	✓	✓
2007-0.05-0.1	✓	✓	✓	✓	✓	✓	✓
2008-0.05-0.15	✓	✓	✓	✓	✓	✓	✓
D1	✓	✓	✓	✓	✓	✓	✓

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.

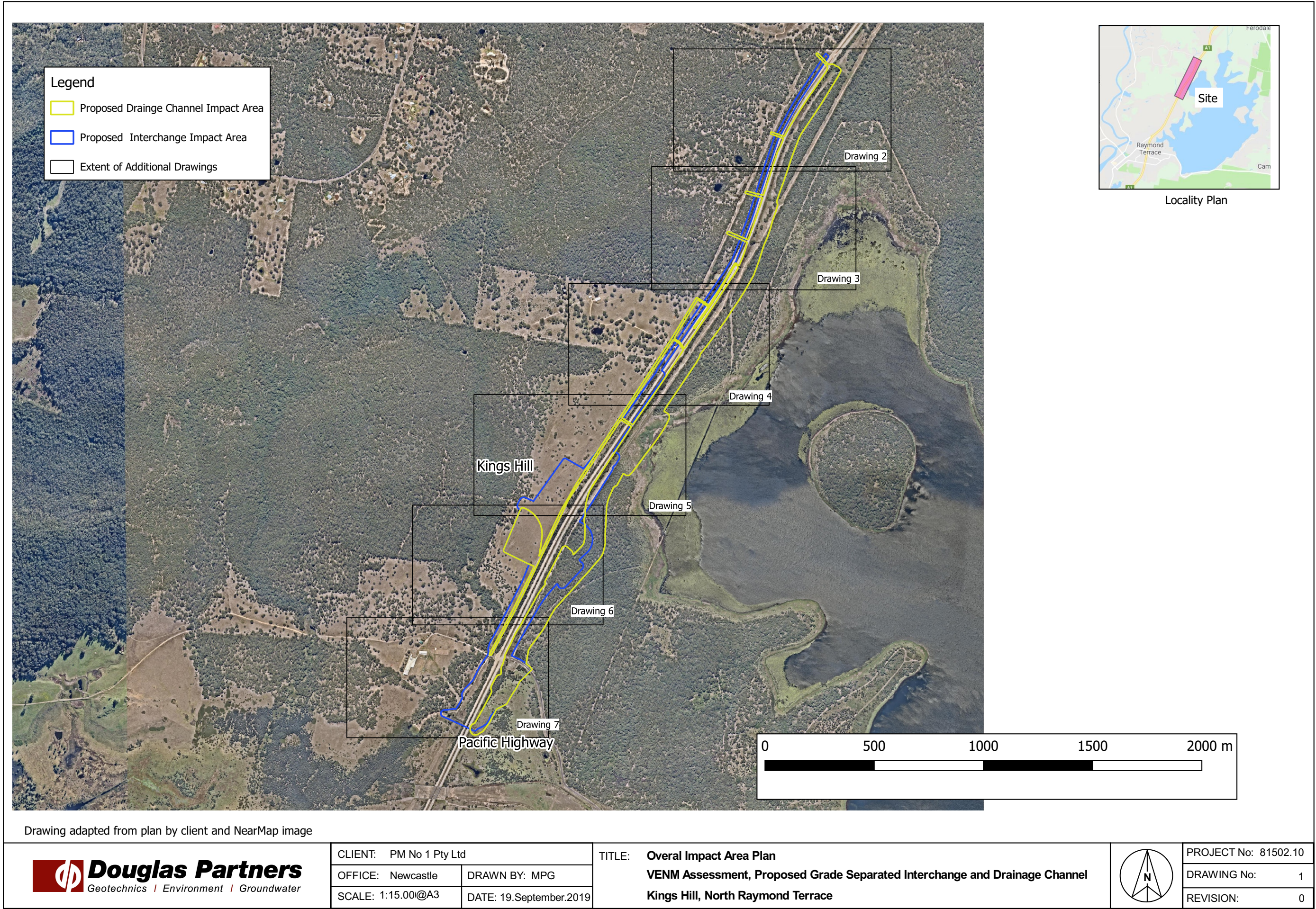
Requests for longer term sample storage must be received in writing.

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.

Appendix D

Drawing 1 – Overall Impact Area Plan
Drawings 2 to 7 – Test Location Plans (showing areas excluded from
this assessment)



Legend

- Approximate Location of Bores (Present Investigation)
- Approximate Location of Previous Investigation Bore/Pits
- Approximate Location of Bore/DPTs (DP2019a)
- Proposed Drainage Channel Impact Area
- Proposed Interchange Impact Area
- Areas excluded from this assessment requiring additional assessment for waste classification
- Location and Orientation of Photos shown in report



Drawing adapted from plan by client and NearMap image

 Douglas Partners Geotechnics Environment Groundwater	CLIENT: PM No 1 Pty Ltd		TITLE: Test Location Plan (showing areas excluded from this assessment) Preliminary Waste Classification, Proposed Grade Separated Interchange and Drainage Channel Kings Hill, North Raymond Terrace		PROJECT No: 81502.10
	OFFICE: Newcastle	DRAWN BY: MPG			DRAWING No: 2
	SCALE: 1:2,500 @A3	DATE: 20 September 2019			REVISION: 0



Drawing adapted from plan by client and NearMap image

 Douglas Partners <i>Geotechnics Environment Groundwater</i>	CLIENT: PM No 1 Pty Ltd		TITLE: Test Location Plan (showing areas excluded from this assessment) Preliminary Waste Classification, Proposed Grade Separated Interchange and Drainage Channel Kings Hill, North Raymond Terrace		PROJECT No: 81502.10
	OFFICE: Newcastle	DRAWN BY: MPG			DRAWING No: 3
	SCALE: 1:2,500 @A3	DATE: 20 September 2019			REVISION: 0

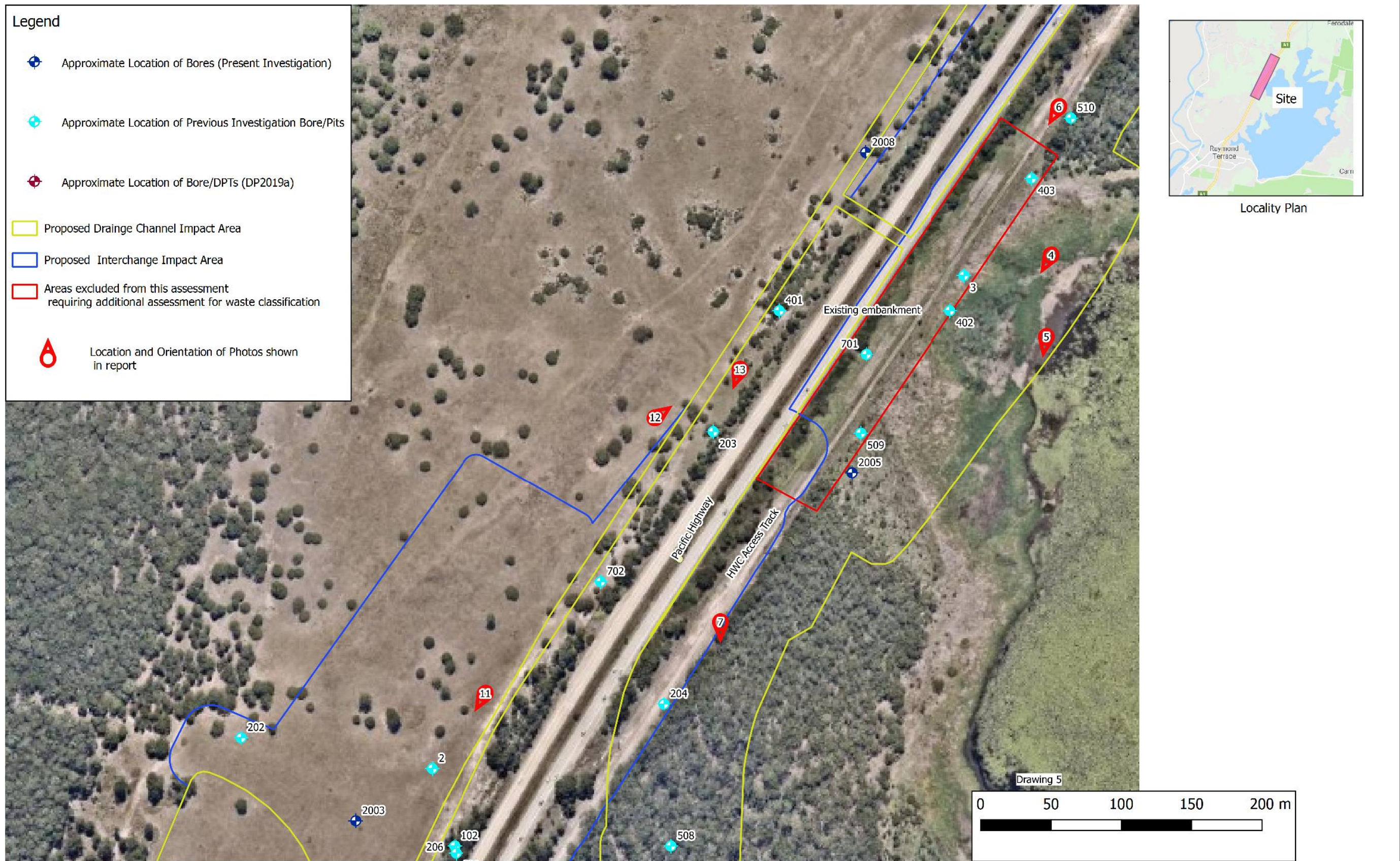
Legend

- Approximate Location of Bores (Present Investigation)
- Approximate Location of Previous Investigation Bore/Pits
- Approximate Location of Bore/DPTs (DP2019a)
- Proposed Drainage Channel Impact Area
- Proposed Interchange Impact Area
- Areas excluded from this assessment requiring additional assessment for waste classification
- Location and Orientation of Photos shown in report



Drawing adapted from plan by client and NearMap image

	CLIENT: PM No 1 Pty Ltd		TITLE: Test Location Plan (showing areas excluded from this assessment) Preliminary Waste Classification, Proposed Grade Separated Interchange and Drainage Channel Kings Hill, North Raymond Terrace		PROJECT No: 81502.10
	OFFICE: Newcastle	DRAWN BY: MPG			DRAWING No: 4
	SCALE: 1:2,500 @A3	DATE: 20 September 2019			REVISION: 0

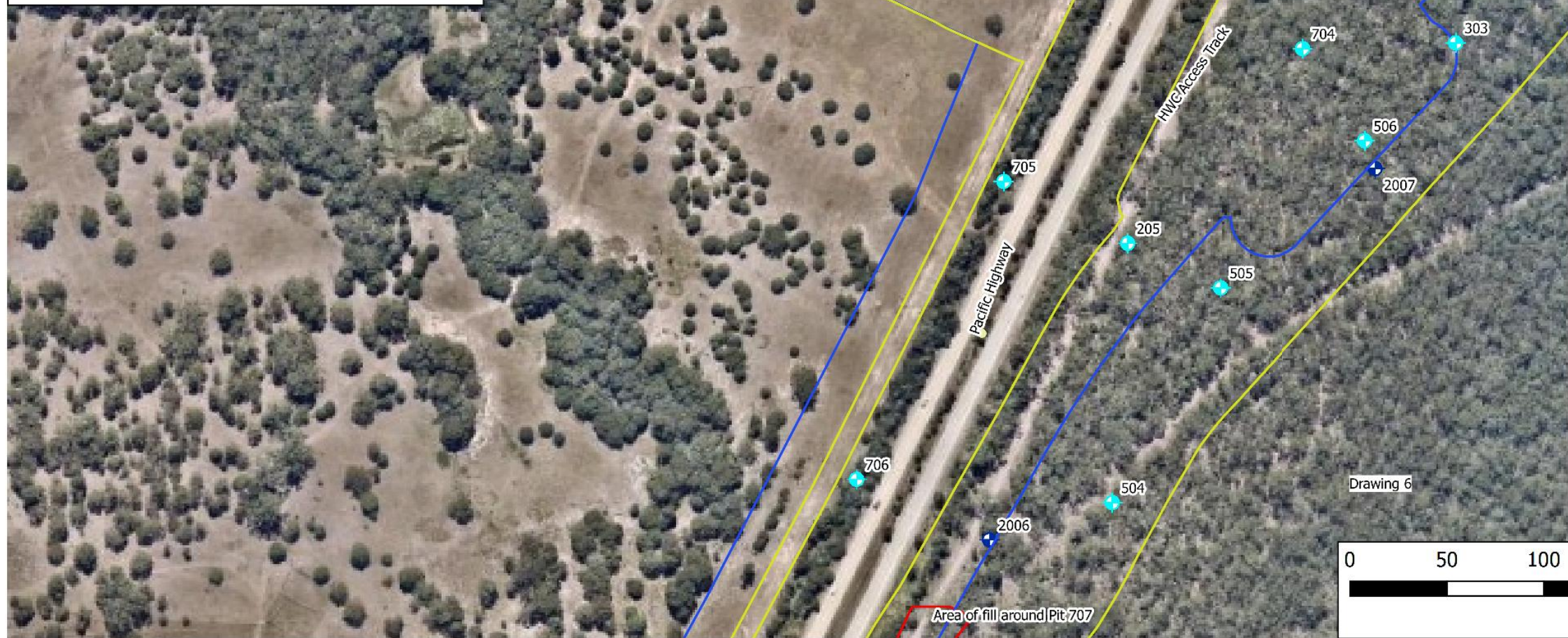


Drawing adapted from plan by client and NearMap image

 Douglas Partners Geotechnics Environment Groundwater	CLIENT: PM No 1 Pty Ltd		TITLE: Test Location Plan (showing areas excluded from this assessment) Preliminary Waste Classification, Proposed Grade Separated Interchange and Drainage Channel Kings Hill, North Raymond Terrace		PROJECT No: 81502.10
	OFFICE: Newcastle	DRAWN BY: MPG			DRAWING No: 5
	SCALE: 1:2.500 @A3	DATE: 20.September.2019			REVISION: 0

Legend

- Approximate Location of Bores (Present Investigation)
- Approximate Location of Previous Investigation Bore/Pits
- Approximate Location of Bore/DPTs (DP2019a)
- Proposed Drainage Channel Impact Area
- Proposed Interchange Impact Area
- Areas excluded from this assessment requiring additional assessment for waste classification
- Location and Orientation of Photos shown in report

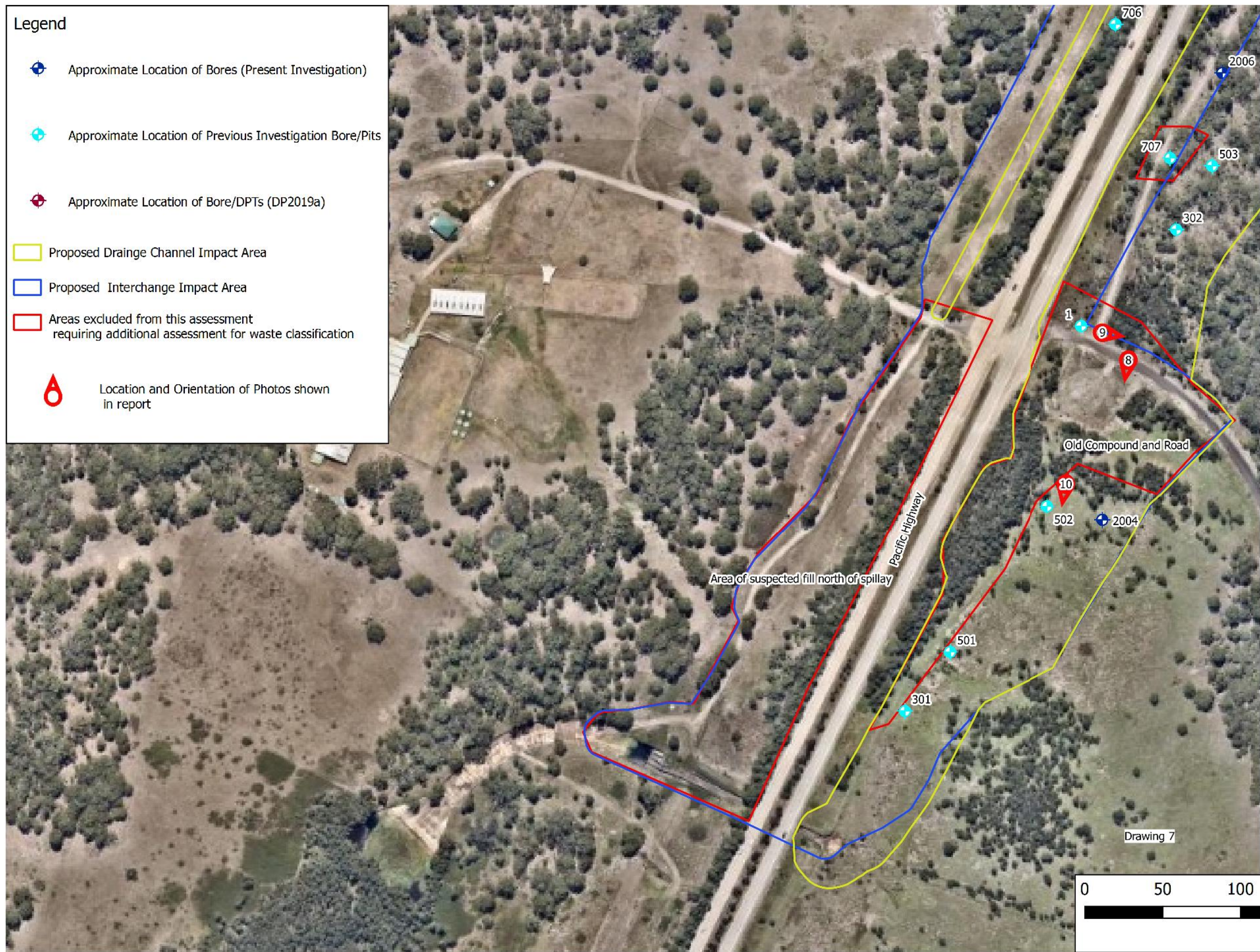


Drawing adapted from plan by client and NearMap image

	CLIENT: PM No 1 Pty Ltd		TITLE: Test Location Plan (showing areas excluded from this assessment) Preliminary Waste Classification, Proposed Grade Separated Interchange and Drainage Channel Kings Hill, North Raymond Terrace		PROJECT No: 81502.10
	OFFICE: Newcastle	DRAWN BY: MPG			DRAWING No: 6
	SCALE: 1:2.500 @A3	DATE: 20.September.2019			REVISION: 0

Legend

- Approximate Location of Bores (Present Investigation)
- Approximate Location of Previous Investigation Bore/Pits
- Approximate Location of Bore/DPTs (DP2019a)
- Proposed Drainage Channel Impact Area
- Proposed Interchange Impact Area
- Areas excluded from this assessment requiring additional assessment for waste classification
- Location and Orientation of Photos shown in report



Drawing adapted from plan by client and NearMap image

	CLIENT: PM No 1 Pty Ltd		TITLE: Test Location Plan (showing areas excluded from this assessment) Preliminary Waste Classification, Proposed Grade Separated Interchange and Drainage Channel Kings Hill, North Raymond Terrace		PROJECT No: 81502.10
	OFFICE: Newcastle	DRAWN BY: MPG			DRAWING No: 7
	SCALE: 1:2.500 @A3	DATE: 20.September.2019			REVISION: 0