Douglas Partners
Geotechnics | Environment | Groundwater

Integrated Practical Solutions

Report on
Preliminary Acid Sulphate Soil and Groundwater Investigation

Proposed Garden Street Extension
Between Harpenden and Balfour Streets, Huntingdale

Prepared for
City of Gosnells

Project 88978.00
January 2018

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	88978.00	Document No.	R.001.Rev0
Document title	Report on Preliminary Acid Sulphate Soil and Groundwater Investigation Proposed Garden Street Extension		
Site address	Between Harpenden and Balfour Streets, Huntingdale		
Report prepared for	City of Gosnells		
File name	88978.00.R.001.Rev0		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Nizam Ahamed	Rob Shapland	25 January 2018

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	-	Ms Glenda Lawrence, City of Gosnells

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.

	Signature	Date
Author		25 January 2018
Reviewer		25 January 2018

bsi. ISO 9001 Quality Management

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
36 O'Malley Street
Osborne Park WA 6017
Phone (08) 9204 3511
Fax (08) 9204 3522

Executive Summary

This report presents the methodology and results of a preliminary acid sulphate soil and groundwater investigation between chainages 0m to 850m of the proposed road alignment for the Garden Street Extension in Huntingdale, Western Australia (hereinafter referred to as the "site"). This investigation was commissioned by Ms Glenda Lawrence of the City of Gosnells (CoG), and was undertaken in general accordance with Douglas Partners Pty Ltd's (DP's) proposal (PER170430) dated 6 October 2017.

The proposed road extension requires the clearing of 4.35 ha of native vegetation between chainages 0 m to 850 m and integration of the extension with Holmes Street between chainages 850 m and 1380 m. Given that only integration works will be undertaken between chainages 850 m to 1380 m, this investigation only targeted the sections where vegetation and/or wetland clearing is proposed ie between chainages 0 m to 850 m (ie the site).

The purpose of the preliminary acid sulphate soil and groundwater investigation is to evaluate the occurrence of actual or potential occurrence of acid sulphate soils and the groundwater regime along the alignment of the proposed road extension with due consideration to proposed excavations. The information obtained during the investigation would be required for the following:

- To affirm a commitment made by the CoG during the environmental approvals process to carry out a preliminary acid sulphate soil investigation and if necessary, prepare a management plan to ensure the surrounding wetland is not impacted by acidification.
- Inform the requirements of an acid sulphate soil management plan (if required).
- Inform the requirements of a dewatering management plan (if required).
- Provide supporting information as part of an application for a dewatering license (if required).

Based on the results of the investigation, DP concludes that whilst acid sulphate soils have been identified in the silty sand profiles at BH04 at 0.3m, BH06 at 2.5m and BH10 at 5.8m, it is noted that the anticipated maximum extent of the proposed excavations in the vicinity of these locations are not anticipated to intersect the silty sand profiles comprising acid sulphate soils. Therefore, based on the results of the acid sulphate soil investigation along the proposed alignment of the Garden Street extension, management of acid sulphate soils (ie lime dosing of soils) is not deemed to be warranted. However, given the interpolated top of exceedance is likely to be close to the base of excavation at BH10 and noting that ASS are present at shallow depths (~0.3m) in the vicinity of BH04 (where filling will be undertaken), it is recommended that in order to reduce the potential risk of acidification of the base of the excavation, a layer of ag-lime should be placed over the base of the trench between test locations BH09 – BH11 and BH03 to BH05. A rate of 1 kg/m^2 using a good quality ag-lime with a minimum effective neutralising capacity (ENV) of 50% is recommended.

With regards to groundwater, given the recorded groundwater levels of between RL 19.863 m AHD and RL 20.097 m AHD in December 2017 (close the annual maximum) and noting that the excavations will extend to a maximum RL 21.245m AHD, dewatering to facilitate excavation during the road extension works is unlikely to be required as long as the excavations are completed during the dry season. In this regard, it should also be noted that groundwater levels are affected by climatic conditions and soil permeability, and can therefore fluctuate over time. Therefore, it is emphasized that the groundwater levels should be verified immediately prior to the commencement of works.

Furthermore, if the design levels change and/or deeper excavations are required, the potential for intersecting the water table should be reassessed.

With regard to the potential for dewatering at the site, DP recommends that the construction works should be undertaken during the dry season, and to the extent practical, dewatering should be avoided at the site for the following reasons:

- With reference to Section 4.6, the site is located within a conservation category wetland. Section 3.3.9 of DWER (2015a) notes that dewatering or any other groundwater disturbance should not be allowed to cause the lowering of the water level in a water body with environmental value (including a conservation category wetland), and should not lower the water level by more than 10cm next to the body;
- With reference to Section 4.5, it is noted that the areas between chainages 240m and 630m are prone to flooding during the wet season. Additionally, review of the soil data for the current investigation indicates that acid sulphate soils are present in the silty sand profiles. In this regard in the vicinity of BH04 (chainage 300m), acid sulphate soils are present at reasonably shallow depths of approximately 0.3m. As such, even minor lowering of the water table in the area therefore has the potential to expose acid sulphate soils. Furthermore, review of the groundwater quality results for the site also indicates that the groundwater at the site typically ranges between Class 4 – 5, and therefore has a very low buffering capacity. Consequently, disturbances to the water levels and water quality at the site should be avoided.
- Given that parts of the site are located within a conservation category wetland, it is currently not known if the existing vegetation species would be sensitive to any drawdown. Additionally, the groundwater at BH06 was found to be saline, and would therefore pose a concern in relation to management of the effluent if it were to be discharged on site.

Given the sensitive nature of the wetland and in light of the low groundwater pH and apparent absence of alkalinity, DP also recommends that a groundwater monitoring event should be undertaken to ascertain groundwater levels and baseline groundwater data immediately prior to construction. Subsequently, a post-construction groundwater monitoring event should also be undertaken with a view to comparing the data against the baseline data and to evaluate whether significant changes to groundwater quality have occurred as a result of the road extension works.

Table of Contents

Report on Preliminary Acid Sulphate Soil and Groundwater Investigation Proposed Garden Street Extension Between Harpenden and Balfour Streets, Huntingdale

1. Introduction

This report presents the methodology and results of a preliminary acid sulphate soil and groundwater investigation between chainages 0m to 850m of the proposed road alignment for the Garden Street Extension in Huntingdale, Western Australia (hereinafter referred to as the "site"). The location of the site and an aerial image of the site are shown in Drawings 1 and 2, respectively (Appendix A). This investigation was commissioned by Ms Glenda Lawrence of the City of Gosnells (CoG), and was undertaken in general accordance with Douglas Partners Pty Ltd's (DP's) proposal (PER170430) dated 6 October 2017.

The proposed road extension requires the clearing of 4.35 ha of native vegetation between chainages 0 m to 850 m and integration of the extension with Holmes Street between chainages 850 m and 1380 m. Longitudinal Sections showing chainages 0 – 1380 m (as provided to DP by CoG) are presented in Appendix B. Given that only integration works will be undertaken between chainages 850 m to 1380 m, this investigation only targeted the sections where vegetation and/or wetland clearing is proposed ie between chainages 0 m to 850 m (ie the site).

The purpose of the preliminary acid sulphate soil and groundwater investigation is to evaluate the occurrence of actual or potential occurrence of acid sulphate soils and the groundwater regime along the alignment of the proposed road extension with due consideration to proposed excavations. The information obtained during the investigation would be required for the following:

- To affirm a commitment made by the CoG during the environmental approvals process to carry out a preliminary acid sulphate soil investigation and if necessary, prepare a management plan to ensure the surrounding wetland is not impacted by acidification.
- Inform the requirements of an acid sulphate soil management plan (if required).
- Inform the requirements of a dewatering management plan (if required).
- Provide supporting information as part of an application for a dewatering license (if required).

2. Scope of Work

2.1 Preliminary Acid Sulphate Soil and Groundwater Investigation

To meet the purpose of the preliminary acid sulphate soil and groundwater investigation, the following scope of work was undertaken:

- Desktop review of the occurrence of acid sulphate soils based on consideration of:
  - Published geology, topography and hydrogeology for the area;
  - Risk category for the area as shown on the applicable WAPC risk map;

- Drilling, logging and sampling of 12 boreholes (BH01 to BH12) to depths between 1.0 m and 6.5 m below ground level;
- Collection of soil samples from every horizon and at least every 0.25 m depth intervals from each borehole location;
- Installation of a groundwater monitoring well at three borehole locations (BH04, BH06 and BH08) to depths ranging between 3.0 – 6.0 m to facilitate measurement of groundwater levels and groundwater sampling and analysis;
- Screening of 162 soil samples (plus 10 QA/QC samples) for pH_F (pH in water) and pH_{FOX} (pH following chemical oxidation by hydrogen peroxide);
- Carry out SPOCAS suite of testing on 20 selected soil samples (including one QA/QC sample) for assessment of acid sulphate soils;
- Groundwater gauging and sampling of three groundwater monitoring wells (BH04, BH06 and BH08) for laboratory analysis of the following:
  - pH, EC, salinity, total suspended solids (TSS), total dissolved solids (TDS);
  - Total acidity and total alkalinity;
  - Chloride and sulphate;
  - Total and dissolved metals (aluminium, iron, arsenic, chromium, cadmium, manganese, nickel, selenium and zinc);
  - Ammoniacal nitrogen and total nitrogen;
  - Total phosphorus and filterable reactive phosphorus; and
  - Major anions and cations.
- Preparation of this report containing:
  - A site description of the assessment area;
  - A description of the methodology adopted for the investigation;
  - Logs of the encountered ground conditions including surface levels of the borehole and groundwater monitoring well locations;
  - Results and interpretation of acid sulphate soils and groundwater laboratory analysis;
  - A discussion of potential impacts of proposed earthworks and dewatering operations; and
  - Recommendations for an Acid Sulphate Soil and Dewatering Management Plan (if deemed necessary).

3. Site Identification

3.1 Site Identification

The site identification details are provided in Table 1 below.

Table 1: Site Identification Details

Identification	Description
Cadastre Identification	"P Road"
Street Address	Corner of Garden and Harpenden Streets up to Holmes Street, Huntingdale
Road Alignment Dimensions	~ 850m long x ~ 40m wide.
Local Government Area	City of Gosnells
Current Land use	Bushland
Site Co-ordinates (PCG 84)	Northeast corner: 63026.8, 248489.6 Northwest corner: 63002.5, 248467.0 Southeast corner: 63427.3, 247769.5 Southwest corner: 63389.9, 247759.1

4. Existing Environment

4.1 Site Description

At the time of the investigation, the site was vacant with the majority of the site comprising natural vegetation and bushland. Along the western perimeter of the site is an unsealed track approximately 40m wide.

4.2 Topography

Contour information provided by the CoG indicates that the site topography generally falls to the south and includes noticeable mounds and troughs within the site. Surface levels range from approximately RL 22.3 m (relative to Australian Height Datum [AHD]) near the Harpenden Street intersection (north, at chainage 40m) to approximately RL 22.7 m AHD at the Balfour Street intersection (south, at chainage 850m).

The following two noticeable mounds are also present at the site:

- At chainage 150m (northern portion of the site), a maximum of RL 23.2 m AHD; and
- At chainage 740m (southern portion of site) a maximum of RL 27.6 m AHD.

The lowest points at the site are present between chainages 240 m and 630m where the surface levels range between approximately RL 20.3m (chainage 510m) and RL 21.9m (chainage 630m).

4.3 Geology

The Armadale 1:50,000 Environmental Geology sheet indicates that over the majority of the site, the shallow sub surface conditions comprise areas of Bassendean sand overlying clayey materials of the Guildford formation. Additionally, peaty sand swamp deposits are also present in the central portion of the site, and generally coincide with the lower lying areas of the site. The site geology is shown on Drawing 3, Appendix A.

4.4 Hydrogeology

The Perth Groundwater Atlas (2004 ie typically seasonal minimum) indicates that in May 2003, the groundwater level along the alignment was approximately RL 18 m AHD, ie between approximately 2.3 m and 9.6 m below the existing surface. The Atlas also indicates that in May 2003, the regional groundwater flow was to the northeast. Additionally, the Perth Groundwater Atlas (1997) also indicates the average maximum groundwater level along the proposed alignment is approximately RL 21 m AHD, ie between the surface and 6.6 m below the existing surface level. The difference between the data provided in the two atlases suggests the presence of a perched groundwater table and/or seasonal inundation during the wet season. Further, information provided by CoG suggests that surface water is present in the lower lying areas in the wetter parts of the year.

The May 2003 and October 1997 groundwater contours are shown on Drawing 3, Appendix A.

4.5 Hydrology

At the time of the current investigation no visible surface water bodies were present on the site. However, it is noted that during the wet season, the central portion of the site becomes inundated. In this regard, review of information provided by the client (refer Longitudinal Sections in Appendix B) indicate that lower parts of the site ie chainages 240 – 630m are prone to flooding during the wet season.

The closest down-gradient waterbodies are a series of unnamed lakes located approximately 1.3 km north-east of the site.

4.6 Geomorphic Wetlands

The Department of Water and Environmental Regulation (DWER) geomorphic wetlands database indicates that the central portion of the site intersects a conservation category wetland (wetland ID 15423).

Additionally, a multiple use wetland (ID 15449) is located approximately 150m west of the site, and a Resource Enhancement wetland (ID 14279) is located approximately 250m west of the site. These offsite wetlands have been developed as residential properties.

With reference to *Position Statement: Wetlands, Waters & Rivers Commission, 2001*, the above mentioned wetlands are described as:

- conservation category – wetlands support a high level of ecological attributes and functions;
- multiple use wetlands - wetlands with few important ecological attributes and functions remaining; and
- resource enhancement - wetlands which have been partially modified but still support substantial ecological attributes and functions.

The locations of the wetlands within and in the general vicinity of the site are shown on Drawing 4, Appendix A.

4.7 Acid Sulphate Soil Risk

Published acid sulphate soil risk mapping indicates that the majority of the site is in an area mapped as '*moderate to low risk of acid sulphate soils occurring within 3 m of the natural soil surface*'. Notwithstanding, areas mapped as peaty sand swamp deposits which are mapped as '*high to moderate risk of acid sulphate soils occurring within 3 m of the natural soil surface'* are also present in the central portion of the site ie in the vicinity of the wetlands (refer Drawing 5, Appendix A).

4.8 Beneficial Uses of Groundwater

A search of the DWER registered groundwater bore database was undertaken to assess the beneficial usage of groundwater in the vicinity of the site. A search of bores within a 1 km radius of the site indicated the presence of 40 registered bores.

As such, there are no registered bores located within the site. The closest registered bores down gradient of the site are located approximately 800 m north-east of the site. The information provided by the DWER database suggests these bores are likely utilised for monitoring and/or irrigation.

The identified beneficial use of groundwater in the area, therefore, appears to be predominantly related to groundwater monitoring or irrigation.

5. Sampling and Analysis Methodology

5.1 Objective

The objective of the preliminary acid sulphate soil and groundwater investigation is to assess the occurrence of actual and potential acid sulphate soils and the groundwater regime with due consideration of anticipated excavations for the proposed development.

5.2 Sampling Methodology and Rationale

The fieldwork was carried out on 5 and 15 December 2017, and comprised the following:

- Drilling of twelve boreholes (BH01 BH12) at selected locations along the proposed road alignment to depths of between 1.0 m and 6.5 m; and
- Collection of groundwater samples from three groundwater monitoring wells (BH04, BH06 and BH08).

The number of test locations along the proposed road alignment was established with reference to the *Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes* [DWER (2015)]. This guideline specifies the following sampling densities for acid sulphate soil investigations:

- Minor linear disturbances: sampling locations at 100 m intervals where excavations are less than 1.0 m; and
- Major linear disturbances: sampling locations at 50 m intervals where excavations are greater than 1.0 m.

Following a review of the proposed road extension design and with reference to DWER guidelines, the following sampling frequency was adopted:

- Sampling at 100 m intervals along the proposed alignment where proposed excavations are less than 1.0 m below the existing surface level;
- Sampling at 50 m intervals along the proposed alignment where proposed excavations are greater than 1.0 m below the existing surface level.

Additionally, as specified by DWER (2015), the depth of investigation should be a minimum of 1.0 m below the proposed depth of disturbance. In this regard, discussions with the City of Gosnells indicate that that the excavations for construction of the road would be to a maximum of 0.5 m below the design level. Consequently, all test locations were extended to at least 1.5 m below the design road level in order to conform to DWER guidance. With regard to areas that are to be filled, it has been assumed that excavations in these areas will be limited to the removal of topsoil ie between 0.1 – 0.2m only, and hence test bores in these locations have been extended to at least 1m.

A summary of the surface levels and investigation depths are presented in Table 2 and the borehole locations are shown on Drawing 6, Appendix A.

Table 2: Sampling Locations and Investigation Depths

Borehole Location	Surface Level[1] (m AHD)	Proposed Road Extension			Investigation Depth (m)
		Chainage (m)	Finished Level[1] (m AHD)	Assumed Maximum Excavation Depth (m)	
BH01	~22.9 [1]	~100	22.27	1.0	2.0
BH02	~23.2 [1]	~150	22.02	1.7	2.7
BH03	~22.7 [1]	~200	21.77	1.5	2.5
BH04	20.63 [2]	~300	22.17	-0.8	3.0[3]
BH05	~21.4 [1]	~400	22.67	-0.8	1.0
BH06	20.28 [2]	~500	22.36	-1.5	3.0[3]
BH07	~21.0 [1]	~600	21.78	-0.3	1.0
BH08	24.51 [2]	~650	22.03	3	6.0[4]
BH09	~26.3 [1]	~700	22.28	4.5	5.5
BH10	~27.6 [1]	~750	22.53	5.5	6.5
BH11	~26.0 [1]	~800	22.67	3.9	5.0
BH12	~22.7 [1]	~850	22.28	0.9	2.0

Notes:
[1] Levels interpolated from Drawings E90-15-002 and E90-15-003 (refer Appendix B).
[2] Levels surveyed by registered surveyors (Harley Dykstra Pty Ltd) on 15 December 2017.
[3] Borehole drilled to 3.0 m to facilitate groundwater well installation.
[4] Borehole drilled to 6.0 m to facilitate groundwater well installation.

Boreholes BH01, BH02, BH04, BH06, BH08, BH09, BH10, BH11 and BH12 were advanced using a Geo-probe 7822-DT operated by Direct Push Probing (DPP) using direct push probe drilling methods. Boreholes BH04, BH06 and BH08 were drilled using a 110mm hand auger. Additionally, as required by the DWER for this project, BH01 – BH12 were placed along existing tracks/ clearings such that no vegetation was cleared as part of the fieldwork.

Soil samples were collected at 0.25 m intervals from each borehole location for the assessment of acid sulphate soils. The soil samples were immediately placed into labelled snap lock bags and hand pressed to exclude air and stored on ice in a chilled insulated container for subsequent freezing at DP's office.

Test locations were established using GPS co-ordinates and aerial photography. The test locations are presented on Drawing 6, Appendix A.

Groundwater monitoring wells were installed in BH04, BH06 and BH08 to facilitate the assessment of groundwater depths and allow for the sampling and analysis of groundwater. The monitoring bores were constructed using 50 mm internal diameter Class 18 PVC casing with machine slotted screened

sections. The construction details for the groundwater monitoring wells are shown on the bore logs provided in Appendix C.

Groundwater gauging and sampling of monitoring bores BH04, BH06 and BH08 was carried out on 15 December 2017 in general accordance with DP internal procedures. Physical parameters (pH, temperature, dissolved oxygen, electrical conductivity and redox) were measured using a pre-calibrated YSI water quality meter (provided by Active Environmental Solutions Hire [AESH]) by continuously passing the purged water through a low flow cell.

All groundwater samples were collected into laboratory prepared bottles labelled, and placed in a chilled insulated container. The following sample handling and transport procedures were employed:

- laboratory prepared sample bottles were labelled with individual and unique identification details, including project number and sample number;
- samples collected for the analysis of dissolved metals were field filtered using new 0.45 µm pore size filters;
- samples were placed in insulated coolers and maintained at a cool temperature until transported to the analytical laboratory;
- chain-of-custody documentation was maintained at all times and countersigned by the receiving laboratory on transfer of samples; and
- A National Association of Testing Authorities (NATA) registered laboratory (MPL Laboratories [MPL]) was engaged to conduct the analysis.

5.3 Acid Sulphate Soil Analysis

Initial acid sulphate soil screening tests were undertaken on all soil samples by MPL in accordance with the method as described in Ahern CR, McElnea AE, Sullivan LA (2004), *Acid Sulphate Soils Laboratory Methods Guidelines*. The screening tests comprised measurement of pH of the soil in water (pH_F) and the pH of the soil after oxidation with a 30% solution of hydrogen peroxide (pH_{FOX}).

Following the screening tests, as required by DWER (2015), selected soil samples were submitted to MPL to undergo the SPOCAS suite of analysis. Soil samples were submitted for laboratory analysis with due consideration of the following:

- Lowest reported pH_{FOX} within a soil strata at each test location;
- Reported reaction strength;
- Visual identification of the soils encountered; and
- Depth of excavation.

The screening results and laboratory analysis are presented in Tables D-1, Appendix D along with the detailed laboratory reports and associated chain of custody documentation.

5.4 Groundwater Analysis

Groundwater sampling and analysis is generally required as part of acid sulphate soil investigations to evaluate the following:

- Suitability for disposal (if dewatering is required) and any treatment requirements;
- Vulnerability of the groundwater to acidification; and
- Baseline groundwater quality.

The results of the groundwater investigation enable evaluation of options for dewatering methodologies and the management, treatment and disposal of dewatering effluent. As required by DWER (2015), analysis of groundwater included the following:

- pH, EC, salinity, TDS and TSS;
- total acidity and total alkalinity;
- chloride and sulphate;
- total and dissolved metals/metalloids (aluminium, iron, arsenic, chromium, cadmium, manganese, nickel, selenium and zinc);
- ammoniacal nitrogen and total nitrogen;
- total phosphorus and filterable reactive phosphorus; and
- major anions and cations.

The groundwater quality results are presented in Table D-2, Appendix D together with the detailed laboratory reports and associated chain of custody documentation.

6. Adopted Assessment Criteria

6.1 Acid Sulphate Soils

The screening test results were assessed for the possible presence of actual acid sulphate soil (AASS) or potential acid sulphate soil (PASS) on the basis of the following guidance indicators specified in the DWER (2015), namely:

- $pH_F \leq 4$ strongly indicates oxidation has occurred in the past and that AASS are likely to be present; and
- $pH_{FOX} < 3$, plus a pH_{FOX} reading at least one pH unit below the corresponding pH_F, plus a strong reaction with peroxide, strongly indicates the presence of PASS.

DWER (2015) specifies texture-based action criteria to initiate management of acid sulphate soils. These are summarised in Table 3.

Table 3: Texture-Based Action Criteria

Type of Material		Net Acidity Action Criteria	
		< 1,000 tonnes of material is disturbed	> 1,000 tonnes of material is disturbed
Texture range McDonald et al (1990)	Approx. Clay content (%)	Equivalent sulphur (%S)	Equivalent sulphur (%S)
Coarse texture sands to loamy sands	< 5	0.03	0.03
Medium texture sandy loams to light clays	5 – 40	0.06	0.03
Fine texture medium to heavy clays and silty clays	> 40	0.1	0.03

Note: Table adopted from Table 10 of DWER (2015)

If the net acidity, calculated from the results of the Titratable Actual Acidity (TAA) and the peroxide oxidisable sulphur (S_{POS}) is greater than the appropriate action criterion for the amount of disturbance, it is considered that acid sulphate soils are present and excavations/dewatering within this material would require specific management.

Net acidity using the SPOCAS suite of analysis is calculated as follows:

Net Acidity ($\%_{sulphur}$) = S_{POS} + TAA + S_{NAS} – ANC/FF whereby:

- TAA - titratable actual acidity;
- S_{POS} – peroxide oxidisable sulphur;
- S_{NAS} - retained acidity (reported for pH_{kCl} <4.5);
- ANC_E – excess acid neutralising capacity (reported for pH_{kCl} >6.5); and
- FF – fineness factor (assumed by the laboratory to be 1.5).

As per DWER requirements, in the absence of particle size information, ANC_e has been excluded from the net acidity equation. Given that greater than 1,000 tonnes of soils is likely to be disturbed as part of road extension, an action criterion of 0.03% has been adopted for the assessment.

6.2 Groundwater

Assessment of the groundwater results was undertaken with consideration of the following:

- assessed buffering capacity of groundwater;
- DWER criteria for onsite discharge;
- Short Term and Long Term irrigation criteria (dust suppression); and
- Freshwater criteria as the site is located within a conservation category wetland that is seasonally inundated.

The guideline titled *Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes* [DWER (2015a)] specifies guidance on buffering capacity of groundwater adapted from the Swedish EPA, 2002. These are summarised in Table 4.

Table 4: Assessment of the Buffering Capacity of Groundwater

Class	Designation	Total Alkalinity (mg/L)	pH	Description
1	Very high alkalinity	>180	>6.5	Adequate to maintain acceptable pH in future
2	High alkalinity	60 – 80	>6	Adequate to maintain acceptable pH in future
3	Moderate alkalinity	30 – 60	5.5 – 7.5	Inadequate to maintain stable, acceptable pH level in areas vulnerable to acidification
4	Low alkalinity	10 - 30	5.0 – 6.0	Inadequate to maintain stable, acceptable pH in future
5	Very low alkalinity	<10	<6.0	Unacceptable pH level under all circumstances

Note: Table adopted from Table 5 (DWER, 2015a) which was adapted from Swedish EPA, 2002

DWER (2015a) specifies minimum trigger values for onsite disposal of dewatering effluent in terms of pH and total acidity. Dewatering effluent for onsite disposal should meet the following criteria:

- pH >6; and
- total acidity <40mg/L.

DWER (2015a) outlines a number of chemical indicators which may indicate that groundwater is being affected by, or has already been affected by, the oxidation of sulphides. These include:

- an alkalinity/sulphate ratio of less than 5; and/or
- a soluble aluminium concentration of greater than 1 mg/L.

Additionally, the Groundwater Investigation Levels (GILs) adopted for the assessment are sourced from '*Australian Water Quality Guidelines for Fresh and Marine Water Quality, 2000'* (ANZECC & ARMCANZ, 2000) and '*Contaminated Sites Ground and Surface Water Chemical Screening Guidelines'* (Department of Health [DoH], 2014).

DoH (2014) is designed to protect the health of the public who may be exposed to groundwater that contains chemical residues in a non-potable setting. The guideline states that the level of a chemical in groundwater which requires reporting is generally a factor of ten times the corresponding Health value, or in its absence, the Aesthetic value in the *Australian Drinking Water Guidelines* (NHRMC & NRMMC, 2011) (ADWG). Therefore, for this assessment the domestic non-potable groundwater use criterion has been calculated by multiplying the appropriate ADWG value by ten. The adopted assessment criteria for groundwater are summarised in Table 5.

Table 5: Groundwater Investigation Levels

Analyte	Freshwater Criteria [1] (mg/L)	Short Term Irrigation Waters[1] (mg/L)	Long-Term Irrigation Waters[1] (mg/L)	Domestic non-potable groundwater use[2] (mg/L)
pH	-	6.0 – 8.5	6.0 – 8.5	-
Aluminium	0.055	20	5	2
Arsenic	0.013	2	0.1	0.1
Cadmium	0.0002	0.05	0.01	0.02
Chromium (unspeciated)	0.001	1	0.1	-
Iron (Total)	0.3	10	0.2	3
Manganese	1.9	10	0.2	5
Nickel	0.011	2	0.2	0.2
Selenium	0.005	0.05	0.02	0.1
Zinc	0.008	5	2	30
Chloride	-	-	-	2500
Sulphate	-	-	-	5000
Total Nitrogen	2	25 – 125	5	-
Total Phosphorous	-	0.8 - 12	0.05	-
NOx as N	0.7	-	-	-
Ammonia as N at pH 6	2.57	-	-	-
Phosphate as P	0.06	-	-	-

Notes: [1] Freshwater, Short Term Irrigation and Long Term Irrigation criteria ANZECC & ARMCANZ (2000) *Australian Water Quality Guidelines for Fresh and Marine Water Quality.*
[2] DoH (2014) *Contaminated Sites Ground and Surface Water Chemical Screening Guidelines*

7. Field Work Results

7.1 Sub Surface Conditions

Detailed borehole logs of the ground conditions along the proposed road alignment are presented in Appendix C, together with notes defining sampling methods, soil descriptions, symbols and abbreviations.

The encountered ground conditions generally comprised topsoil sand overlying silty sand and sand with varying degrees of silt followed by clays and/or cemented silty sand. The following profiles were recorded:

- **Topsoil** – brown, grey, fine to medium grained silty sand topsoil to depths of up to 0.3 m at all bore locations except BH05 and BH07;
- **Sand** – white, brown and/or grey, fine to medium grained sands to depths of up to 5.8m (BH10);
- **Cemented Silty Sand** – brown, fine to medium grained cemented silty sand profiles were encountered at the following locations:
  - BH04 between 2.4m to borehole completion (3m);
  - BH08 between 4.3 – 5.3 m and 5.5 – 5.6m;
  - BH10 between 5.8 to borehole completion (6.5m).
- **Clay** – brown-grey low plasticity clay at BH06 between 1.8 – 2.5m; and
- **Silty Sand** – brown and/or grey fine to medium grained silty sand (no cementation evident) at BH04 from 0.3m up to 1.0m and at BH06 from 2.5m to borehole completion ie 3m.

7.2 Groundwater

Depth to groundwater was measured on 15 December 2017. A summary of the recorded groundwater depths and levels are presented in Table 6.

Table 6: Summary of Groundwater Levels – 15 December 2017

Date	Monitoring Bore	Top of Casing (TOC) Level[1] (m AHD)	Surface Level[1] (m AHD)	Groundwater (GW) Depth[2] (m below TOC)	Depth to GW (m below surface)	GW Level[3] m AHD
15/12/2017	BH04	21.287	20.630	1.190	0.533	20.097
	BH06	20.898	20.280	1.035	0.417	19.863
	BH08	25.192	24.510	5.195	4.513	19.997

Notes: [1] Surface levels based on survey completed by Harley Dykstra Pty Ltd on 15 December 2017.
[2] GW Depth measured by DP on 15 December 2017.
[3] Groundwater level = Surface level – Depth to GW.

The recorded groundwater levels at the site were generally in agreement with the levels published in the Perth Groundwater Atlases (1997 and 2003) ie 18 – 21m AHD. In this regard, it should also be noted that groundwater levels are affected by climatic conditions and soil permeability, and can therefore fluctuate over time.

7.3 Acid Sulphate Soil Testing Results

The screening and laboratory analysis results are presented in Tables D-1, Appendix D, together with the relevant laboratory reports and associated chain-of-custody reports.

7.4 Groundwater Testing Results

The groundwater laboratory results are presented in Table D-2, Appendix D, together with the laboratory reports and associated chain-of-custody reports.

8. Quality Control

8.1 Field Quality Control

As specified under Australian Standard 4482.1-2005 and Australian Standard 5667.1:1998 for Water Quality, the testing program allowed for the collection and analysis of "*blind replicate samples*" for Quality Assurance (QA) purposes. The laboratory results of the blind replicate samples provided an indication of the repeatability of results, as the relative percentage difference (RPD).

To calculate RPD, the following formula was used:

$$\text{RPD (\%)} = \frac{\text{(Result No.1 – Result No. 2)}}{\text{mean result}} \times 100$$

An RPD of 0% to 50% is generally considered acceptable. RPDs should also be assessed in the context of the actual concentration differences registered between the replicate pairs such that, where concentrations less than 10 times the limit of reporting (LOR) are involved, the recommended RPD range of 0% to 50% is not applicable and a wider range of RPD values may be considered acceptable.

Eleven QA/QC samples (ie 10 soil samples and one groundwater sample) were collected and analysed during the current assessment. The calculated RPD results presented in Tables D-3 and D-4, Appendix D ranged from 0% to 133%. In this regard, RPDs greater than 50% were only recorded in two samples.

An RPD of 109% was calculated for TPA (primary 0.041% S and duplicate 0.14% S) for the soil sample collected at test location BH06/2.5, and was outside the acceptable range. As a conservative approach, the higher concentration (0.14% S) has been included in the assessment.

An RPD of 133% was calculated for zinc concentrations (primary 0.015 mg/L, duplicate 0.003 mg/L) for the groundwater sample collected at BH04, which is outside the acceptable range. However, this is not considered to be significant given the following:

- The low actual difference in the concentration of the duplicate pair where RPD exceedance occurred. High RPD values reflect the small differences between two small numbers;
- Most of the recorded concentrations are relatively close to the LOR/PQL. High RPD values reflect the low concentrations.

Generally the results indicate that the sampling methods were acceptable and that the media sampled and analysed were representative of the conditions actually encountered.

8.2 Laboratory Quality Control

MPL undertook internal quality assurance and control analysis testing which comprised:

- review of sample preservation and sample containers;
- review of holding times;
- Laboratory Duplicates;
- Method Blank and Laboratory Control Samples; and
- Matrix Spikes.

Review of the information and results from these tests indicate that no non-conformances or outliers occurred.

9. Proposed Development

It is understood that Garden Street is proposed to be extended between Harpenden Street to Balfour Street in Huntingdale. The proposed road extension will likely require the clearing of up to 4.35 ha of native vegetation between chainages 0 m to 850 m (the site) and integration of the extensions with the existing Holmes Street.

DP understands that the proposed works relevant to the preliminary acid sulphate soil and groundwater investigation at the site are associated with ground disturbing activities generally limited to the following:

- removal of topsoil (typically 0.1 m); and
- limited cut and fill to achieve design levels.

Additionally, based on Drawings E90-15-002 and E90-15-003, Appendix B (provided by the CoG) and discussion with the CoG, the following is understood with respect to the alignment of the proposed road extension:

- The total length of the extension works is approximately 850m (ie between chainages 0 – 850m). The remainder of the works are only associated with integration of the extension with the existing Holmes Street;
- Existing surface levels at the site range between RL 20.3 m (relative to the Australian Height Datum [AHD]) and RL 27.6 m AHD;
- The proposed finished road level ranges between RL 21.27 m AHD and RL 23.01 m AHD;
- To achieve design levels a '*cut*' is required in two sections of the proposed road extension, ie between chainages 0 m to 240 m (maximum cut of 1.2 m) and 630 m to 850 m (maximum cut of 5.1 m). Furthermore, based on information provided by the City of Gosnells, it is understood that

as part of site preparation works, the excavations are anticipated to extend to a maximum depth of 0.5m below the final design levels. On this basis, in areas where a "*cut*" is proposed to achieve design levels, the excavations are likely to extend to approximately RL 21.52m AHD (between chainages 0 – 240m) and approximately RL 21.98m AHD (between chainages 630 – 850m). Furthermore, at the chainage 210m (location of excavation to lowest level), the excavation is anticipated to extend to RL 21.245, AHD; and

- To achieve design levels '*fill*' is required in one section of the site, ie between chainages 240 m to 630 m (maximum fill of 2.1 m).

10. Assessment and Discussion of Results

10.1 Acid Sulphate Soils

The screening test results presented in Table D-1, Appendix D indicate the following:

- the results for pH_F were not indicative of actual acid sulphate soil conditions at 172 soil samples collected along the proposed road alignment; and
- the results for pH_{FOX} were indicative of potential acid sulphate soil conditions along the proposed road alignment with 16 out of 172 samples reporting pH_{FOX}< 3 (~9%).

It is noted that the screening tests undertaken by MPL are indicative only and inferences made from these results should be confirmed by further laboratory testing ie SPOCAS analysis.

The results of SPOCAS analysis on selected soil samples which are summarised in Table D-1, Appendix D, indicate that the calculated net acidity values using S_{POS}, excluding ANC, were above the adopted action criterion of 0.03% S in 4 out of 20 samples (~20%). Net acidities were reported to a maximum of 0.077% S in materials described as grey or brown silty sands.

In order to evaluate the locations and quantity of materials that may require management during the proposed road extension, a summary of the interpolated depth to the top of exceedance is presented in Table 7. The interpretation of the top of exceedance has been undertaken based on the following:

- pH_F reported less than 4.0;
- pH_{FOX} reported less than 3.0;
- Net acidity reported greater than 0.03% S; and
- Exceedences within a similar soil type.

Review of the data indicates that in the majority of the test bores, the anticipated maximum depth of the excavations are unlikely to extend into profiles where exceedances have been recorded. In this regard it is also noted that in the samples collected from BH01 at 1.25m, BH02 at 1.75m, BH09 at 1.75m and BH11 at 2.0m, pH_{FOX} exceedances were recorded in white sands at these specific depths only. As such, similar pH_{FOX} exceedances were not recorded in other samples collected from the same profiles at these bores. Furthermore, the pH_{FOX} exceedances in these samples were not accompanied by SPOCAS exceedances, and review of the TAA and S_{POS} data when compared with TPA data for these samples indicates that the acidity is likely being generated from other sources (such as organic matter) rather than from sulphidic ores. Consequently, the recorded pH_{FOX}

exceedances in the samples collected from BH01 at1.25m, BH02 at 1.75m, BH09 at 1.75m and BH11 at 2.0m are not considered to be representative of potential acid sulphate soils.

Table 7: Summary of Exceedences with Respect to Excavation Depth

Borehole Location	Surface Level (m AHD)	Proposed Road Extension			Interpolated depth to top of exceedance[5] (m)	Management Required
		Chainage (m)	Finished Level[1] (m AHD)	Anticipated Maximum Excavation Depth (m)		
BH01	~22.9 [1]	~100	22.27	1.0	>2.0 1.25 [3]	No (refer discussion below)
BH02	~23.2 [1]	~150	22.02	1.7	>2.0 1.75 [3]	No (refer discussion below)
BH03	~22.7 [1]	~200	21.77	1.5	>2.0 ND	No
BH04	20.63 [2]	~300	22.17	-0.8 (fill)	0.3 [4]	No
BH05	~21.4 [1]	~400	22.67	-0.8 (fill)	>1.0	No
BH06	20.28 [2]	~500	22.36	-1.5 (fill)	2.5 [4]	No
BH07	~21.0 [1]	~600	21.78	-0.3 (fill)	>1.0	No
BH08	24.51 [2]	~650	22.03	3	4.3	No
BH09	~26.3 [1]	~700	22.28	4.5	>5.5 1.75 [3]	No (refer discussion below)
BH10	~27.6 [1]	~750	22.53	5.5	5.8 [4]	No
BH11	~26.0 [1]	~800	22.67	3.9	>5.0 2.0 [3]	No (refer discussion below)
BH12	~22.7 [1]	~850	22.28	0.9	>2.0	No

Note: [1] Surface levels and Finished levels interpolated from information provided by the client (Drawings E90-15-002 and E90-15-003, refer Appendix B).

[2] Surface levels based on topographical survey completed by Harley Dykstra on 15 December 2017.

[3] pH_{FOX} exceedance recorded at specific depth only, and not accompanied by a SPOCAS exceedance. Also refer discussion below.

[4] SPOCAS exceedance recorded in profile, and hence interpolated depth taken from top of offending profile.

[5] Interpolated exceedences based on net acidity > 0.03% and/or pHFOX <3.0 and soil descriptions.

ND - No exceedances recorded

Whilst acid sulphate soils have been identified in the grey and/or brown silty sand profiles at BH04 at 0.3m, BH06 at 2.5m and BH10 at 5.8m, it is noted that the anticipated maximum extent of the proposed excavations in the vicinity of these locations are not anticipated to intersect the silty sand profiles comprising acid sulphate soils. Therefore, based on the results of the acid sulphate soil investigation along the alignment of the proposed Garden Street extension, management of acid sulphate soils (ie lime dosing of soils) is not deemed to be warranted. However, given the interpolated top of exceedance is likely to be close to the base of excavation at BH10 and noting that ASS are present at shallow depths (~0.3m) in the vicinity of BH04 (where filling will be undertaken), it

is recommended that in order to reduce the potential risk of acidification of the base of the excavation, a layer of ag-lime should be placed over the base of the trench between bore locations BH09 – BH11 and BH03 to BH05.

10.2 Groundwater Quality and Potential Dewatering Issues

With regard to groundwater quality, a summary of selected groundwater laboratory results are presented in Table 8. As such, the groundwater analytical results have been compared to the assessment criteria as a precautionary measure and to provide baseline groundwater quality data only.

Table 8: Summary of Selected Water Quality Parameters

Analytes		Groundwater Monitoring Bore		
		BH04	BH06	BH08
Field pH	-	4.89	6.19	4.33
Total Dissolved Solids	(mg/L)	250	7500	180
Total Acidity	(mg/L)	140	61	54
Total Alkalinity	(mg/L)	11	180	<5
Sulphate	(mg/L)	29	300	10
Chloride	(mg/L)	57	3800	43
Total Nitrogen	(mg/L)	7.4	4.5	6.8
Total Phosphorus	(mg/L)	<0.05	<0.05	1.1
Dissolved Aluminium	(mg/L)	1.9	0.67	1.7
Dissolved Iron	(mg/L)	19	0.08	1.1

With consideration of the assessment criteria presented in Table 4 for assessment of buffering capacity, the results for field pH and total alkalinity generally indicate that:

- at BH04, the groundwater would be categorised as Class 4 with low pH (Inadequate to maintain stable, acceptable pH in future). Additionally, a review of the chemical indicators, namely the alkalinity/sulphate ratio and the dissolved aluminium concentrations (>1 mg/L), suggests that the groundwater may be being affected by, or has already been affected by the oxidation of sulphides;
- at BH06, the groundwater would be categorised as saline (ie >5000 mg/L) and Class 2 (Adequate to maintain acceptable pH in future); and
- at BH08, the groundwater would be categorised as Class 5 with very low alkalinity (Unacceptable pH level under all circumstance). Additionally, a review of the chemical indicators, namely the alkalinity/sulphate ratio and the dissolved aluminium concentrations (>1 mg/L), suggests that the groundwater may be being affected by, or has already been affected by the oxidation of sulphides.

The following GIL exceedances were also recorded:

- Physical Parameters:
  - pH was below the short term irrigation (STI) and long term irrigation (LTI) criteria (pH 6.0-8.5) at monitoring bores BH04 (4.4) and BH08 (4.3);
  - chloride concentration in BH06 (3,800 mg/L) exceeded the domestic non-potable (DNP) criterion of 250 mg/L;
- Nutrients:
  - total nitrogen concentrations in BH04 (7.4 mg/L) and BH08 (6.8 mg/L) exceeded the freshwater (FW, 2 mg/L), STI (25 -125 mg/L) and LTI (5mg/L) criteria;
  - NOx as nitrogen concentrations in BH04 (1.1 mg/L) and BH08 (3mg/L) exceeded the FW criterion of 0.7 mg/L;
  - The concentration of Phosphate as P in BH08 (0.43mg/L) exceeded the LTI criterion (0.05 mg/L);
- Dissolved metals:
  - Aluminum concentrations in all samples exceeded the DNP (0.055 mg/L) and FW (0.2 mg/L) criteria;
  - Chromium concentrations in all samples exceeded the adopted FW criterion of 0.001 mg/L;
  - Iron concentrations in BH04 (19 mg/L) and BH08 (1.1 mg/L) exceeded the FW (0.3 mg/L), LTI (0.2 mg/L) and DNP (0.3 mg/L) criteria. Additionally, the iron concentrations in BH04 also exceeded the STI criterion of 10 mg/L;
  - Zinc concentrations in all samples exceeded the FW criterion of 0.008 mg/L.

Therefore, a review of the baseline groundwater quality data for the site indicates that a number of GIL exceedances have been detected. Notwithstanding, the recorded exceedances are most likely attributable to regional sources and are considered to be generally representative of the groundwater quality in the area.

With regard to groundwater levels, given the recorded groundwater levels of between RL 19.863 m AHD and RL 20.097 m AHD in December 2017 (close the annual maximum) and noting that the excavations will extend to a maximum RL 21.245m AHD, dewatering to facilitate excavation during the road extension works is unlikely to be required as long as the excavations are completed during the dry season. In this regard, it should also be noted that groundwater levels are affected by climatic conditions and soil permeability, and can therefore fluctuate over time. Therefore, it is emphasized that the groundwater levels should be verified immediately prior to the commencement of works. Furthermore, if the design levels change and/or deeper excavations are required, the potential for intersecting the water table should be reassessed.

With regard to the potential for dewatering at the site, DP recommends that the construction works should be undertaken during the dry season, and to the extent practical, dewatering should be avoided at the site for the following reasons:

- With reference to Section 4.6, the site is located within a conservation category wetland. Section 3.3.9 of DWER (2015a) notes that dewatering or any other groundwater disturbance should not be allowed to cause the lowering of the water level in a water body with environmental

value (including a conservation category wetland), and should not lower the water level by more than 10cm next to the body;

- With reference to Section 4.5, it is noted that the areas between chainages 240m and 630m are prone to flooding during the wet season. Additionally, review of the soil data for the current investigation indicates that acid sulphate soils are present in the silty sand profiles. In this regard in the vicinity of BH04 (chainage 300m), acid sulphate soils are present at reasonably shallow depths of approximately 0.3m. As such, even minor lowering of the water table in the area therefore has the potential to expose acid sulphate soils. Furthermore, review of the groundwater quality results for the site also indicates that the groundwater at the site typically ranges between Class 4 – 5, and therefore has a very low buffering capacity. Consequently, disturbances to the water levels and water quality at the site should be avoided.
- Given that parts of the site are located within a conservation category wetland, it is currently not known if the existing vegetation species would be sensitive to any drawdown. Additionally, the groundwater at BH06 was found to be saline, and would therefore pose a concern in relation to management of the effluent if it were to be discharged on site.

Given the sensitive nature of the wetland and in light of the low groundwater pH and apparent absence of alkalinity, DP also recommends that a groundwater monitoring event should be undertaken to ascertain groundwater levels and baseline groundwater data immediately prior to construction. Subsequently, a post-construction groundwater monitoring event should also be undertaken with a view to comparing the data against the baseline data and to evaluate whether significant changes to groundwater quality have occurred as a result of the road extension works.

11. Potential Impacts

The potential impacts associated with the excavation works described previously required for the Garden Street extension is summarised in Table 9.

Table 9: Potential Impacts – Excavations

Potential Impact	Environmental Objective	Proposed Management
• the base of the excavation could become acidic and mobilise metals species to groundwater.	• minimise potential impacts to soil and groundwater as a result of acidic soil and /or acid sulphate soils.	Based on the results of the acid sulphate soil investigation along the alignment of the proposed Garden Street extension, management of acid sulphate soils (ie lime dosing of soils) is not deemed to be warranted. However, given the interpolated top of exceedance is likely to be close to the base of excavation at BH10 and noting that ASS are present at shallow depths (~0.3m) in the vicinity of BH04 (where filling will be undertaken), it is recommended that in order to reduce the potential risk of acidification of the base of the excavation, a layer of ag-lime should be placed over the base of the trench between test locations BH09 – BH11 and BH03 to BH05.

12. Conclusions and Recommendations

Based on the results of the investigation, DP concludes that whilst acid sulphate soils have been identified in the silty sand profiles at BH04 at 0.3m, BH06 at 2.5m and BH10 at 5.8m, it is noted that the anticipated maximum extent of the proposed excavations in the vicinity of these locations are not anticipated to intersect the silty sand profiles comprising acid sulphate soils. Therefore, based on the results of the acid sulphate soil investigation along the proposed alignment of the Garden Street extension, management of acid sulphate soils (ie lime dosing of soils) is not deemed to be warranted. However, given the interpolated top of exceedance is likely to be close to the base of excavation at BH10 and noting that ASS are present at shallow depths (~0.3m) in the vicinity of BH04 (where filling will be undertaken), it is recommended that in order to reduce the potential risk of acidification of the base of the excavation, a layer of ag-lime should be placed over the base of the trench between test locations BH09 – BH11 and BH03 to BH05. A rate of 1 kg/m^2 using a good quality ag-lime with a minimum effective neutralising capacity (ENV) of 50% is recommended.

With regards to groundwater, given the recorded groundwater levels of between RL 19.863 m AHD and RL 20.097 m AHD in December 2017 (close the annual maximum) and noting that the excavations will extend to a maximum RL 21.245m AHD, dewatering to facilitate excavation during the road extension works is unlikely to be required as long as the excavations are completed during the dry season. In this regard, it should also be noted that groundwater levels are affected by climatic conditions and soil permeability, and can therefore fluctuate over time. Therefore, it is emphasized that the groundwater levels should be verified immediately prior to the commencement of works. Furthermore, if the design levels change and/or deeper excavations are required, the potential for intersecting the water table should be reassessed.

With regard to the potential for dewatering at the site, DP recommends that the construction works should be undertaken during the dry season, and to the extent practical, dewatering should be avoided at the site for the following reasons:

- With reference to Section 4.6, the site is located within a conservation category wetland. Section 3.3.9 of DWER (2015a) notes that dewatering or any other groundwater disturbance should not be allowed to cause the lowering of the water level in a water body with environmental value (including a conservation category wetland), and should not lower the water level by more than 10cm next to the body;
- With reference to Section 4.5, it is noted that the areas between chainages 240m and 630m are prone to flooding during the wet season. Additionally, review of the soil data for the current investigation indicates that acid sulphate soils are present in the silty sand profiles. In this regard in the vicinity of BH04 (chainage 300m), acid sulphate soils are present at reasonably shallow depths of approximately 0.3m. As such, even minor lowering of the water table in the area therefore has the potential to expose acid sulphate soils. Furthermore, review of the groundwater quality results for the site also indicates that the groundwater at the site typically ranges between Class 4 – 5, and therefore has a very low buffering capacity. Consequently, disturbances to the water levels and water quality at the site should be avoided.
- Given that parts of the site are located within a conservation category wetland, it is currently not known if the existing vegetation species would be sensitive to any drawdown. Additionally, the groundwater at BH06 was found to be saline, and would therefore pose a concern in relation to management of the effluent if it were to be discharged on site.

Given the sensitive nature of the wetland and in light of the low groundwater pH and apparent absence of alkalinity, DP also recommends that a groundwater monitoring event should be undertaken to ascertain groundwater levels and baseline groundwater data immediately prior to construction. Subsequently, a post-construction groundwater monitoring event should also be undertaken with a view to comparing the data against the baseline data and to evaluate whether significant changes to groundwater quality have occurred as a result of the road extension works.

13. References

Ahern CR., Ahern MR., and Powell B, *Guidelines for Sampling and Analysis of Lowland Acid Sulphate Soils (ASS) in Queensland 1998*, QASSIT, Department of Natural Resource, Resources Sciences Centre, Indooroopilly, Queensland.

AS 1726 -1993, *Geotechnical Site Investigations.*

Australian Standards AS 4482.1-2005, *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 1:Non-volatile and Semi-volatile substances*.

Department of Environment Regulation (June 2015) *Identification and Investigation of* Acid Sulphate *Soils and Acidic Landscapes*, Perth, Western Australia.

Department of Environment Regulation (June 2015) Treatment and Management of Soil and Water in Acid Sulphate Soil Landscapes, Perth, Western Australia.

Geological Survey of Western Australia (1986), 1:50 000 Environmental Geology Series.

Waters & Rivers Commission (2001) Position Statement: Wetlands.

14. Limitations

Douglas Partners (DP) has prepared this report for the proposed Garden Street extension, located between Harpenden Street and Holmes Street, Huntingdale, WA in accordance with DP's proposal (PER170430) dated 6 October 2017. Acceptance of this proposal (PER170430) was received from Ms Glenda Lawrence of City of Gosnells. The report is provided for the exclusive use of the City of Gosnells for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. 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 only at the specific sampling 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 anthropogenic 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 limited by undetected variations in ground conditions between sampling 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 notes 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 given 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.

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.

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.

Appendix A

About This Report
Drawings

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

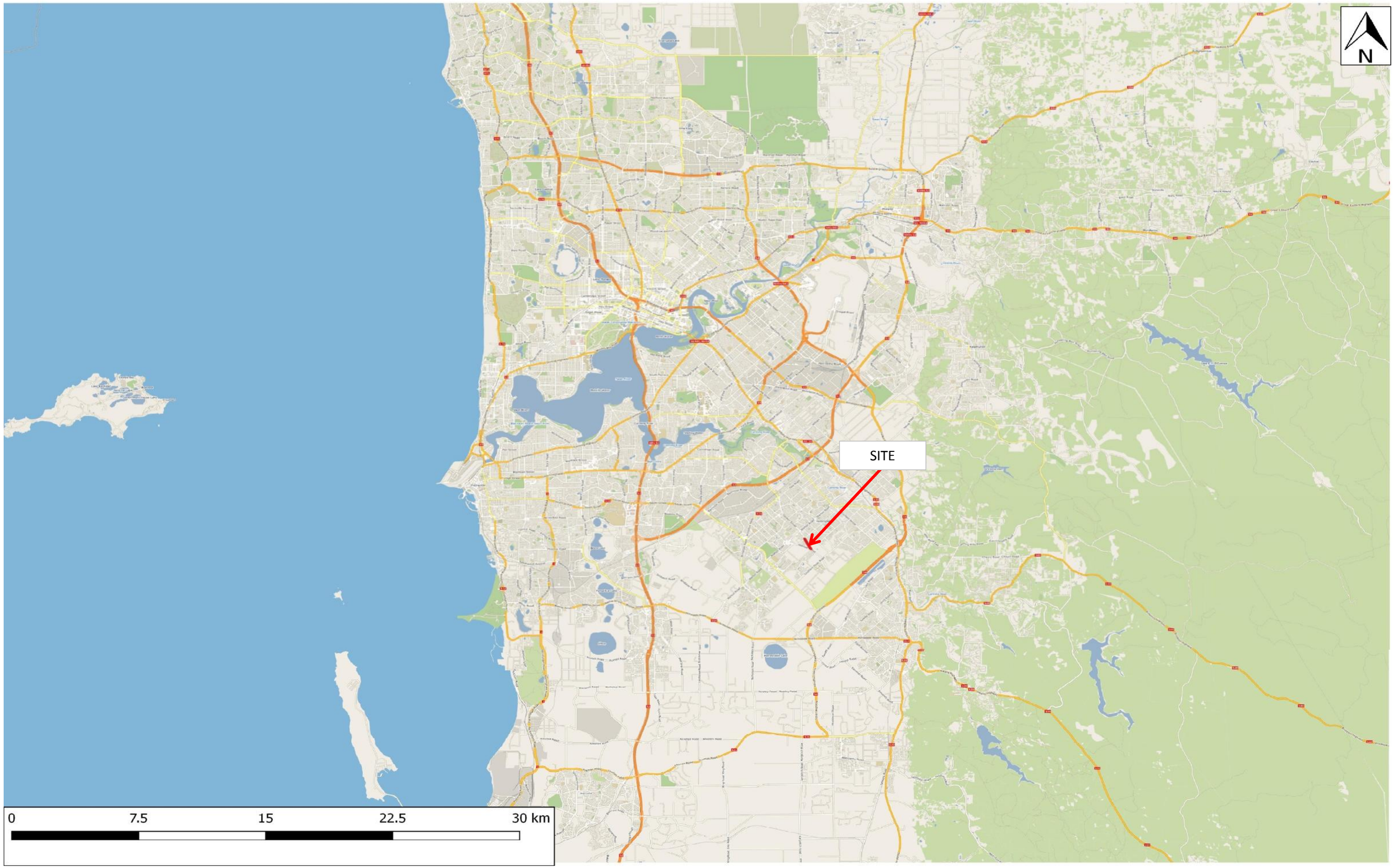
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later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

Information for Contractual Purposes

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

Site Inspection

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



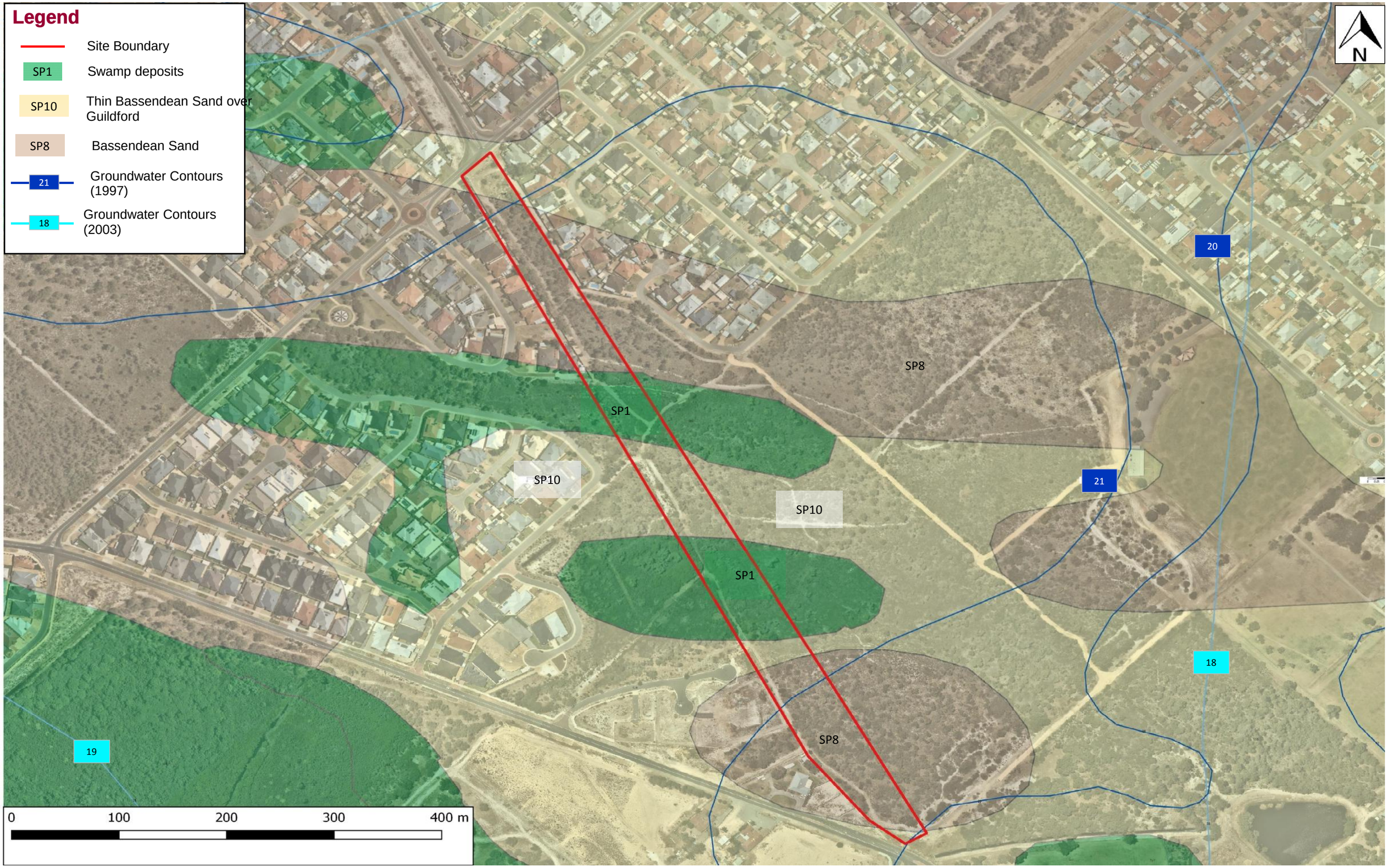
Base Image Source: Street Maps

Douglas Partners
Geotechnics / Environment / Groundwater

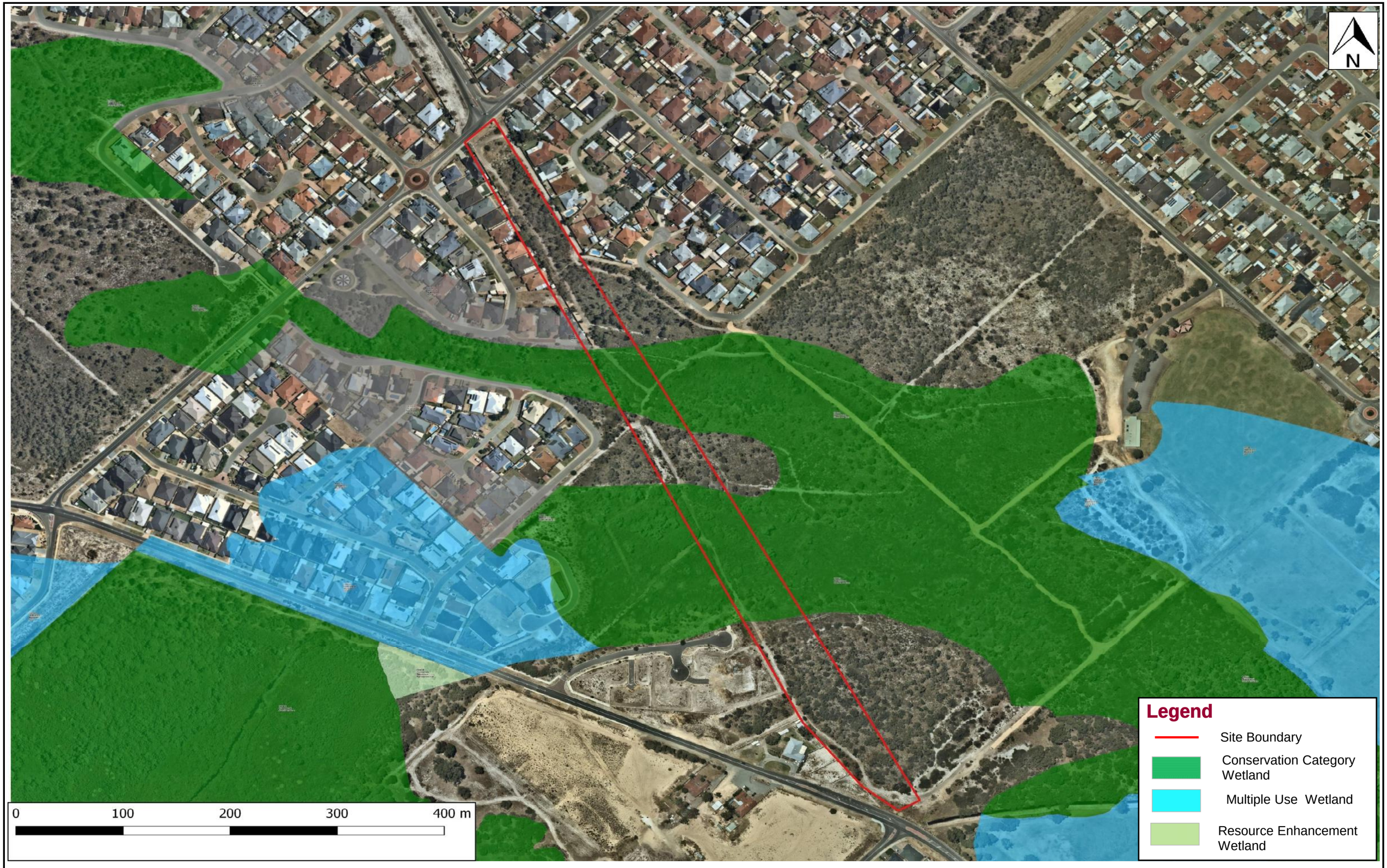
CLIENT: City of Gosnells		**Locality Plan**	Project 88978.00
OFFICE: Perth	DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No: 1
SCALE: As shown	DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision: 0

Base Image Source: Nearmap

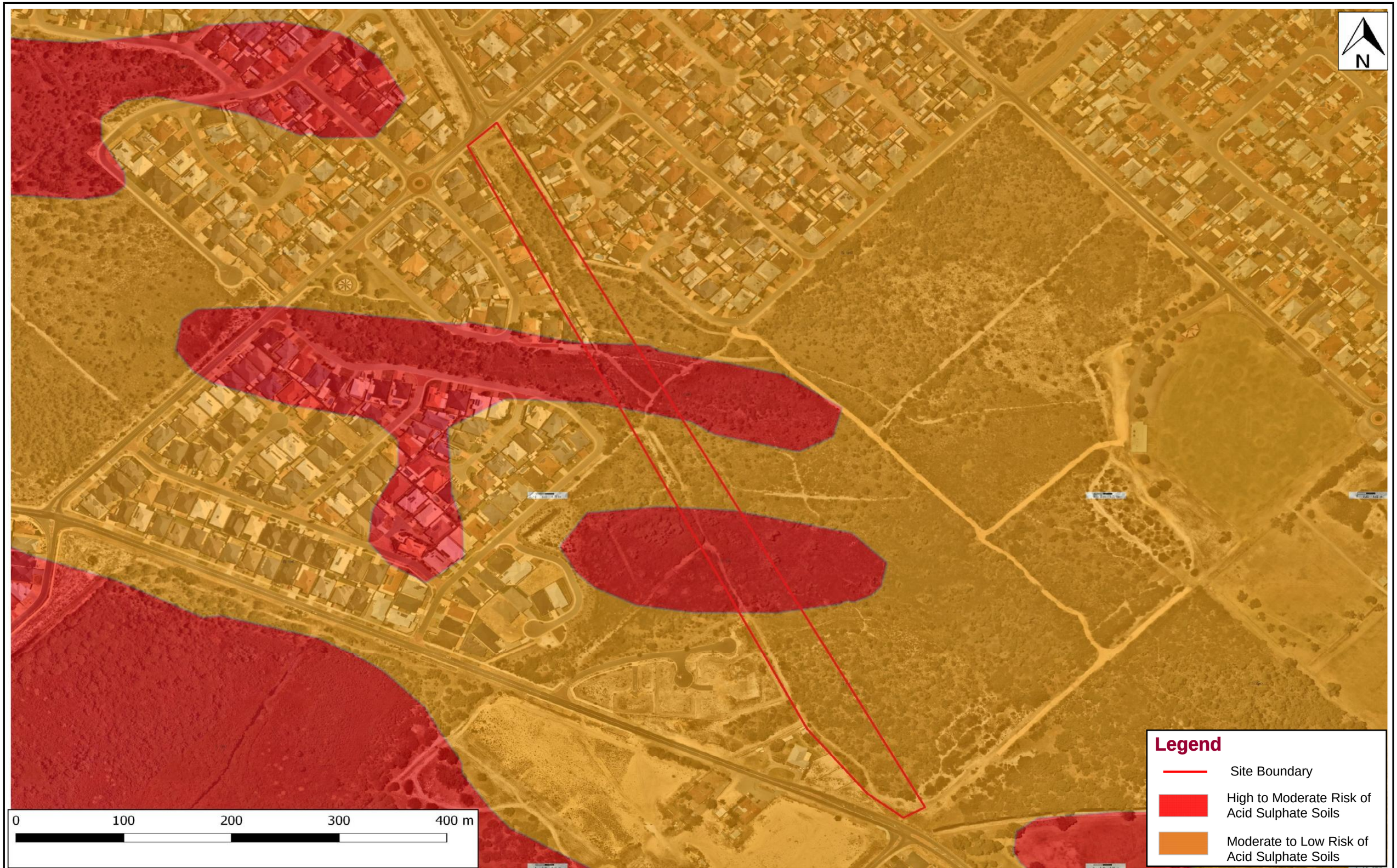
Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: City of Gosnells	**Site Aerial Photograph**	Project 88978.00
	OFFICE: Perth DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No: 2
	SCALE: As shown DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision: 0



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: City of Gosnells	**Published Geology and Groundwater Contour Mapping**	Project 88978.00
	OFFICE: Perth DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No: 3
	SCALE: As shown DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision: 0



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: City of Gosnells		**Published Geomorphic Wetland Mapping**	Project	88978.00
	OFFICE: Perth	DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No:	4
	SCALE: As shown	DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision:	0



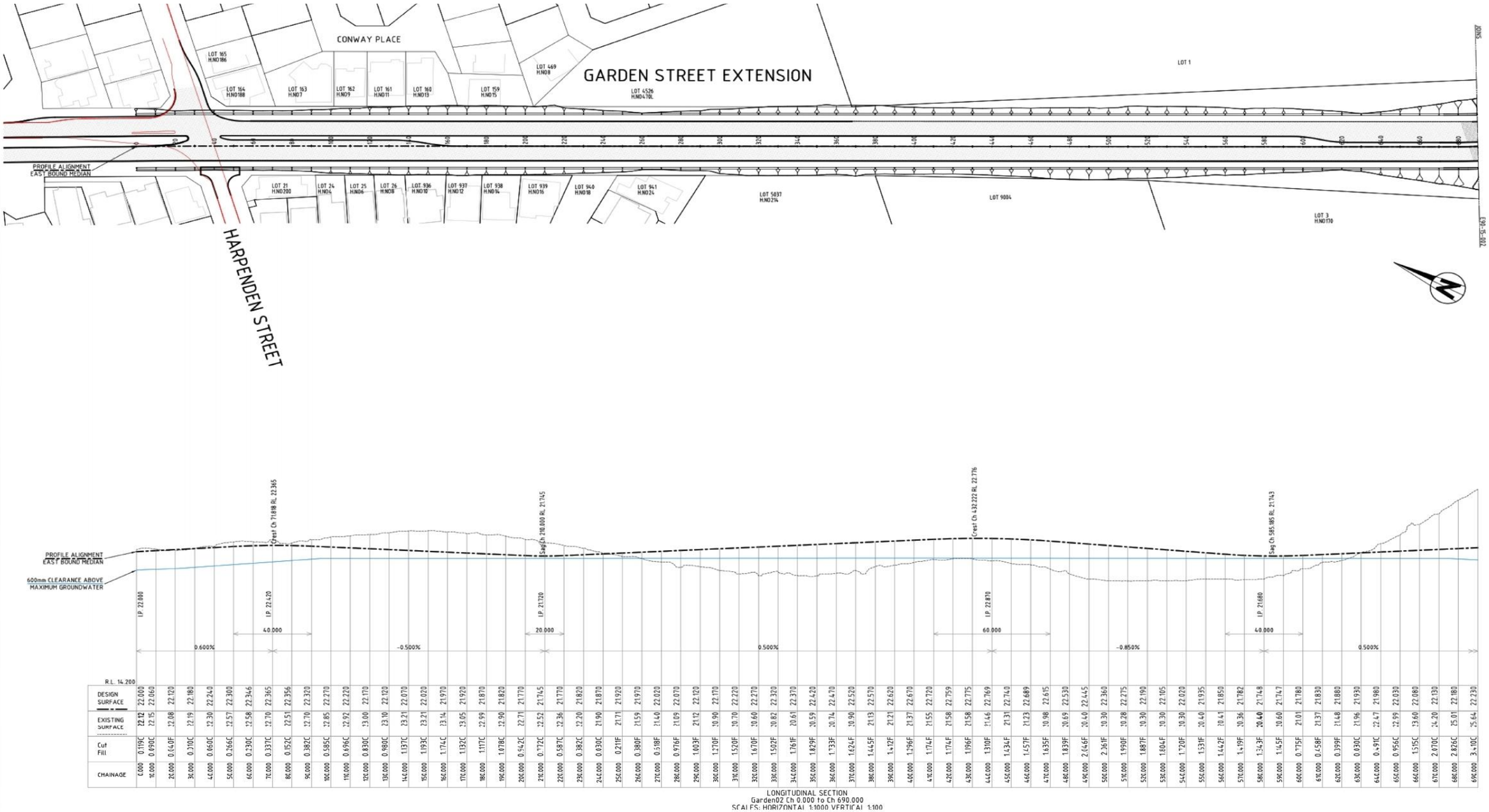
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Gosnells		**Published Acid Sulphate Soil Risk Mapping**	Project 88978.00
OFFICE: Perth	DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No: 5
SCALE: As shown	DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision: 0

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: City of Gosnells		**Published Acid Sulphate Soil Risk Mapping**	Project	88978.00
	OFFICE: Perth	DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No:	6
	SCALE: As shown	DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision:	0

Appendix B

Longitudinal Sections for Proposed Development (Client Supplied)



AMENDMENTS					
REV	DATE	DESCRIPTION	BY	CHK'D	APP'D

GENERAL NOTES

1. THIS DRAWING ALWAYS REMAINS THE PROPERTY OF THE CITY OF GOSNELLS AND MUST NOT BE RETAINED OR REPRODUCED WITHOUT PERMISSION.
2. IN THE ABSENCE OF THE APPROVED SIGNATURE (ie MANAGER TECHNICAL SERVICES) THIS DRAWING SHALL BE TREATED AS PRELIMINARY.
3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. ANNOTATED DIMENSIONS SHALL ALWAYS TAKE PRECEDENCE OVER SCALED DISTANCES.

NOTE:
ALL WORKS SHALL BE IMPLEMENTED IN ACCORDANCE WITH THE CITY'S SPECIFICATIONS, CONTRACTUAL CONDITIONS AND INDUSTRY BEST PRACTICE, BUT WHERE NO DETAILS HAVE BEEN PROVIDED, TO THE REQUIREMENTS OF THE PROJECT DESIGNER. ANY CONFLICTS, OMISSIONS, ISSUES OR VARIATIONS ARE TO BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE PROJECT DESIGNER.

CITY OF GOSNELLS
TECHNICAL SERVICES
2120 Albany Highway Gosnells 6110
PO Box 662 Gosnells 6990
Western Australia
Telephone 08 9397 3000
Facsimile 08 9397 3333
Online www.gosnells.wa.gov.au

DESIGN	GR	DATE	NOV'15
DRAWN	GR		NOV'15
CHECKED			
SURVEY	AERIAL/SR		

SCALE: HORIZ. 1:1000 VERT. 1:100
DATUM: AHD
GRID SYSTEM: PCG
JOB NUMBER: FP

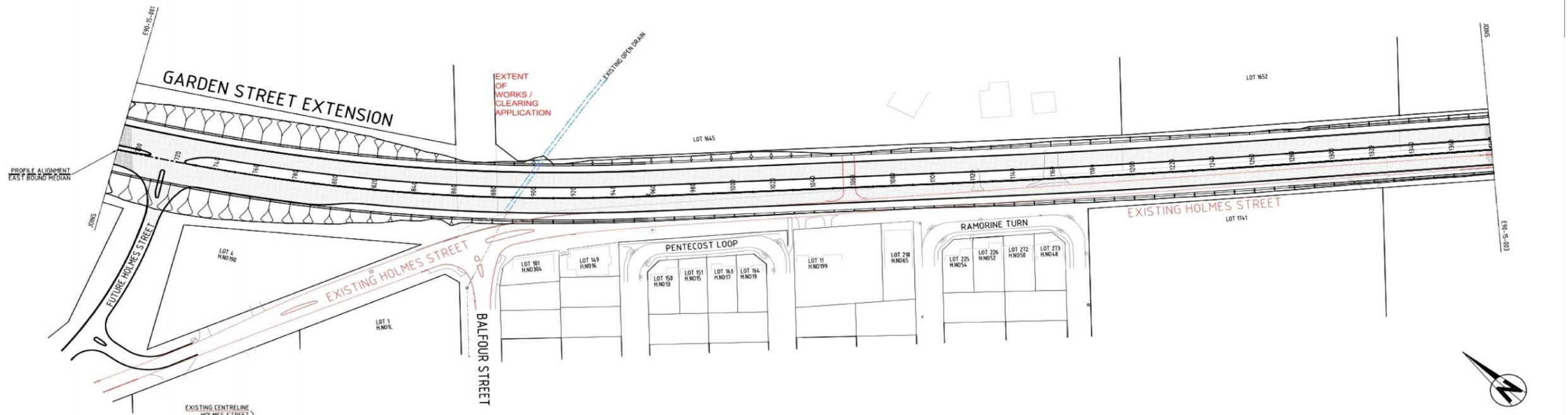
PROJECT: GARDEN STREET EXTENSION
HARPENDEN STREET TO PASSMORE STREET
DRAWING TITLE: ROADWORKS
PLAN AND PROFILE
CH 0 TO CH 690

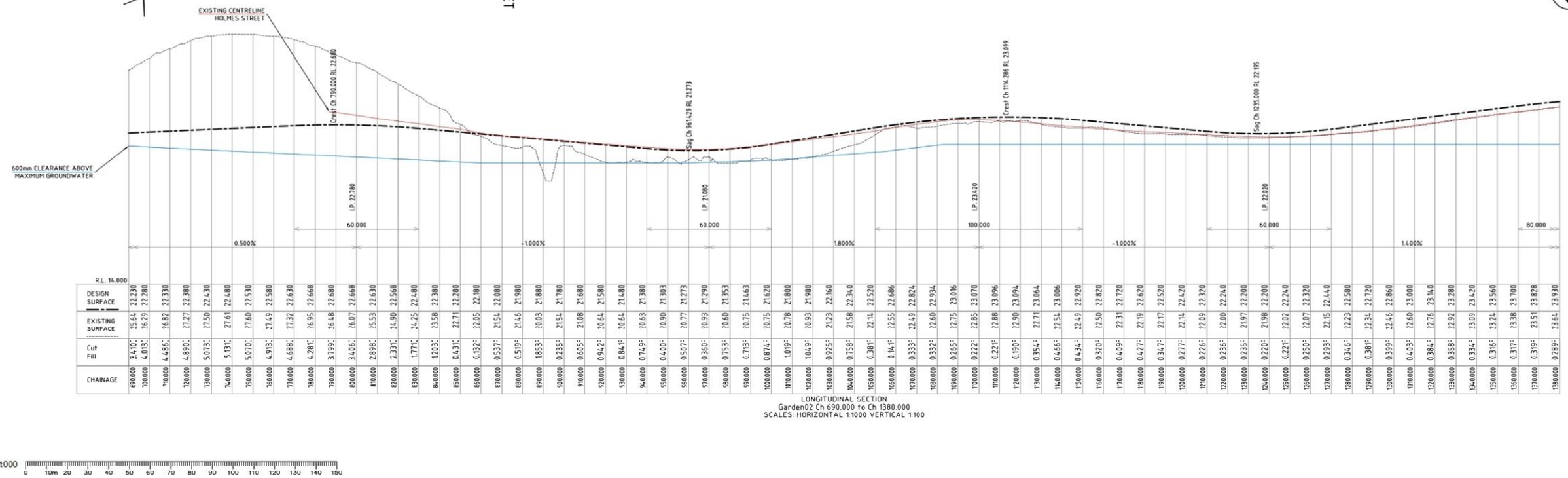
PLAN No E90-15-002 REV
FORWARD PLANNING | A1
MANAGER TECHNICAL SERVICES
M BOTTE DATE

Base Image Source: Drawing supplied by City of Gosnells (Plan No. E90-15-002)

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Gosnells		**Longitudinal Section - Chainage 0 m - 690m**	Project: 88978.00
OFFICE: Perth	DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No: B-1
SCALE: As shown	DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision: 0





AMENDMENTS					
REV	DATE	DESCRIPTION	BY	CHK'D	APP'D

GENERAL NOTES

1. THIS DRAWING ALWAYS REMAINS THE PROPERTY OF THE CITY OF GOSNELLS AND MUST NOT BE RETAINED OR REPRODUCED WITHOUT PERMISSION.
2. IN THE ABSENCE OF THE APPROVED SIGNATURE (ie MANAGER TECHNICAL SERVICES) THIS DRAWING SHALL BE TREATED AS PRELIMINARY.
3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. ANNOTATED DIMENSIONS SHALL ALWAYS TAKE PRECEDENCE OVER SCALED DISTANCES.

NOTE:
ALL WORKS SHALL BE IMPLEMENTED IN ACCORDANCE WITH THE CITY'S SPECIFICATIONS, CONTRACTUAL CONDITIONS AND INDUSTRY BEST PRACTICE, BUT WHERE NO DETAILS HAVE BEEN PROVIDED, TO THE REQUIREMENTS OF THE PROJECT DESIGNER. ANY CONFLICTS, OMISSIONS, ISSUES OR VARIATIONS ARE TO BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE PROJECT DESIGNER.

CITY OF GOSNELLS

TECHNICAL SERVICES

2120 Albany Highway Gosnells 6110
PO Box 662 Gosnells 6990
Western Australia

Telephone 08 9397 3000
Facsimile 08 9397 3333
Online www.gosnells.wa.gov.au

DESIGN	GR	DATE	NOV'15
DRAWN	GR		NOV'15
CHECKED			
SURVEY	AERIAL/SR		

SCALE HORIZ. 1:1000 VERT. 1:100
DATUM AHD
GRID SYSTEM PCG
JOB NUMBER FP

PROJECT
GARDEN STREET EXTENSION
HARPENDEN STREET TO PASSMORE STREET

DRAWING TITLE
ROADWORKS
PLAN AND PROFILE
CH 690 TO CH 1380

PLAN No E90-15-003 REV

FORWARD PLANNING | A1

MANAGER TECHNICAL SERVICES
M. BOTTE DATE

Base Image Source: Drawing supplied by City of Gosnells (Plan No. E90-15-003)

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Gosnells		**Longitudinal Section - Chainage 690 m - 1380m**	Project 88978.00
OFFICE: Perth	DRAWN BY: NSA	Preliminary Acid Sulphate Soil and Groundwater Investigation	Drawing No: B-2
SCALE: As shown	DATE: December 2017	Corner of Garden and Harpenden Street, Huntingdale	Revision: 0

Appendix C

Borehole Logs (BH01 to BH12)
Sampling Methods, Soil Descriptions, Symbols and Abbreviations

Sampling Methods

Douglas Partners

Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. 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	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

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

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

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	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

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;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

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

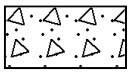
Symbols & Abbreviations

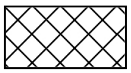
Graphic Symbols for Soil and Rock

General

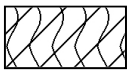

Asphalt

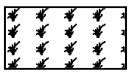

Road base

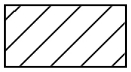

Concrete

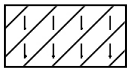

Filling

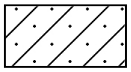
Soils


Topsoil

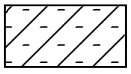

Peat

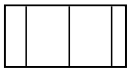

Clay

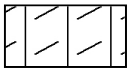

Silty clay

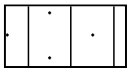

Sandy clay

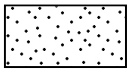

Gravelly clay

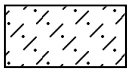

Shaly clay

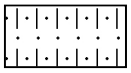

Silt


Clayey silt


Sandy silt

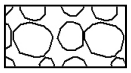

Sand

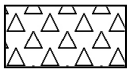

Clayey sand


Silty sand


Gravel

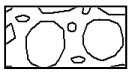

Sandy gravel


Cobbles, boulders

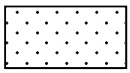

Talus

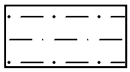
Sedimentary Rocks

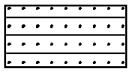

Boulder conglomerate

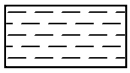

Conglomerate


Conglomeratic sandstone

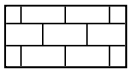

Sandstone


Siltstone

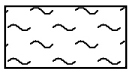

Laminite

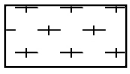

Mudstone, claystone, shale


Coal


Limestone

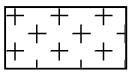
Metamorphic Rocks

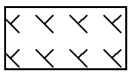

Slate, phyllite, schist

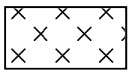

Gneiss

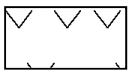

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~22.9*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH01
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	TOPSOIL (SILTY SAND) - grey-brown, fine to medium grained silty sand topsoil with some rootlets and organic matter.		E	0.25				
		SAND - brown-grey, fine to medium grained sand.		E	0.5				
		- becoming white from 0.6 m.		E	0.75		DUP1		
	1			E	1.0				
				E	1.25				
				E	1.5				
				E	1.75				
	2.0	Bore discontinued at 2.0m (target depth).		E	2.0				

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.
REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~23.2*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH02
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	TOPSOIL (SILTY SAND) - grey, fine to medium grained silty sand topsoil with a trace of rootlets.		E	0.25				
		SAND - white, fine to medium grained sand/		E	0.5				
				E	0.75				
	1			E	1.0				
				E	1.25				
				E	1.5		DUP2		
				E	1.75				
	2			E	2.0				
				E	2.25				
				E	2.5				
				E	2.75				
	3	- becoming wet from 2.9 m.		E	3.0				
	3.0	Bore discontinued at 3.0m (target depth).							
	4								
	5								
	6								
	7								
	8								
	9								

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.
REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~22.7*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH03
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.25	TOPSOIL (SILTY SAND) - grey, fine to medium grained silty sand topsoil with a trace of rootlets.		E	0.25				
		SAND - white, fine to medium grained sand.		E	0.5				
				E	0.75				
	1			E	1.0				
				E	1.25				
				E	1.5				
		- becoming moist from 1.75 m.		E	1.75				
	2			E	2.0				
				E	2.25				
		- becoming light brown from 2.25 m.							
	2.5	Bore discontinued at 2.5m (target depth).		E	2.5				
	3								
	4								
	5								
	6								
	7								
	8								
	9								

RIG: 110 mm hand auger. **DRILLER:** **LOGGED:** N Ahamed. **CASING:**

TYPE OF BORING: Hand augered borehole.

WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.

REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: 20.63 #
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH04
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	TOPSOIL (SILTY SAND) - dark grey, fine to medium grained silty sand topsoil with some rootlets.		E	0.25				50 mm Class 18 PVC Pipe. Bentonite Seal
		SILTY SAND - dark grey, fine to medium grained silty sand.		E	0.5			15-12-17	
				E	0.75				
1	1.0	SAND - brown, fine to medium grained sand, moist.		E	1.0				1 Gravel Pack
				E	1.25				
		- becoming wet from 1.5 m.		E	1.5				
				E	1.75				
2				E	2.0		DUP3		2
				E	2.25				
	2.4	SILTY SAND - dark brown, fine to medium grained, strongly cemented silty sand.		E	2.5				50 mm Class 18 Slotted PVC Pipe
				E	2.75				
3	3.0	Bore discontinued at 3.0m (target depth).		E	3.0				3 End Cap
4									4
5									5
6									6
7									7
8									8
9									9

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Groundwater observed at 0.533 m bgl on 15 December 2017.
REMARKS: # Levels surveyed by registered surveyors (Harley Dykstra Pty Ltd) on 15 December 2017.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~21.4 *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH05
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SAND - white-grey, fine to medium grained sand.		E	0.25				
		- with a trace of silt and organic matter to 0.3 m.		E	0.5				
				E	0.75				
	1.0	Bore discontinued at 1.0m (target depth).		E	1.0		DUP5		

RIG: 110 mm hand auger. **DRILLER:** **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Hand augered borehole.
WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.
REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: 20.28 #
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH06
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.28	TOPSOIL (SILTY SAND) - brown, fine to medium grained silty sand with some organic matter and peat, moist.		E	0.25				50 mm Class 18 PVC Pipe. Bentonite Seal
		SILTY SAND - brown, fine to medium grained silty sand.		E	0.5			15-12-17	
	0.7	- becoming wet from 0.6 m.		E	0.75				
1		SAND - brown, fine to medium grained sand, wet. - with a trace of clay from 1.0 m.		E	1.0				1 Gravel Pack
				E	1.25				
				E	1.5				
	1.8			E	1.75				
2		CLAY - brown-grey, low plasticity clay.		E	2.0				2
				E	2.25		DUP4		
	2.5			E	2.5		DUP10		50 mm Class 18 Slotted PVC Pipe
		SILTY SAND - brown, fine to medium grained silty sand.		E	2.75				
3	3.0			E	3.0				3 End Cap
		Bore discontinued at 3.0m (target depth).							
4									4
5									5
6									6
7									7
8									8
9									9

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Groundwater observed at 0.417 m bgl on 15 December 2017.
REMARKS: # Levels surveyed by registered surveyors (Harley Dykstra Pty Ltd) on 15 December 2017.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~21.0 *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH07
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SAND - grey-white, fine to medium grained sand.		E	0.25				
		- with a trace of silt and rootlets to 0.3 m.		E	0.5				
				E	0.75				
	1.0			E	1.0				
		Bore discontinued at 1.0m (target depth).							

RIG: 110 mm hand auger. **DRILLER:** **LOGGED:** N Ahamed. **CASING:**

TYPE OF BORING: Hand augered borehole.

WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.

REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: 24.51 #
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH08
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	TOPSOIL (SILTY SAND) - brown, fine to medium grained silty sand topsoil.		E	0.25				Cuttings
	0.3	SAND - white, fine to medium grained sand.		E	0.5				
				E	0.75				
	1			E	1.0				50 mm Class 18 PVC Pipe.
				E	1.25				
				E	1.5		DUP6		
				E	1.75				
	2			E	2.0				Bentonite Seal
				E	2.25				
				E	2.5				Gravel Pack
				E	2.75				
	3			E	3.0				
				E	3.25				
				E	3.5				
				E	3.75				
	4			E	4.0				50 mm Class 18 Slotted PVC Pipe
	4.3	SILTY SAND - brown, weakly cemented, fine to medium grained silty sand.		E	4.25				
				E	4.5			15-12-17	
				E	4.75				
	5			E	5.0				
	5.3	SAND - white, fine to medium grained sand.		E	5.25				
	5.5			E	5.5				
	5.6	SILTY SAND - brown, weakly cemented, fine to medium grained silty sand.		E	5.75				
	6			E	6.0				End Cap
	6.0	SAND - white, fine to medium grained sand.							
		Bore discontinued at 6.0m (target depth).							
	7								
	8								
	9								

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**

TYPE OF BORING: Push probe.

WATER OBSERVATIONS: Groundwater observed at 4.513 m bgl on 15 December 2017.

REMARKS: # Levels surveyed by registered surveyors (Harley Dykstra Pty Ltd) on 15 December 2017.

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~26.3 *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH09
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	TOPSOIL (SILTY SAND) - brown, fine to medium grained silty sand topsoil.		E	0.25				
		SAND - white, fine to medium grained sand with a trace of organic matter.		E	0.5				
				E	0.75				
	1			E	1.0				
				E	1.25				
				E	1.5				
				E	1.75				
	2			E	2.0				
				E	2.25				
				E	2.5				
				E	2.75				
	3			E	3.0				
				E	3.25				
				E	3.5				
				E	3.75		DUP7		
	4			E	4.0				
				E	4.25				
				E	4.5				
				E	4.75				
	5			E	5.0				
				E	5.25				
	5.5	Bore discontinued at 5.5m (target depth).		E	5.5				
	6								
	7								
	8								
	9								

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.
REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~27.6*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.25	TOPSOIL (SILTY SAND) - brown, fine to medium grained silty sand topsoil with some rootlets.		E	0.25				
		SILTY SAND - light brown, fine to medium grained silty sand.		E	0.5				
				E	0.75				
	1			E	1.0				1
				E	1.25				
	1.5	SAND - white, fine to medium grained sand.		E	1.5				
				E	1.75				
	2			E	2.0				2
				E	2.25				
				E	2.5				
				E	2.75				
	3			E	3.0				3
				E	3.25				
				E	3.5				
				E	3.75				
	4			E	4.0				4
		- becoming white mottled light brown.		E	4.25				
				E	4.5				
				E	4.75				
	5			E	5.0		DUP8		5
				E	5.25				
				E	5.5				
	5.8			E	5.75				
		SILTY SAND - brown, fine to medium grained medium cemented silty sand (coffee rock), moist.		E	6.0				
	6			E	6.25				6
	6.5	- becoming strongly cemented from 6.45 m.		E	6.5				
		Bore discontinued at 6.5m (target depth).							
	7								7
	8								8
	9								9

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.
REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~26.0*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH11
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	TOPSOIL (SILTY SAND) - brown, fine to medium grained silty sand topsoil with a trace of rootlets.		E	0.25				
	0.3	SAND - white, fine to medium grained sand.		E	0.5				
				E	0.75				
	1			E	1.0				
				E	1.25				
				E	1.5				
				E	1.75				
	2			E	2.0				
				E	2.25				
				E	2.5				
				E	2.75				
	3			E	3.0		DUP9		
				E	3.25				
				E	3.5				
				E	3.75				
	4	- becoming light brown from 4.0 m.		E	4.0				
				E	4.25				
				E	4.5				
				E	4.75				
	5			E	5.0				
	5.0	Bore discontinued at 5.0m (target depth).							
	6								
	7								
	8								
	9								

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.
REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Gosnells
PROJECT: Preliminary ASS and Groundwater Investigation
LOCATION: Garden Street, Huntingdale

SURFACE LEVEL: ~22.7*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH12
PROJECT No: 88978
DATE: 5/12/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.25	TOPSOIL (SILTY SAND) - brown, fine to medium grained silty sand topsoil with a trace of rootlets.		E	0.25				
		SAND - white, fine to medium grained sand.		E	0.5				
				E	0.75				
	1			E	1.0				
				E	1.25				
				E	1.5				
				E	1.75				
	2 2.0			E	2.0				
		Bore discontinued at 2.0m (target depth).							
	3								
	4								
	5								
	6								
	7								
	8								
	9								

RIG: Geoprobe 7822DT. **DRILLER:** DPP. **LOGGED:** N Ahamed. **CASING:**
TYPE OF BORING: Push probe.
WATER OBSERVATIONS: Drilling method precluded accurate groundwater measurement.
REMARKS: *- Surface level interpolated from client supplied Drawings E90-15-002 and E90-15-003

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix D

Table D-1: Summary of Soil Laboratory Results
Table D-2: Summary of Groundwater Laboratory Results
Table D-3: Quality Assurance RPDs – Soil
Table D-4: Quality Assurance RPDs - Groundwater
Sample Receipts, Laboratory Reports and Chain of Custody Forms

Table D-1: Summary of Soil Laboratory Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening Tests[1]				SPOCAS Suite of Testing							
				pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	pH_{OX}	TAA[4] (%S)	TPA[5] (%S)	S_{POS}[6] (%S)	SNAS[7] (%S)	ANCe[8] (%S)	Net[9] Acidity (%S)
Assessment Criteria				**<4**	**<3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**>0.03**
BH01	BH01/0.25	0.25	TOPSOIL - grey-brown	5.0	3.4	Low	1.6	-	-	-	-	-	-	-	-
BH01	BH01/0.5	0.5	SAND - brown-grey	5.2	4.0	Low	1.2	-	-	-	-	-	-	-	-
BH01	BH01/0.75	0.75	SAND - white	5.2	4.0	Low	1.2	-	-	-	-	-	-	-	-
BH01	BH01/1	1	SAND - white	5.3	4.4	Low	0.9	-	-	-	-	-	-	-	-
BH01	BH01/1.25	1.25	SAND - white	6.3	**2.8**	Low	3.5	5.8	4.2	<0.01	<0.01	<0.005	<0.005	<0.005	<0.01
BH01	BH01/1.5	1.5	SAND - white	6.2	4.2	Low	2	-	-	-	-	-	-	-	-
BH01	BH01/1.75	1.75	SAND - white	6.0	4.6	Low	1.4	-	-	-	-	-	-	-	-
BH01	BH01/2.0	2	SAND - white	6.0	4.5	Low	1.5	-	-	-	-	-	-	-	-
BH02	BH02/0.25	0.25	TOPSOIL - grey	5.3	3.6	Low	1.7	-	-	-	-	-	-	-	-
BH02	BH02/0.5	0.5	SAND - white	5.3	3.4	Low	1.9	-	-	-	-	-	-	-	-
BH02	BH02/0.75	0.75	SAND - white	5.3	3.4	Low	1.9	5.6	2.8	0.015	0.16	0.006	<0.005	<0.005	0.021
BH02	BH02/1.0	1	SAND - white	5.2	3.6	Low	1.6	-	-	-	-	-	-	-	-
BH02	BH02/1.25	1.25	SAND - white	5.1	3.4	Low	1.7	-	-	-	-	-	-	-	-
BH02	BH02/1.5	1.5	SAND - white	5.0	3.3	Low	1.7	-	-	-	-	-	-	-	-
BH02	BH02/1.75	1.75	SAND - white	5.6	**2.8**	Low	2.8	5.8	4.4	<0.01	<0.01	<0.005	<0.005	<0.005	0.010
BH02	BH02/2	2	SAND - white	5.7	**2.8**	Low	2.9	-	-	-	-	-	-	-	-
BH02	BH02/2.25	2.25	SAND - white	5.4	3.8	Low	1.6	-	-	-	-	-	-	-	-
BH02	BH02/2.5	2.5	SAND - white	5.2	3.9	Low	1.3	-	-	-	-	-	-	-	-
BH02	BH02/2.75	2.75	SAND - white	5.0	3.7	Low	1.3	-	-	-	-	-	-	-	-
BH02	BH02/3	3	SAND - white	5.0	4.1	Low	0.9	-	-	-	-	-	-	-	-
BH03	BH03/0.25	0.25	TOPSOIL - grey	4.9	3.4	Low	1.5	-	-	-	-	-	-	-	-
BH03	BH03/0.5	0.5	SAND - white	5.0	3.6	Low	1.4	-	-	-	-	-	-	-	-
BH03	BH03/0.75	0.75	SAND - white	5.0	3.6	Low	1.4	5.6	2.9	<0.01	0.08	<0.005	<0.005	<0.005	<0.01
BH03	BH03/1	1	SAND - white	5.2	4.2	Low	1	-	-	-	-	-	-	-	-
BH03	BH03/1.25	1.25	SAND - white	5.1	4.3	Low	0.8	-	-	-	-	-	-	-	-
BH03	BH03/1.5	1.5	SAND - white	5.1	4.2	Low	0.9	-	-	-	-	-	-	-	-
BH03	BH03/1.75	1.75	SAND - white	5.0	4.2	Low	0.8	-	-	-	-	-	-	-	-
BH03	BH03/2	2	SAND - white	5.0	4.2	Low	0.8	-	-	-	-	-	-	-	-
BH03	BH03/2.25	2.25	SAND - light brown	5.0	3.8	Low	1.2	-	-	-	-	-	-	-	-
BH03	BH03/2.5	2.5	SAND - light brown	5.1	3.8	Low	1.3	-	-	-	-	-	-	-	-
BH04	BH04/0.25	0.25	TOPSOIL - dark grey	5.2	**2.1**	Low	3.1	-	-	-	-	-	-	-	-
BH04	BH04/0.5	0.5	SILTY SAND - dark grey	5.2	**2.4**	Low	2.8	5.4	2.6	0.024	0.29	0.01	<0.005	<0.005	**0.033**
BH04	BH04/0.75	0.75	SILTY SAND - dark grey	5.0	**2.7**	Low	2.3	-	-	-	-	-	-	-	-
BH04	BH04/1	1	SILTY SAND - dark grey	4.6	**3.0**	Low	1.6	-	-	-	-	-	-	-	-
BH04	BH04/1.25	1.25	SAND - brown-grey	4.7	**2.6**	Low	2.1	-	-	-	-	-	-	-	-
BH04	BH04/1.5	1.5	SAND - brown-grey	5.1	**2.8**	Low	2.3	-	-	-	-	-	-	-	-
BH04	BH04/1.75	1.75	SAND - brown-grey	5.5	**2.6**	Low	2.9	-	-	-	-	-	-	-	-
BH04	BH04/2	2	SAND - brown-grey	5.3	3.4	Low	1.9	-	-	-	-	-	-	-	-
BH04	BH04/2.25	2.25	SAND - brown-grey	5.2	3.1	Low	2.1	-	-	-	-	-	-	-	-
BH04	BH04/2.5	2.5	SILTY SAND - dark brown	4.5	3.5	Low	1	-	-	-	-	-	-	-	-
BH04	BH04/2.75	2.75	SILTY SAND - dark brown	4.5	3.2	Low	1.3	-	-	-	-	-	-	-	-
BH04	BH04/3	3	SILTY SAND - dark brown	4.6	**2.8**	Low	1.8	-	-	-	-	-	-	-	-
BH05	BH05/0.25	0.25	SAND - white-grey	4.8	3.4	Low	1.4	5.3	2.7	0.02	0.16	<0.005	<0.005	<0.005	0.022
BH05	BH05/0.5	0.5	SAND - white-grey	4.7	3.4	Low	1.3	-	-	-	-	-	-	-	-
BH05	BH05/0.75	0.75	SAND - white-grey	4.7	3.7	Low	1	-	-	-	-	-	-	-	-
BH05	BH05/1	1	SAND - white-grey	4.4	3.7	Low	0.7	-	-	-	-	-	-	-	-
BH06	BH06/0.25	0.25	TOPSOIL - brown	6.3	3.7	Low	2.6	-	-	-	-	-	-	-	-
BH06	BH06/0.5	0.5	SILTY SAND - brown	7.0	4.0	Low	3	6.5	3.5	<0.01	<0.01	0.021	<0.005	<0.005	0.021
BH06	BH06/0.75	0.75	SAND - brown	8.6	6.4	Low	2.2	-	-	-	-	-	-	-	-
BH06	BH06/1	1	SAND - brown	8.9	6.2	Low	2.7	-	-	-	-	-	-	-	-
BH06	BH06/1.25	1.25	SAND - brown	8.6	6.2	Low	2.4	-	-	-	-	-	-	-	-
BH06	BH06/1.5	1.5	SAND - brown	8.3	6.2	Low	2.1	-	-	-	-	-	-	-	-
BH06	BH06/1.75	1.75	SAND - brown	8.2	6.3	Low	1.9	-	-	-	-	-	-	-	-

Table D-1: Summary of Soil Laboratory Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening Tests[1]				SPOCAS Suite of Testing							
				pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	pH_{OX}	TAA[4] (%S)	TPA[5] (%S)	S_{POS}[6] (%S)	SNAS[7] (%S)	ANCe[8] (%S)	Net[9] Acidity (%S)
Assessment Criteria				**<4**	**<3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**>0.03**
BH06	BH06/2	2	CLAY - brown-grey	8.6	6.2	Low	2.4	-	-	-	-	-	-	-	-
BH06	BH06/2.25	2.25	CLAY - brown-grey	8.6	6.2	Low	2.4	-	-	-	-	-	-	-	-
BH06	BH06/2.5	2.5	SILTY SAND - brown	8.3	**2.7**	Extreme	5.6	6.1	3.8	<0.01	0.041	0.074	<0.005	<0.005	**0.08**
BH06	BH06/2.75	2.75	SILTY SAND - brown	7.7	5.3	Low	2.4	-	-	-	-	-	-	-	-
BH06	BH06/3	3	SILTY SAND - brown	7.8	**1.3**	Low	6.5	-	-	-	-	-	-	-	-
BH07	BH07/0.25	0.25	SAND - grey-white	5.6	4.2	Low	1.4	-	-	-	-	-	-	-	-
BH07	BH07/0.5	0.5	SAND - grey-white	5.5	4.2	Low	1.3	5.5	2.8	0.013	0.13	0.009	<0.005	<0.005	0.02
BH07	BH07/0.75	0.75	SAND - grey-white	4.5	4.0	Low	0.5	-	-	-	-	-	-	-	-
BH07	BH07/1	1	SAND - grey-white	4.4	4.0	Low	0.4	-	-	-	-	-	-	-	-
BH08	BH08/0.25	0.25	TOPSOIL - brown	5.6	4.0	Low	1.6	-	-	-	-	-	-	-	-
BH08	BH08/0.5	0.5	SAND - white	5.5	4.2	Low	1.3	-	-	-	-	-	-	-	-
BH08	BH08/0.75	0.75	SAND - white	5.4	4.4	Low	1	-	-	-	-	-	-	-	-
BH08	BH08/1	1	SAND - white	5.5	4.1	Low	1.4	5.8	4	<0.01	<0.01	0.019	<0.005	<0.005	0.03
BH08	BH08/1.25	1.25	SAND - white	5.3	4.6	Low	0.7	-	-	-	-	-	-	-	-
BH08	BH08/1.5	1.5	SAND - white	5.1	4.5	Low	0.6	-	-	-	-	-	-	-	-
BH08	BH08/1.75	1.75	SAND - white	6.0	3.8	Low	2.2	5.9	4.3	<0.01	<0.01	0.006	<0.005	<0.005	<0.01
BH08	BH08/2	2	SAND - white	5.9	4.1	Low	1.8	-	-	-	-	-	-	-	-
BH08	BH08/2.25	2.25	SAND - white	5.5	4.7	Low	0.8	-	-	-	-	-	-	-	-
BH08	BH08/2.5	2.5	SAND - white	5.1	4.7	Low	0.4	-	-	-	-	-	-	-	-
BH08	BH08/2.75	2.75	SAND - white	4.9	4.6	Low	0.3	-	-	-	-	-	-	-	-
BH08	BH08/3	3	SAND - white	5.2	4.7	Low	0.5	-	-	-	-	-	-	-	-
BH08	BH08/3.25	3.25	SAND - white	6.6	3.3	Low	3.3	-	-	-	-	-	-	-	-
BH08	BH08/3.5	3.5	SAND - white	5.3	4.1	Low	1.2	-	-	-	-	-	-	-	-
BH08	BH08/3.75	3.75	SAND - white	4.9	4.4	Low	0.5	-	-	-	-	-	-	-	-
BH08	BH08/4	4	SAND - white	5.0	4.4	Low	0.6	-	-	-	-	-	-	-	-
BH08	BH08/4.25	4.25	SAND - white	5.1	4.2	Low	0.9	-	-	-	-	-	-	-	-
BH08	BH08/4.5	4.5	SILTY SAND - brown	4.5	3.4	Low	1.1	-	-	-	-	-	-	-	-
BH08	BH08/4.75	4.75	SILTY SAND - brown	4.4	3.4	Low	1	-	-	-	-	-	-	-	-
BH08	BH08/5	5	SILTY SAND - brown	4.6	3.6	Low	1	-	-	-	-	-	-	-	-
BH08	BH08/5.25	5.25	SILTY SAND - brown	4.9	3.7	Low	1.2	-	-	-	-	-	-	-	-
BH08	BH08/5.5	5.5	SAND - white	5.0	3.9	Low	1.1	-	-	-	-	-	-	-	-
BH08	BH08/6	6	SAND - white	5.2	4.6	Low	0.6	-	-	-	-	-	-	-	-
BH09	BH09/0.25	0.25	TOPSOIL - brown	4.9	3.3	Low	1.6	-	-	-	-	-	-	-	-
BH09	BH09/0.5	0.5	SAND - white	4.9	3.3	Low	1.6	-	-	-	-	-	-	-	-
BH09	BH09/0.75	0.75	SAND - white	5.1	3.6	Low	1.5	-	-	-	-	-	-	-	-
BH09	BH09/1	1	SAND - white	4.9	3.5	Low	1.4	-	-	-	-	-	-	-	-
BH09	BH09/1.25	1.25	SAND - white	4.9	3.9	Low	1	-	-	-	-	-	-	-	-
BH09	BH09/1.5	1.5	SAND - white	4.7	3.3	Low	1.4	-	-	-	-	-	-	-	-
BH09	BH09/1.75	1.75	SAND - white	5.2	**2.9**	Low	2.3	5.7	3.4	<0.01	<0.01	<0.005	<0.005	<0.005	<0.01
BH09	BH09/2	2	SAND - white	4.5	3.4	Low	1.1	-	-	-	-	-	-	-	-
BH09	BH09/2.25	2.25	SAND - white	4.9	4.4	Low	0.5	-	-	-	-	-	-	-	-
BH09	BH09/2.5	2.5	SAND - white	4.8	4.4	Low	0.4	-	-	-	-	-	-	-	-
BH09	BH09/2.75	2.75	SAND - white	4.9	4.7	Low	0.2	-	-	-	-	-	-	-	-
BH09	BH09/3	3	SAND - white	5.0	4.5	Low	0.5	-	-	-	-	-	-	-	-
BH09	BH09/3.25	3.25	SAND - white	5.8	3.4	Low	2.4	5.9	4.5	<0.01	<0.01	<0.005	<0.005	<0.005	<0.01
BH09	BH09/3.5	3.5	SAND - white	4.7	3.4	Low	1.3	-	-	-	-	-	-	-	-
BH09	BH09/3.75	3.75	SAND - white	5.1	4.3	Low	0.8	-	-	-	-	-	-	-	-
BH09	BH09/4	4	SAND - white	5.1	4.5	Low	0.6	-	-	-	-	-	-	-	-
BH09	BH09/4.25	4.25	SAND - white	5.1	4.4	Low	0.7	-	-	-	-	-	-	-	-
BH09	BH09/4.5	4.5	SAND - white	4.8	3.9	Low	0.9	-	-	-	-	-	-	-	-
BH09	BH09/4.75	4.75	SAND - white	5.1	4.0	Low	1.1	-	-	-	-	-	-	-	-
BH09	BH09/5	5	SAND - white	5.0	4.2	Low	0.8	-	-	-	-	-	-	-	-
BH09	BH09/5.25	5.25	SAND - white	5.2	4.2	Low	1	-	-	-	-	-	-	-	-

Table D-1: Summary of Soil Laboratory Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening Tests[1]				SPOCAS Suite of Testing							
				pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	pH_{OX}	TAA[4] (%S)	TPA[5] (%S)	S_{POS}[6] (%S)	SNAS[7] (%S)	ANCe[8] (%S)	Net[9] Acidity (%S)
Assessment Criteria				**<4**	**<3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**>0.03**
BH09	BH09/5.5	5.5	SAND - white	4.8	3.9	Low	0.9	-	-	-	-	-	-	-	-
BH09	BH09/5.75	5.75	SAND - white	5.6	4.0	Low	1.6	-	-	-	-	-	-	-	-
BH10	BH10/0.25	0.25	TOPSOIL - brown	5.4	3.3	Low	2.1	-	-	-	-	-	-	-	-
BH10	BH10/0.5	0.5	SILTY SAND - light brown	5.2	3.4	Low	1.8	-	-	-	-	-	-	-	-
BH10	BH10/0.75	0.75	SILTY SAND - light brown	5.0	3.5	Low	1.5	-	-	-	-	-	-	-	-
BH10	BH10/1	1	SILTY SAND - light brown	5.1	3.4	Low	1.7	-	-	-	-	-	-	-	-
BH10	BH10/1.25	1.25	SILTY SAND - light brown	5.0	3.5	Low	1.5	-	-	-	-	-	-	-	-
BH10	BH10/1.5	1.5	SAND - white	5.2	3.6	Low	1.6	-	-	-	-	-	-	-	-
BH10	BH10/1.75	1.75	SAND - white	7.2	4.1	Low	3.1	-	-	-	-	-	-	-	-
BH10	BH10/2	2	SAND - white	6.5	**2.9**	Low	3.6	6	5.1	<0.01	<0.01	<0.005	<0.005	<0.005	<0.01
BH10	BH10/2.25	2.25	SAND - white	5.2	3.2	Low	2	-	-	-	-	-	-	-	-
BH10	BH10/2.5	2.5	SAND - white	5.1	3.2	Low	1.9	-	-	-	-	-	-	-	-
BH10	BH10/2.75	2.75	SAND - white	5.0	3.9	Low	1.1	-	-	-	-	-	-	-	-
BH10	BH10/3	3	SAND - white	5.1	4.0	Low	1.1	-	-	-	-	-	-	-	-
BH10	BH10/3.25	3.25	SAND - white	7.9	4.3	Low	3.6	-	-	-	-	-	-	-	-
BH10	BH10/3.5	3.5	SAND - white	7.8	4.2	Low	3.6	-	-	-	-	-	-	-	-
BH10	BH10/3.75	3.75	SAND - white	7.7	4.0	Low	3.7	-	-	-	-	-	-	-	-
BH10	BH10/4	4	SAND - white	5.2	4.2	Low	1	-	-	-	-	-	-	-	-
BH10	BH10/4.25	4.25	SAND - white	5.8	4.7	Low	1.1	-	-	-	-	-	-	-	-
BH10	BH10/4.5	4.5	SAND - white mottled light brown	5.8	4.6	Low	1.2	-	-	-	-	-	-	-	-
BH10	BH10/4.75	4.75	SAND - white mottled light brown	6.3	3.9	Low	2.4	5.9	4.7	<0.01	<0.01	<0.005	<0.005	<0.005	<0.01
BH10	BH10/5	5	SAND - white mottled light brown	5.4	4.6	Low	0.8	-	-	-	-	-	-	-	-
BH10	BH10/5.25	5.25	SAND - white mottled light brown	5.4	4.6	Low	0.8	-	-	-	-	-	-	-	-
BH10	BH10/5.5	5.5	SAND - white mottled light brown	5.4	4.6	Low	0.8	-	-	-	-	-	-	-	-
BH10	BH10/5.75	5.75	SAND - white mottled light brown	5.4	4.7	Low	0.7	-	-	-	-	-	-	-	-
BH10	BH10/6	6	SILTY SAND - brown	4.8	3.6	Low	1.2	5.4	4.8	0.027	<0.01	0.007	<0.005	<0.005	**0.03**
BH10	BH10/6.25	6.25	SILTY SAND - brown	4.6	3.7	Low	0.9	-	-	-	-	-	-	-	-
BH10	BH10/6.5	6.5	SILTY SAND - brown	4.7	3.6	Low	1.1	-	-	-	-	-	-	-	-
BH11	BH11/0.25	0.25	TOPSOIL - brown	6.0	3.8	Low	2.2	-	-	-	-	-	-	-	-
BH11	BH11/0.5	0.5	SAND - white	5.4	3.7	Low	1.7	-	-	-	-	-	-	-	-
BH11	BH11/0.75	0.75	SAND - white	5.1	3.9	Low	1.2	-	-	-	-	-	-	-	-
BH11	BH11/1	1	SAND - white	5.0	3.7	Low	1.3	-	-	-	-	-	-	-	-
BH11	BH11/1.25	1.25	SAND - white	5.1	4.0	Low	1.1	-	-	-	-	-	-	-	-
BH11	BH11/1.5	1.5	SAND - white	5.4	3.7	Low	1.7	-	-	-	-	-	-	-	-
BH11	BH11/1.75	1.75	SAND - white	6.3	3.4	Low	2.9	-	-	-	-	-	-	-	-
BH11	BH11/2	2	SAND - white	6.1	**3.0**	Low	3.1	5.9	4.4	<0.01	<0.01	0.007	<0.005	<0.005	0.01
BH11	BH11/2.25	2.25	SAND - white	5.3	3.6	Low	1.7	-	-	-	-	-	-	-	-
BH11	BH11/2.5	2.5	SAND - white	4.6	3.4	Low	1.2	-	-	-	-	-	-	-	-
BH11	BH11/2.75	2.75	SAND - white	4.7	3.7	Low	1	-	-	-	-	-	-	-	-
BH11	BH11/3	3	SAND - white	4.8	4.1	Low	0.7	-	-	-	-	-	-	-	-
BH11	BH11/3.25	3.25	SAND - white	6.2	3.3	Low	2.9	-	-	-	-	-	-	-	-
BH11	BH11/3.5	3.5	SAND - white	4.7	4.0	Low	0.7	-	-	-	-	-	-	-	-
BH11	BH11/3.75	3.75	SAND - white	4.7	3.6	Low	1.1	-	-	-	-	-	-	-	-
BH11	BH11/4	4	SAND - light brown	4.7	4.3	Low	0.4	-	-	-	-	-	-	-	-
BH11	BH11/4.25	4.25	SAND - light brown	6.9	4.5	Medium	2.4	5.9	4.9	<0.01	<0.01	<0.005	<0.005	<0.005	<0.01
BH11	BH11/4.50	4.5	SAND - light brown	4.6	4.2	Low	0.4	-	-	-	-	-	-	-	-
BH11	BH11/4.75	4.75	SAND - light brown	4.8	3.7	Low	1.1	-	-	-	-	-	-	-	-
BH11	BH11/5	5	SAND - light brown	4.7	4.1	Low	0.6	-	-	-	-	-	-	-	-
BH12	BH12/0.25	0.25	TOPSOIL - brown	6.0	4.2	Low	1.8	-	-	-	-	-	-	-	-
BH12	BH12/0.5	0.5	SAND - white	5.6	4.2	Low	1.4	-	-	-	-	-	-	-	-
BH12	BH12/0.75	0.75	SAND - white	5.9	4.5	Low	1.4	5.9	4	<0.01	<0.01	<0.005	<0.005	<0.005	<0.01
BH12	BH12/1	1	SAND - white	6.0	4.6	Low	1.4	-	-	-	-	-	-	-	-
BH12	BH12/1.25	1.25	SAND - white	5.9	3.8	Low	2.1	-	-	-	-	-	-	-	-

Table D-1: Summary of Soil Laboratory Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening Tests[1]				SPOCAS Suite of Testing							
				pH_F	pH_{FOX}	Reaction[2] Strength	Δ pH[3]	pH_{KCl}	pH_{OX}	TAA[4] (%S)	TPA[5] (%S)	S_{POS}[6] (%S)	SNAS[7] (%S)	ANCe[8] (%S)	Net[9] Acidity (%S)
Assessment Criteria				**<4**	**<3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**>0.03**
BH12	BH12/1.5	1.5	SAND - white	6.2	4.7	Low	1.5	-	-	-	-	-	-	-	-
BH12	BH12/1.75	1.75	SAND - white	6.0	4.6	Low	1.4	-	-	-	-	-	-	-	-
BH12	BH12/2	2	SAND - white	5.0	3.9	Low	1.1	-	-	-	-	-	-	-	-
	DUP1			5.6	4.6	Low	1	-	-	-	-	-	-	-	-
	DUP2			4.8	3.7	Low	1.1	-	-	-	-	-	-	-	-
	DUP3			5.0	3.3	Low	1.7	-	-	-	-	-	-	-	-
	DUP4			8.4	6.3	Low	2.1	-	-	-	-	-	-	-	-
	DUP5			4.4	3.8	Low	0.6	-	-	-	-	-	-	-	-
	DUP6			5.0	4.3	Low	0.7	-	-	-	-	-	-	-	-
	DUP7			5.0	3.7	Low	1.3	-	-	-	-	-	-	-	-
	DUP8			5.2	4.5	Low	0.7	-	-	-	-	-	-	-	-
	DUP9			4.9	4.1	Low	0.8	-	-	-	-	-	-	-	-
	DUP10			NT	NT	-	-	5.9	3.8	<0.01	0.14	0.067	NT	NT	**0.07**

Note:

1. Screening Tests undertaken by MPL Laboratories
2. Low – indicates no or low effervescence in hydrogen peroxide;
   Moderate – indicates moderate effervescence in hydrogen peroxide;
   High – indicates vigorous effervescence in hydrogen peroxide.
3. Δ pH – pHF - pHFOX
4. TAA – titratable actual acidity
5. TPA – titratable peroxide acidity;
6. Spos – peroxide oxidisable sulphur
7. SNAS – net acidity soluble sulphur (reported for pHkCl < 4.5)
8. ANCe – excess acid neutralising capacity (reported for pHkCl > 6.5).
9. Net Acidity = TAA + Spos + NASS. (It should be noted that ANC is excluded as per WA Guidelines)

NT Not Tested

0.04 Exceedance of criteria.

Table D-2: Summary of Groundwater Laboratory Results

Analyte Group / Analyte	Unit	PQL	FW	STI[1]	LTI[1]	DNP[2]	Test Location	BH04	BH06	BH08
								15/12/2017	15/12/2017	15/12/2017
Miscellaneous Inorganics										
pH in water	pH Units	0.1		6-8.5	6 - 8.5	-		4.4 [STI, LTI]	6.4	4.3
Electrical Conductivity water	µS/cm	1		-	-	-		410	12000	290
Total Dissolved Solids	mg/L	5		-	-	-		250	7500	180
Suspended Solids	mg/L	5		-	-	-		120	39	16
Chloride in water	mg/L	1		-	-	250		57	3800 [DNP]	43
Sulphate in water	mg/L	1		-	-	1000		29	300	10
Nutrients										
Total Nitrogen (Total N)	mg/L	0.1	2	25 - 125	5	-		7.4 [FW, STI, LTI]	4.5	6.8 [FW, STI, LTI]
Total Kjeldahl Nitrogen	mg/L	0.1	-	-	-	-		6.3	4.5	4.1
NOx as N	mg/L	0.005	0.7	-	-	-		1.1 [FW]	<0.25	3 [FW]
Ammonia as N at pH 6	mg/L	0.01	2.57	-	-	-		0.91	0.45	<0.25
Total Phosphorus (Total P)	mg/L	0.05	-	0.8 - 12	-	-		<0.05	<0.05	1.1
Phosphate as P	mg/L	0.005	0.06	-	0.05	-		<0.25	<0.25	0.43 [FW, LTI]
Acidity										
Acidity as $CaCO_3$	mg/L	5		-	-	-		140	61	54
Alkalinity										
Hydroxide, OH^- as $CaCO_3$	mg/L	5		-	-	-		<5	<5	<5
Carbonate, CO_3^{2-} as $CaCO_3$	mg/L	5		-	-	-		<5	<5	<5
Bicarbonate, HCO_3 as $CaCO_3$	mg/L	5		-	-	-		11	180	<5
Total Alkalinity	mg/L	5		-	-	-		11	180	<5
Dissolved Metals										
Aluminium	mg/L	0.01	0.055	20	5	0.2		1.9 [FW, DNP]	0.67 [FW, DNP]	1.7 [FW, DNP]
Arsenic	mg/L	0.001	0.013	2	0.1	0.1		0.001	0.002	<0.001
Cadmium	mg/L	0.0001	0.0002	0.05	0.01	0.02		<0.0001	<0.0001	0.0002
Calcium	mg/L	0.5	-	-	-	-		4.6	22	5.7
Chromium	mg/L	0.001	0.001			0.5		0.046 [FW]	0.003 [FW]	0.002 [FW]
Iron	mg/L	0.01	0.3	10	0.2	0.3		19 [FW, STI, LTI, DNP]	0.08	1.1 [FW,LTI,DNP]
Magnesium				-	-	-		3.7	220	4.8
Manganese	mg/L	0.005	1.9	10	0.2	5.0		0.15	<0.005	0.014
Nickel	mg/L	0.001	0.011	2	0.2	0.2		0.005	0.002	0.002
Potassium								10	13	11
Selenium	mg/L	0.001	0.005	0.05	0.02	0.1		0.001	<0.001	<0.001
Sodium	mg/L	0.5		-	-	-		61	2200	31
Zinc	mg/L	0.001	0.008	5	2	3		0.015 [FW]	0.009 [FW]	0.015 [FW]
Total Metals										
Aluminium	mg/L	0.01	-	-	-	-		2.6	1.3	2.3
Arsenic	mg/L	0.001	-	-	-	-		0.003	0.003	<0.001
Cadmium	mg/L	0.0001	-	-	-	-		<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	-	-	-	-		0.049	0.005	0.004
Iron	mg/L	0.01	-	-	-	-		20	0.19	1.2
Manganese	mg/L	0.005	-	-	-	-		0.16	<0.005	0.015
Nickel	mg/L	0.001	-	-	-	-		0.007	0.003	0.002
Selenium	mg/L	0.001	-	-	-	-		0.001	0.001	<0.001
Zinc	mg/L	0.001	-	-	-	-		0.006	0.004	0.014

Note:

1. NHMRC / NRMMC (2011) Australian Drinking Water Guidelines –Long term irrigation water values.
2. DoH (2014) Contaminated Sites Ground and Surface Water Chemical Screening Guidelines

Exceedance of criteria

Table D-3: Summary of Quality Assurance RPD Results - Soil

Test Location	Sample ID	Depth (m)	Screening Tests[1]		SPOCAS Suite of Testing						
			pH_F	pH_{FOX}	pH_{KCl}	pH_{OX}	TAA[4] (%S)	TPA[5] (%S)	S_{POS}[6] (%S)	N_{RASS}[7] (%S)	ANC[8] (%S)
BH01	BH01/0.75	0.75	5.2	4.0	-	-	-	-	-	-	-
	DUP1		5.6	4.6	-	-	-	-	-	-	-
RPD (%)			**7**	**14**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH02	BH02/1.5	1.5	5.0	3.3	-	-	-	-	-	-	-
	DUP2		4.8	3.7	-	-	-	-	-	-	-
RPD (%)			**4**	**11**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH04	BH04/2	2	5.3	3.4	-	-	-	-	-	-	-
	DUP3		5.0	3.3	-	-	-	-	-	-	-
RPD (%)			**6**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH05	BH05/1	1	4.4	3.7	-	-	-	-	-	-	-
	DUP5		4.4	3.8	-	-	-	-	-	-	-
RPD (%)			**0**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH06	BH06/2.25	2.25	8.6	6.2	-	-	-	-	-	-	-
	DUP4		8.4	6.3	-	-	-	-	-	-	-
RPD (%)			**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH06	BH06/2.5	2.5	8.3	2.7	6.1	3.8	<0.01	0.041	0.074	<0.005	<0.005
	DUP10		-	-	5.9	3.8	<0.01	0.14	0.067	NT	NT
RPD (%)			-	-	**3**	**0**	**0**	**109**	**10**	-	-
BH08	BH08/1.5	1.5	5.1	4.5	-	-	-	-	-	-	-
	DUP6		5.0	4.3	-	-	-	-	-	-	-
RPD (%)			**2**	**5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH09	BH09/3.75	3.75	5.1	4.3	-	-	-	-	-	-	-
	DUP7		5.0	3.7	-	-	-	-	-	-	-
RPD (%)			**2**	**15**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH10	BH10/5	5	5.4	4.6	-	-	-	-	-	-	-
	DUP8		5.2	4.5	-	-	-	-	-	-	-
RPD (%)			**4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
BH11	BH11/3	3	4.8	4.1	-	-	-	-	-	-	-
	DUP9		4.9	4.1	-	-	-	-	-	-	-
RPD (%)			**2**	**0**	-	-	**-**	**-**	**-**	**-**	**-**

Note:

51 Exceedance of criteria.

Table D-4: Summary of Quality Assurance RPDs - GW

		Date Sampled	15/12/2017		
		Test Location	BH04	BD1/151217	RPD
Analyte	**Units**	**PQL**			
Dissolved Metals					
Arsenic	mg/L	0.001	0.001	0.002	**67**
Cadmium	mg/L	0.0001	<0.0001	<0.0001	**0**
Chromium	mg/L	0.001	0.046	0.048	**4**
Nickel	mg/L	0.001	0.005	0.006	**18**
Zinc	mg/L	0.001	0.015	0.003	**133**

Note:

Exceedance of criteria

Douglas Partners
Geotechnics / Environment / Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes											NOTES
						pH(F)	pH(FOX)										
BH01/0.25	0.25	6/12/2017	Soil	Freezer		X	X										Please use the
BH01/0.5	0.5	6/12/2017	Soil	Freezer		X	X										reduced rate of
BH01/0.75	0.75	6/12/2017	Soil	Freezer		X	X										$7.00 for both pH(F)
BH01/1	1	6/12/2017	Soil	Freezer		X	X										and pH(FOX) as
BH01/1.25	1.25	6/12/2017	Soil	Freezer		X	X										agreed with Stacey
BH01/1.5	1.5	6/12/2017	Soil	Freezer		X	X										in an email dated
BH01/1.75	1.75	6/12/2017	Soil	Freezer		X	X										15 September 2016
BH01/2	2	6/12/2017	Soil	Freezer		X	X										
BH02/0.25	0.25	6/12/2017	Soil	Freezer		X	X										
BH02/0.5	0.5	6/12/2017	Soil	Freezer		X	X										
BH02/0.75	0.75	6/12/2017	Soil	Freezer		X	X										
BH02/1	1	6/12/2017	Soil	Freezer		X	X										
BH02/1.25	1.25	6/12/2017	Soil	Freezer		X	X										
BH02/1.5	1.5	6/12/2017	Soil	Freezer		X	X										
BH02/1.75	1.75	6/12/2017	Soil	Freezer		X	X										
LOR (S)																	
LOR (W)																	

Eml Laboratories ENVIROLAB group
Job No.- 25259
Date Rec - 7-12
Time Rec - 1035
Rec By - mc
TAT Req - SAME 1 / 2 / 3 (STD)
Temp - Cool / ambient
Cooling - Ice / Ice pack / None
Security Seal - Yes / No

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed
Relinquished By: Nizam Ahamed
Sign:
Date/Time: 6/12/2017

Received By: MC
Relinquished By:
Sign:
Date/Time: 7/12/17

**** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL****

Send Results to:
Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522
Accounts:
perth@douglaspartners.com.au

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes												NOTES
						pH(F)	pH(FOX)											
BH02/2	2	6/12/2017	Soil	Freezer		X	X											Please use the
BH02/2.25	2.25	6/12/2017	Soil	Freezer		X	X											reduced rate of
BH02/2.5	2.5	6/12/2017	Soil	Freezer		X	X											$7.00 for both pH(F)
BH02/2.75	2.75	6/12/2017	Soil	Freezer		X	X											and pH(FOX) as
BH02/3	3	6/12/2017	Soil	Freezer		X	X											agreed with Stacey
BH03/0.25	0.25	6/12/2017	Soil	Freezer		X	X											in an email dated
BH03/0.5	0.5	6/12/2017	Soil	Freezer		X	X											15 September 2016
BH03/0.75	0.75	6/12/2017	Soil	Freezer		X	X											
BH03/1	1	6/12/2017	Soil	Freezer		X	X											
BH03/1.25	1.25	6/12/2017	Soil	Freezer		X	X											
BH03/1.5	1.5	6/12/2017	Soil	Freezer		X	X											
BH03/1.75	1.75	6/12/2017	Soil	Freezer		X	X											
BH03/2	2	6/12/2017	Soil	Freezer		X	X											
BH03/2.25	2.25	6/12/2017	Soil	Freezer		X	X											
BH03/2.5	2.5	6/12/2017	Soil	Freezer		X	X											
LOR (S)																		
LOR (W)																		

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed Relinquished By: Nizam Ahamed Sign: Date/Time: 6/12/2017

Received By: MC Relinquished By: Sign: Date/Time: 7/12/17

**** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL****

Send Results to:
Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522
Accounts:
perth@douglaspartners.com.au

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes												NOTES
						pH(F)	pH(FOX)											
BH04/0.25	0.25	6/12/2017	Soil	Freezer		X	X											Please use the
BH04/0.5	0.5	6/12/2017	Soil	Freezer		X	X											reduced rate of
BH04/0.75	0.75	6/12/2017	Soil	Freezer		X	X											$7.00 for both pH(F)
BH04/1	1	6/12/2017	Soil	Freezer		X	X											and pH(FOX) as
BH04/1.25	1.25	6/12/2017	Soil	Freezer		X	X											agreed with Stacey
BH04/1.5	1.5	6/12/2017	Soil	Freezer		X	X											in an email dated
BH04/1.75	1.75	6/12/2017	Soil	Freezer		X	X											15 September 2016
BH04/2	2	6/12/2017	Soil	Freezer		X	X											
BH04/2.25	2.25	6/12/2017	Soil	Freezer		X	X											
BH04/2.5	2.5	6/12/2017	Soil	Freezer		X	X											
BH04/2.75	2.75	6/12/2017	Soil	Freezer		X	X											
BH04/3	3	6/12/2017	Soil	Freezer		X	X											
BH05/0.25	0.25	6/12/2017	Soil	Freezer		X	X											
BH05/0.5	0.5	6/12/2017	Soil	Freezer		X	X											
BH05/0.75	0.75	6/12/2017	Soil	Freezer		X	X											
LOR (S)																		
LOR (W)																		

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed
Relinquished By: Nizam Ahamed
Sign:
Date/Time: 6/12/2017

Received By: mc
Relinquished By:
Sign:
Date/Time: 7/12/17

**** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL****

Send Results to:
Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522
Accounts:
perth@douglaspartners.com.au

Douglas Partners
Geotechnics / Environment / Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes											NOTES
						pH(F)	pH(FOX)										
BH05/1	1	6/12/2017	Soil	Freezer		X	X										Please use the
BH06/0.25	0.25	6/12/2017	Soil	Freezer		X	X										reduced rate of
BH06/0.5	0.5	6/12/2017	Soil	Freezer		X	X										$7.00 for both pH(F)
BH06/0.75	0.75	6/12/2017	Soil	Freezer		X	X										and pH(FOX) as
BH06/1	1	6/12/2017	Soil	Freezer		X	X										agreed with Stacey
BH06/1.25	1.25	6/12/2017	Soil	Freezer		X	X										in an email dated
BH06/1.5	1.5	6/12/2017	Soil	Freezer		X	X										15 September 2016
BH06/1.75	1.75	6/12/2017	Soil	Freezer		X	X										
BH06/2	2	6/12/2017	Soil	Freezer		X	X										
BH06/2.25	2.25	6/12/2017	Soil	Freezer		X	X										
BH06/2.5	2.5	6/12/2017	Soil	Freezer		X	X										
BH06/2.75	2.75	6/12/2017	Soil	Freezer		X	X										
BH06/3	3	6/12/2017	Soil	Freezer		X	X										
BH07/0.25	0.25	6/12/2017	Soil	Freezer		X	X										
BH07/0.5	0.5	6/12/2017	Soil	Freezer		X	X										
LOR (S)																	
LOR (W)																	

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed Relinquished By: Nizam Ahamed Sign: Date/Time: 6/12/2017

Received By: mc Relinquished By: Sign: Date/Time: 17/12/17

**** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL****

Send Results to:
Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522
Accounts:
perth@douglaspartners.com.au

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes											NOTES
						pH(F)	pH(FOX)										
BH07/0.75	0.75	6/12/2017	Soil	Freezer		X	X										Please use the
BH07/1	1	6/12/2017	Soil	Freezer		X	X										reduced rate of
BH08/0.25	0.25	6/12/2017	Soil	Freezer		X	X										$7.00 for both pH(F)
BH08/0.5	0.5	6/12/2017	Soil	Freezer		X	X										and pH(FOX) as
BH08/0.75	0.75	6/12/2017	Soil	Freezer		X	X										agreed with Stacey
BH08/1	1	6/12/2017	Soil	Freezer		X	X										in an email dated
BH08/1.25	1.25	6/12/2017	Soil	Freezer		X	X										15 September 2016
BH08/1.5	1.5	6/12/2017	Soil	Freezer		X	X										
BH08/1.75	1.75	6/12/2017	Soil	Freezer		X	X										
BH08/2	2	6/12/2017	Soil	Freezer		X	X										
BH08/2.25	2.25	6/12/2017	Soil	Freezer		X	X										
BH08/2.5	2.5	6/12/2017	Soil	Freezer		X	X										
BH08/2.75	2.75	6/12/2017	Soil	Freezer		X	X										
BH08/3	3	6/12/2017	Soil	Freezer		X	X										
BH08/3.25	3.25	6/12/2017	Soil	Freezer		X	X										
LOR (S)																	
LOR (W)																	

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed
Relinquished By: Nizam Ahamed
Sign:
Date/Time: 6/12/2017

Received By: MC
Relinquished By:
Sign:
Date/Time: 7/12/17

** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL**

Send Results to:
Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522
Accounts:
perth@douglaspartners.com.au

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes											NOTES
						pH(F)	pH(FOX)										
BH09/1.75	1.75	6/12/2017	Soil	Freezer		X	X										$7.00 for both pH(F)
BH09/2	2	6/12/2017	Soil	Freezer		X	X										and pH(FOX) as
BH09/2.25	2.25	6/12/2017	Soil	Freezer		X	X										agreed with Stacey
BH09/2.5	2.5	6/12/2017	Soil	Freezer		X	X										in an email dated
BH09/2.75	2.75	6/12/2017	Soil	Freezer		X	X										15 September 2016
BH09/3	3	6/12/2017	Soil	Freezer		X	X										
BH09/3.25	3.25	6/12/2017	Soil	Freezer		X	X										
BH09/3.5	3.5	6/12/2017	Soil	Freezer		X	X										
BH09/3.75	3.75	6/12/2017	Soil	Freezer		X	X										
BH09/4	4	6/12/2017	Soil	Freezer		X	X										
BH09/4.25	4.25	6/12/2017	Soil	Freezer		X	X										
BH09/4.5	4.5	6/12/2017	Soil	Freezer		X	X										
BH09/4.75	4.75	6/12/2017	Soil	Freezer		X	X										
BH09/5	5	6/12/2017	Soil	Freezer		X	X										Please use the
BH09/5.25	5.25	6/12/2017	Soil	Freezer		X	X										reduced rate of
LOR (S)																	
LOR (W)																	

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed Relinquished By: Nizam Ahamed Sign: Date/Time: 6/12/2017

Received By: Relinquished By: Sign: Date/Time: 7/6/17

** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL**

Send Results to:
Douglas Partners Pty Ltd
37 O'Malley Street
OSBORNE PARK 6018
Ph: (08) 9204 3512
Fax: (08) 9204 3523
Accounts:
perth@douglaspartners.com.au

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes												NOTES
						pH(F)	pH(FOX)											
BH10/4.25	4.25	6/12/2017	Soil	Freezer		X	X											and pH(FOX) as
BH10/4.5	4.5	6/12/2017	Soil	Freezer		X	X											agreed with Stacey
BH10/4.75	4.75	6/12/2017	Soil	Freezer		X	X											in an email dated
BH10/5	5	6/12/2017	Soil	Freezer		X	X											15 September 2016
BH10/5.25	5.25	6/12/2017	Soil	Freezer		X	X											
BH10/5.5	5.5	6/12/2017	Soil	Freezer		X	X											
BH10/5.75	5.75	6/12/2017	Soil	Freezer		X	X											
BH10/6	6	6/12/2017	Soil	Freezer		X	X											
BH10/6.25	6.25	6/12/2017	Soil	Freezer		X	X											
BH10/6.5	6.5	6/12/2017	Soil	Freezer		X	X											
BH11/0.25	0.25	6/12/2017	Soil	Freezer		X	X											
BH11/0.5	0.5	6/12/2017	Soil	Freezer		X	X											
BH11/0.75	0.75	6/12/2017	Soil	Freezer		X	X											Please use the
BH11/1	1	6/12/2017	Soil	Freezer		X	X											reduced rate of
BH11/1.25	1.25	6/12/2017	Soil	Freezer		X	X											$7.00 for both pH(F)
LOR (S)																		
LOR (W)																		

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed Relinquished By: Nizam Ahamed Sign: Date/Time: 6/12/2017

Received By: MC Relinquished By: Sign: Date/Time: 7/12/17

** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL**

Send Results to:
Douglas Partners Pty Ltd
37 O'Malley Street
OSBORNE PARK 6018
Ph: (08) 9204 3512
Fax: (08) 9204 3523
Accounts:
perth@douglaspartners.com.au

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY Despatch Sheet

Project Name: Huntingdale, Garden St-ASS
Project No: 88978
DP Contact Person: Nizam Ahamed
Prior Storage: Freezer

To: MPL Envirolab
16-18 Hayden Court
Myaree
Ph: 9317 2505

Sample ID	Depth (m)	Sampling Date	Sample Type S - Soil W - Water	Preservation	Lab ID	Analytes											NOTES
						pH(F)	pH(FOX)										
BH12/0.75	0.75	6/12/2017	Soil	Freezer		X	X										in an email dated
BH12/1	1	6/12/2017	Soil	Freezer		X	X										15 September 2016
BH12/1.25	1.25	6/12/2017	Soil	Freezer		X	X										
BH12/1.5	1.5	6/12/2017	Soil	Freezer		X	X										
BH12/1.75	1.75	6/12/2017	Soil	Freezer		X	X										
BH12/2	2	6/12/2017	Soil	Freezer		X	X										
DUP1	-	6/12/2017	Soil	Freezer		X	X										
DUP2	-	6/12/2017	Soil	Freezer		X	X										
DUP3	-	6/12/2017	Soil	Freezer		X	X										
DUP4	-	6/12/2017	Soil	Freezer		X	X										
DUP5	-	6/12/2017	Soil	Freezer		X	X										Please use the
DUP6	-	6/12/2017	Soil	Freezer		X	X										reduced rate of
DUP7	-	6/12/2017	Soil	Freezer		X	X										$7.00 for both pH(F)
DUP8	-	6/12/2017	Soil	Freezer		X	X										and pH(FOX) as
DUP9	-	6/12/2017	Soil	Freezer		X	X										agreed with Stacey
LOR (S)																	
LOR (W)																	

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: Nizam Ahamed Relinquished By: Nizam Ahamed Sign: Date/Time: 6/12/2017

Received By: Relinquished By: Sign: Date/Time: 7/12/17

**** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL****

Send Results to:
Douglas Partners Pty Ltd
38 O'Malley Street
OSBORNE PARK 6019
Ph: (08) 9204 3513
Fax: (08) 9204 3524
Accounts:
perth@douglaspartners.com.au

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 204259

Client Details

Client	Douglas Partners Perth
Attention	Nizam Ahamed
Address	36 O'Malley St, Osborne Park, WA, 6017

Sample Details

Your Reference	**88978**
Number of Samples	174 soils
Date samples received	07/12/2017
Date completed instructions received	07/12/2017
Location	Huntingdale, Garden St - ASS

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	14/12/2017
Date of Issue	08/12/2017

Results Approved By
Stacey Hawkins, Acid Soils Supervisor

Authorised By

Todd Lee, Laboratory Manager

sPOCAS field test						
Our Reference		204259-1	204259-2	204259-3	204259-4	204259-5
Your Reference	UNITS	BH01/0.25	BH01/0.5	BH01/0.75	BH01/1	BH01/1.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.0	5.2	5.2	5.3	6.3
pHFOX (field peroxide test)*	pH Units	3.4	4.0	4.0	4.4	2.8
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-6	204259-7	204259-8	204259-9	204259-10
Your Reference	UNITS	BH01/1.5	BH01/1.75	BH01/2.0	BH02/0.25	BH02/0.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	6.2	6.0	6.0	5.3	5.3
pHFOX (field peroxide test)*	pH Units	4.2	4.6	4.5	3.6	3.4
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-11	204259-12	204259-13	204259-14	204259-15
Your Reference	UNITS	BH02/0.75	BH02/1.0	BH02/1.25	BH02/1.5	BH02/1.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.3	5.2	5.1	5.0	5.6
pHFOX (field peroxide test)*	pH Units	3.4	3.6	3.4	3.3	2.8
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-16	204259-17	204259-18	204259-19	204259-20
Your Reference	UNITS	BH02/2	BH02/2.25	BH02/2.5	BH02/2.75	BH02/3
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.7	5.4	5.2	5.0	5.0
pHFOX (field peroxide test)*	pH Units	2.8	3.8	3.9	3.7	4.1
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-21	204259-22	204259-23	204259-24	204259-25
Your Reference	UNITS	BH03/0.25	BH3/0.5	BH3/0.75	BH3/1	BH03/1.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.9	5.0	5.0	5.2	5.1
pHFOX (field peroxide test)*	pH Units	3.4	3.6	3.6	4.2	4.3
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-26	204259-27	204259-28	204259-29	204259-30
Your Reference	UNITS	BH03/1.5	BH03/1.75	BH03/2	BH03/2.25	BH03/2.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.1	5.0	5.0	5.0	5.1
pHFOX (field peroxide test)*	pH Units	4.2	4.2	4.2	3.8	3.8
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-31	204259-32	204259-33	204259-34	204259-35
Your Reference	UNITS	BH04/0.25	BH04/0.5	BH04/0.75	BH04/1	BH04/1.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.2	5.2	5.0	4.6	4.7
pHFOX (field peroxide test)*	pH Units	2.1	2.4	2.7	3.0	2.6
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-36	204259-37	204259-38	204259-39	204259-40
Your Reference	UNITS	BH04/1.5	BH04/1.75	BH04/2	BH04/2.25	BH04/2.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.1	5.5	5.3	5.2	4.5
pHFOX (field peroxide test)*	pH Units	2.8	2.6	3.4	3.1	3.5
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-41	204259-42	204259-43	204259-44	204259-45
Your Reference	UNITS	BH04/2.75	BH04/3	BH05/0.25	BH05/0.5	BH05/0.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.5	4.6	4.8	4.7	4.7
pHFOX (field peroxide test)*	pH Units	3.2	2.8	3.4	3.4	3.7
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-46	204259-47	204259-48	204259-49	204259-50
Your Reference	UNITS	BH05/1	BH06/0.25	BH06/0.5	BH06/0.75	BH06/1
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.4	6.3	7.0	8.6	8.9
pHFOX (field peroxide test)*	pH Units	3.7	3.7	4.0	6.4	6.2
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-51	204259-52	204259-53	204259-54	204259-55
Your Reference	UNITS	BH06/1.25	BH06/1.5	BH06/1.75	BH06/2	BH06/2.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	8.6	8.3	8.2	8.6	8.6
pHFOX (field peroxide test)*	pH Units	6.2	6.2	6.3	6.2	6.2
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-56	204259-57	204259-58	204259-59	204259-60
Your Reference	UNITS	BH06/2.5	BH06/2.75	BH06/3	BH07/0.25	BH07/0.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	8.3	7.7	7.8	5.6	5.5
pHFOX (field peroxide test)*	pH Units	2.7	5.3	1.3	4.2	4.2
Reaction Rate*	-	Extreme	low	low	low	low

sPOCAS field test						
Our Reference		204259-61	204259-62	204259-63	204259-64	204259-65
Your Reference	UNITS	BH07/0.75	BH07/1	BH08/0.25	BH08/0.5	BH08/0.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.5	4.4	5.6	5.5	5.4
pHFOX (field peroxide test)*	pH Units	4.0	4.0	4.0	4.2	4.4
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-66	204259-67	204259-68	204259-69	204259-70
Your Reference	UNITS	BH08/1	BH08/1.25	BH08/1.5	BH08/1.75	BH08/2
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.5	5.3	5.1	6.0	5.9
pHFOX (field peroxide test)*	pH Units	4.1	4.6	4.5	3.8	4.1
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-71	204259-72	204259-73	204259-74	204259-75
Your Reference	UNITS	BH08/2.25	BH08/2.5	BH08/2.75	BH08/3	BH08/3.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.5	5.1	4.9	5.2	6.6
pHFOX (field peroxide test)*	pH Units	4.7	4.7	4.6	4.7	3.3
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-76	204259-77	204259-78	204259-79	204259-80
Your Reference	UNITS	BH09/1.75	BH09/2	BH09/2.25	BH09/2.5	BH09/2.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.2	4.5	4.9	4.8	4.9
pHFOX (field peroxide test)*	pH Units	2.9	3.4	4.4	4.4	4.7
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-81	204259-82	204259-83	204259-84	204259-85
Your Reference	UNITS	BH09/3	BH09/3.25	BH09/3.5	BH09/3.75	BH09/4
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.0	5.8	4.7	5.1	5.1
pHFOX (field peroxide test)*	pH Units	4.5	3.4	3.4	4.3	4.5
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-86	204259-87	204259-88	204259-89	204259-90
Your Reference	UNITS	BH09/4.25	BH09/4.5	BH09/4.75	BH09/5	BH09/5.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.1	4.8	5.1	5.0	5.2
pHFOX (field peroxide test)*	pH Units	4.4	3.9	4.0	4.2	4.2
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-91	204259-92	204259-93	204259-94	204259-95
Your Reference	UNITS	BH10/4.25	BH10/4.5	BH10/4.75	BH10/5	BH10/5.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.8	5.8	6.3	5.4	5.4
pHFOX (field peroxide test)*	pH Units	4.7	4.6	3.9	4.6	4.6
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-96	204259-97	204259-98	204259-99	204259-100
Your Reference	UNITS	BH10/5.5	BH10/5.75	BH10/6	BH10/6.25	BH10/6.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.4	5.4	4.8	4.6	4.7
pHFOX (field peroxide test)*	pH Units	4.6	4.7	3.6	3.7	3.6
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-101	204259-102	204259-103	204259-104	204259-105
Your Reference	UNITS	BH11/0.25	BH11/0.5	BH11/0.75	BH11/1	BH11/1.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	6.0	5.4	5.1	5.0	5.1
pHFOX (field peroxide test)*	pH Units	3.8	3.7	3.9	3.7	4.0
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-106	204259-107	204259-108	204259-109	204259-110
Your Reference	UNITS	BH12/0.75	BH12/1	BH12/1.25	BH12/1.5	BH12/1.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.9	6.0	5.9	6.2	6.0
pHFOX (field peroxide test)*	pH Units	4.5	4.6	3.8	4.7	4.6
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-111	204259-112	204259-113	204259-114	204259-115
Your Reference	UNITS	BH12/2	DUP1	DUP2	DUP3	DUP4
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.0	5.6	4.8	5.0	8.4
pHFOX (field peroxide test)*	pH Units	3.9	4.6	3.7	3.3	6.3
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-116	204259-117	204259-118	204259-119	204259-120
Your Reference	UNITS	DUP5	DUP6	DUP7	DUP8	DUP9
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.4	5.0	5.0	5.2	4.9
pHFOX (field peroxide test)*	pH Units	3.8	4.3	3.7	4.5	4.1
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-121	204259-122	204259-123	204259-124	204259-125
Your Reference	UNITS	BH08/3.5	BH08/3.75	BH08/4	BH08/4.25	BH08/4.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.3	4.9	5.0	5.1	4.5
pHFOX (field peroxide test)*	pH Units	4.1	4.4	4.4	4.2	3.4
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-126	204259-127	204259-128	204259-129	204259-130
Your Reference	UNITS	BH08/4.75	BH08/5	BH08/5.25	BH08/5.5	BH09/5.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.4	4.6	4.9	5.0	5.6
pHFOX (field peroxide test)*	pH Units	3.4	3.6	3.7	3.9	4.0
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-131	204259-132	204259-133	204259-134	204259-135
Your Reference	UNITS	BH08/6	BH09/0.25	BH09/0.5	BH09/0.75	BH09/1
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.2	4.9	4.9	5.1	4.9
pHFOX (field peroxide test)*	pH Units	4.6	3.3	3.3	3.6	3.5
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-136	204259-137	204259-138	204259-139	204259-140
Your Reference	UNITS	BH09/1.25	BH09/1.5	BH09/5.5	BH10/0.25	BH10/0.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.9	4.7	4.8	5.4	5.2
pHFOX (field peroxide test)*	pH Units	3.9	3.3	3.9	3.3	3.4
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-141	204259-142	204259-143	204259-144	204259-145
Your Reference	UNITS	BH10/0.75	BH10/1	BH10/1.25	BH10/1.5	BH10/1.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	5.0	5.1	5.0	5.2	7.2
pHFOX (field peroxide test)*	pH Units	3.5	3.4	3.5	3.6	4.1
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-146	204259-147	204259-148	204259-149	204259-150
Your Reference	UNITS	BH10/2	BH10/2.25	BH10/2.5	BH10/2.75	BH10/3
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	6.5	5.2	5.1	5.0	5.1
pHFOX (field peroxide test)*	pH Units	2.9	3.2	3.2	3.9	4.0
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-151	204259-152	204259-153	204259-154	204259-155
Your Reference	UNITS	BH10/3.25	BH10/3.5	BH10/3.75	BH10/4	BH11/1.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	7.9	7.8	7.7	5.2	5.4
pHFOX (field peroxide test)*	pH Units	4.3	4.2	4.0	4.2	3.7
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-156	204259-157	204259-158	204259-159	204259-160
Your Reference	UNITS	BH11/1.75	BH11/2	BH11/2.25	BH11/2.5	BH11/2.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	6.3	6.1	5.3	4.6	4.7
pHFOX (field peroxide test)*	pH Units	3.4	3.0	3.6	3.4	3.7
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-161	204259-162	204259-163	204259-164	204259-165
Your Reference	UNITS	BH11/3	BH11/3.25	BH11/3.5	BH11/3.75	BH11/4
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	4.8	6.2	4.7	4.7	4.7
pHFOX (field peroxide test)*	pH Units	4.1	3.3	4.0	3.6	4.3
Reaction Rate*	-	low	low	low	low	low

sPOCAS field test						
Our Reference		204259-166	204259-167	204259-168	204259-169	204259-170
Your Reference	UNITS	BH11/4.25	BH11/4.50	BH11/4.75	BH11/5	BH12/0.25
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	07/12/2017	07/12/2017	07/12/2017	07/12/2017	07/12/2017
Date analysed	-	08/12/2017	08/12/2017	08/12/2017	08/12/2017	08/12/2017
pH_F (field pH test)*	pH Units	6.9	4.6	4.8	4.7	6.0
pHFOX (field peroxide test)*	pH Units	4.5	4.2	3.7	4.1	4.2
Reaction Rate*	-	Medium	low	low	low	low

sPOCAS field test		
Our Reference		204259-171
Your Reference	UNITS	BH12/0.5
Date Sampled		06/12/2017
Type of sample		Frozen soil
Date prepared	-	07/12/2017
Date analysed	-	08/12/2017
pH_F (field pH test)*	pH Units	5.6
pHFOX (field peroxide test)*	pH Units	4.2
Reaction Rate*	-	low

Method ID	Methodology Summary
INORG-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			07/12/2017	1	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			08/12/2017	1	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	1	5.0	5.1	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	1	3.4	3.4	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	11	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	11	5.3	5.4	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	11	3.4	3.5	3	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	21	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	21	4.9	4.9	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	21	3.4	3.3	3	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	31	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	31	5.2	5.2	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	31	2.1	2.1	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	41	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	41	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	41	4.5	4.5	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	41	3.2	3.2	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	51	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	51	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	51	8.6	8.6	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	51	6.2	6.0	3	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	61	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	61	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	61	4.5	4.4	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	61	4.0	3.9	3	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	71	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	71	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	71	5.5	5.4	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	71	4.7	4.7	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	81	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	81	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	81	5.0	4.9	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	81	4.5	4.4	2	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	91	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	91	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	91	5.8	5.8	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	91	4.7	4.7	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	101	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	101	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	101	6.0	6.2	3	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	101	3.8	3.8	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	111	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	111	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	111	5.0	5.1	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	111	3.9	3.8	3	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	121	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	121	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	121	5.3	5.2	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	121	4.1	4.2	2	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	131	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	131	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	131	5.2	5.3	2	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	131	4.6	4.4	4	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	141	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	141	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	141	5.0	5.0	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	141	3.5	3.5	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	151	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	151	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	151	7.9	7.9	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	151	4.3	4.4	2	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	161	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	161	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	161	4.8	4.8	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	161	4.1	4.0	2	[NT]	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	171	07/12/2017	07/12/2017		[NT]	[NT]
Date analysed	-			[NT]	171	08/12/2017	08/12/2017		[NT]	[NT]
pH_F (field pH test)*	pH Units		INORG-063	[NT]	171	5.6	5.6	0	[NT]	[NT]
pHFOX (field peroxide test)*	pH Units		INORG-063	[NT]	171	4.2	4.3	2	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

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.

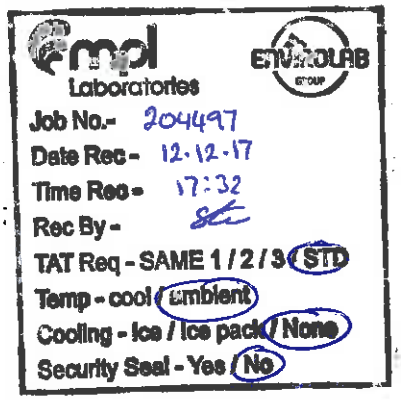
Measurement Uncertainty estimates are available for most tests upon request.

Stacey Hawkins

From: Nizam Ahamed <Nizam.Ahamed@douglaspartners.com.au>
Sent: Tuesday, 12 December 2017 5:32 PM
To: Stacey Hawkins
Subject: RE: Results for Registration 204259 88978

Hi Stacey
In relation to the captioned lab report, can you please undertake the SPOCAS suite on the following samples at the reduced rate that has been discussed with Rob for previous projects:

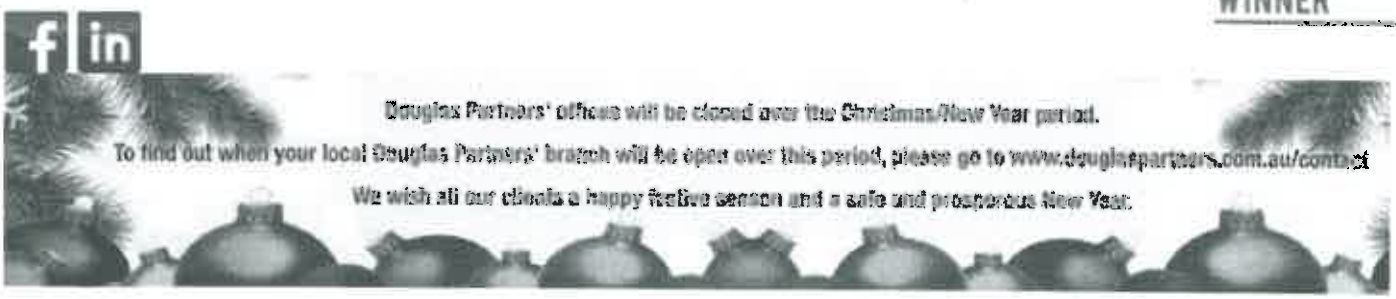
- BH01/1.25;
- BH02/0.75
- BH02/1.75
- BH03/0.75
- BH04/0.5;
- BH05/0.25
- BH06/0.5
- BH06/2.5
- BH07/0.5
- BH08/1.0
- BH08/1.75
- BH09/1.75
- BH09/3.25
- BH10/2.0
- BH10/4.75
- BH10/6.0
- BH11/2.0
- BH11/4.25
- BH12/0.75



Any issues, please let me know.

Thanks and Regards

Nizam Ahamed | Associate / Environmental Scientist
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
36 O'Malley Street Osborne Park WA 6017
P: 08 9204 3511 | F: 08 9204 3522 | M: 0409 773 636 | E: Nizam.Ahamed@douglaspartners.com.au



From: Stacey Hawkins [mailto:shawkins@mpl.com.au]
Sent: Friday, 8 December 2017 11:53 AM

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 204497

Client Details

Client	Douglas Partners Perth
Attention	Nizam Ahamed
Address	36 O'Malley St, Osborne Park, WA, 6017

Sample Details

Your Reference	**88978**
Number of Samples	19 dried soils
Date samples received	07/12/2017
Date completed instructions received	12/12/2017
Location	Huntingdale,Garden St-ASS

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	21/12/2017
Date of Issue	18/12/2017

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
Stacey Hawkins, Acid Soils Supervisor

Authorised By

Todd Lee, Laboratory Manager

sPOCAS						
Our Reference		204497-1	204497-2	204497-3	204497-4	204497-5
Your Reference	UNITS	BH01/1.25	BH02/0.75	BH02/1.75	BH03/0.75	BH04/0.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil	Dried soil
Date prepared	-	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Date analysed	-	18/12/2017	18/12/2017	18/12/2017	18/12/2017	18/12/2017
pH $_{kcl}$	pH units	5.8	5.6	5.8	5.6	5.4
TAA	moles H^+ /t	<5	9.5	<5	<5	15
pH $_{Ox}$	pH units	4.2	2.8	4.4	2.9	2.6
TPA	moles H^+ /t	<5	100	<5	50	180
S_{KCl}	%w/w S	0.012	<0.005	0.006	<0.005	0.007
Ca_{KCl}	%w/w	0.009	0.040	0.006	0.007	0.065
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	0.010
S_P	%w/w	0.008	0.009	0.008	<0.005	0.017
Ca_P	%w/w	0.012	0.042	0.007	0.080	0.066
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	0.010
a-ANC_E	moles H^+ /t	<5	<5	<5	<5	<5
SHCl	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
TSA	moles H^+ /t	<5	92	<5	47	170
s-TAA	%w/w S	<0.01	0.015	<0.01	<0.01	0.024
s-TPA	%w/w S	<0.01	0.16	<0.01	0.080	0.29
s-TSA	%w/w S	<0.01	0.15	<0.01	0.075	0.27
S_{POS}	%w/w S	<0.005	0.006	<0.005	<0.005	0.01
a-S_{POS}	moles H^+ /t	<5	<5	<5	<5	6.1
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	0.073	<0.005
a-Ca_A	moles H^+ /t	<5	<5	<5	37	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	0.059	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+ /t	<5	<5	<5	<5	<5
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	<0.01	<0.01	<0.01	<0.01	<0.01
s-ANC_E	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{NAS}	moles H^+ /t	<5	<5	<5	<5	<5
s-S_{NAS}	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-Net Acidity	%w/w S	<0.01	0.021	0.010	<0.01	0.033
a-Net Acidity	moles H^+ /t	<5	13	6.3	<5	21
Liming rate	kg $CaCO_3$ /t	<0.75	0.98	<0.75	<0.75	1.6
Net Acidity (WA)	%w/w S	<0.01	0.021	0.010	<0.01	0.033
a-Net Acidity without ANCE	moles H^+ /t	<5	13	6.3	<5	21

sPOCAS						
Our Reference		204497-1	204497-2	204497-3	204497-4	204497-5
Your Reference	UNITS	BH01/1.25	BH02/0.75	BH02/1.75	BH03/0.75	BH04/0.5
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil	Dried soil
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	0.98	<0.75	<0.75	1.6

sPOCAS						
Our Reference		204497-6	204497-7	204497-8	204497-9	204497-10
Your Reference	UNITS	BH05/0.25	BH06/0.5	BH06/2.5	BH07/0.5	BH08/1.0
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil	Dried soil
Date prepared	-	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Date analysed	-	18/12/2017	18/12/2017	18/12/2017	18/12/2017	18/12/2017
pH $_{kcl}$	pH units	5.3	6.5	6.1	5.5	5.8
TAA	moles H^+ /t	13	<5	<5	8.2	<5
pH $_{Ox}$	pH units	2.7	3.5	3.8	2.8	4.0
TPA	moles H^+ /t	99	<5	25	79	<5
S_{KCl}	%w/w S	0.007	0.006	0.009	<0.005	<0.005
Ca_{KCl}	%w/w	0.041	0.071	0.012	0.025	0.015
Mg_{KCl}	%w/w	0.007	0.046	0.047	<0.005	0.011
S_P	%w/w	0.009	0.027	0.083	0.012	0.022
Ca_P	%w/w	0.038	0.086	0.013	0.026	0.020
Mg_P	%w/w	<0.005	0.048	0.046	<0.005	0.012
a-ANC_E	moles H^+ /t	<5	<5	<5	<5	<5
SHCl	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
TSA	moles H^+ /t	87	<5	24	71	<5
s-TAA	%w/w S	0.020	<0.01	<0.01	0.013	<0.01
s-TPA	%w/w S	0.16	<0.01	0.041	0.13	<0.01
s-TSA	%w/w S	0.14	<0.01	0.038	0.11	<0.01
S_{POS}	%w/w S	<0.005	0.021	0.074	0.009	0.019
a-S_{POS}	moles H^+ /t	<5	13	46	5.7	12
Ca_A	%w/w Ca	<0.005	0.015	<0.005	<0.005	<0.005
a-Ca_A	moles H^+ /t	<5	7	<5	<5	<5
s-Ca_A	%w/w S	<0.005	0.012	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+ /t	<5	<5	<5	<5	<5
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	<0.01	<0.01	<0.01	<0.01	<0.01
s-ANC_E	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{NAS}	moles H^+ /t	<5	<5	<5	<5	<5
s-S_{NAS}	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-Net Acidity	%w/w S	0.022	<0.01	0.077	0.022	0.025
a-Net Acidity	moles H^+ /t	14	<5	48	14	16
Liming rate	kg $CaCO_3$ /t	1.0	<0.75	3.6	1.0	1.2
Net Acidity (WA)	%w/w S	0.022	0.021	0.077	0.022	0.025
a-Net Acidity without ANCE	moles H^+ /t	14	13	48	14	16

sPOCAS						
Our Reference		204497-6	204497-7	204497-8	204497-9	204497-10
Your Reference	UNITS	BH05/0.25	BH06/0.5	BH06/2.5	BH07/0.5	BH08/1.0
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil	Dried soil
Liming rate without ANCE	kg $CaCO_3$ /t	1.0	0.98	3.6	1.0	1.2

sPOCAS						
Our Reference		204497-11	204497-12	204497-13	204497-14	204497-15
Your Reference	UNITS	BH08/1.75	BH09/1.75	BH09/3.25	BH10/2.0	BH10/4.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil	Dried soil
Date prepared	-	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Date analysed	-	18/12/2017	18/12/2017	18/12/2017	18/12/2017	18/12/2017
pH $_{kcl}$	pH units	5.9	5.7	5.9	6.0	5.9
TAA	moles H^+ /t	<5	<5	<5	<5	<5
pH $_{Ox}$	pH units	4.3	3.4	4.5	5.1	4.7
TPA	moles H^+ /t	<5	<5	<5	<5	<5
S_{KCl}	%w/w S	<0.005	0.009	0.005	0.006	<0.005
Ca_{KCl}	%w/w	<0.005	0.013	<0.005	0.011	<0.005
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	0.008	<0.005	0.008	<0.005	0.006
Ca_P	%w/w	0.006	0.014	0.006	0.012	0.005
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+ /t	<5	<5	<5	<5	<5
SHCl	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
TSA	moles H^+ /t	<5	<5	<5	<5	<5
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	0.006	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+ /t	<5	<5	<5	<5	<5
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+ /t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+ /t	<5	<5	<5	<5	<5
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	<0.01	<0.01	<0.01	<0.01	<0.01
s-ANC_E	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{NAS}	moles H^+ /t	<5	<5	<5	<5	<5
s-S_{NAS}	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+ /t	5.2	<5	<5	<5	<5
Liming rate	kg $CaCO_3$ /t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+ /t	5.2	<5	<5	<5	<5

sPOCAS						
Our Reference		204497-11	204497-12	204497-13	204497-14	204497-15
Your Reference	UNITS	BH08/1.75	BH09/1.75	BH09/3.25	BH10/2.0	BH10/4.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil	Dried soil
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	<0.75	<0.75	<0.75	<0.75

sPOCAS					
Our Reference		204497-16	204497-17	204497-18	204497-19
Your Reference	UNITS	BH10/6.0	BH11/2.0	BH11/4.25	BH12/0.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil
Date prepared	-	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Date analysed	-	18/12/2017	18/12/2017	18/12/2017	18/12/2017
pH $_{kcl}$	pH units	5.4	5.9	5.9	5.9
TAA	moles H^+ /t	17	<5	<5	<5
pH $_{Ox}$	pH units	4.8	4.4	4.9	4.0
TPA	moles H^+ /t	<5	<5	<5	<5
S_{KCl}	%w/w S	0.019	0.005	0.029	0.007
Ca_{KCl}	%w/w	<0.005	0.007	0.009	0.006
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	0.026	0.012	0.008	0.007
Ca_P	%w/w	<0.005	0.012	0.008	0.007
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+ /t	<5	<5	<5	<5
SHCl	%w/w S	<0.005	<0.005	<0.005	<0.005
TSA	moles H^+ /t	<5	<5	<5	<5
s-TAA	%w/w S	0.027	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	0.007	0.007	<0.005	<0.005
a-S_{POS}	moles H^+ /t	<5	<5	<5	<5
Ca_A	%w/w Ca	<0.005	0.005	<0.005	<0.005
a-Ca_A	moles H^+ /t	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+ /t	<5	<5	<5	<5
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	<0.01	<0.01	<0.01	<0.01
s-ANC_E	%w/w S	<0.005	<0.005	<0.005	<0.005
Fineness Factor		2	2	2	2
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005
a-S_{NAS}	moles H^+ /t	<5	<5	<5	<5
s-S_{NAS}	%w/w S	<0.01	<0.01	<0.01	<0.01
s-Net Acidity	%w/w S	0.034	0.013	<0.01	<0.01
a-Net Acidity	moles H^+ /t	21	7.9	<5	<5
Liming rate	kg $CaCO_3$ /t	1.6	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	0.034	0.013	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+ /t	21	7.9	<5	<5

sPOCAS					
Our Reference		204497-16	204497-17	204497-18	204497-19
Your Reference	UNITS	BH10/6.0	BH11/2.0	BH11/4.25	BH12/0.75
Date Sampled		06/12/2017	06/12/2017	06/12/2017	06/12/2017
Type of sample		Dried soil	Dried soil	Dried soil	Dried soil
Liming rate without ANCE	kg $CaCO_3$ /t	1.6	<0.75	<0.75	<0.75

Method ID	Methodology Summary
INORG-064	Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) using ASSMAC guidelines.

QUALITY CONTROL: sPOCAS						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			12/12/2017	1	12/12/2017	12/12/2017		12/12/2017	[NT]
Date analysed	-			18/12/2017	1	18/12/2017	18/12/2017		18/12/2017	[NT]
pH $_{kcl}$	pH units		INORG-064	[NT]	1	5.8	5.9	2	93	[NT]
TAA	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	121	[NT]
pH $_{Ox}$	pH units		INORG-064	[NT]	1	4.2	4.2	0	99	[NT]
TPA	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	90	[NT]
S_{KCl}	%w/w S	0.005	INORG-064	[NT]	1	0.012	0.006	67	[NT]	[NT]
Ca_{KCl}	%w/w	0.005	INORG-064	[NT]	1	0.009	0.01	11	[NT]	[NT]
Mg_{KCl}	%w/w	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
S_P	%w/w	0.005	INORG-064	[NT]	1	0.008	<0.005	46	[NT]	[NT]
Ca_P	%w/w	0.005	INORG-064	[NT]	1	0.012	0.012	0	[NT]	[NT]
Mg_P	%w/w	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
a-ANC_E	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
SHCl	%w/w S	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
TSA	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
s-TAA	%w/w S	0.01	INORG-064	[NT]	1	<0.01	<0.01	0	[NT]	[NT]
s-TPA	%w/w S	0.01	INORG-064	[NT]	1	<0.01	<0.01	0	[NT]	[NT]
s-TSA	%w/w S	0.01	INORG-064	[NT]	1	<0.01	<0.01	0	[NT]	[NT]
S_{POS}	%w/w S	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
a-S_{POS}	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
Ca_A	%w/w Ca	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
a-Ca_A	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
s-Ca_A	%w/w S	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
Mg_A	%w/w Mg	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
a-Mg_A	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
s-Mg_A	%w/w S	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
ANC_E	% $CaCO_3$	0.01	INORG-064	[NT]	1	<0.01	<0.01	0	[NT]	[NT]
s-ANC_E	%w/w S	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
Fineness Factor			INORG-064	[NT]	1	2	2	0	[NT]	[NT]
S_{NAS}	%w/w S	0.005	INORG-064	[NT]	1	<0.005	<0.005	0	[NT]	[NT]
a-S_{NAS}	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
s-S_{NAS}	%w/w S	0.01	INORG-064	[NT]	1	<0.01	<0.01	0	[NT]	[NT]
s-Net Acidity	%w/w S	0.01	INORG-064	[NT]	1	<0.01	<0.01	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
a-Net Acidity	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
Liming rate	kg $CaCO_3$/t	0.75	INORG-064	[NT]	1	<0.75	<0.75	0	[NT]	[NT]
Net Acidity (WA)	%w/w S	0.01	INORG-064	[NT]	1	<0.01	<0.01	0	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	INORG-064	[NT]	1	<5	<5	0	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	INORG-064	[NT]	1	<0.75	<0.75	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	12/12/2017	12/12/2017		[NT]	[NT]
Date analysed	-			[NT]	11	18/12/2017	18/12/2017		[NT]	[NT]
pH $_{kcl}$	pH units		INORG-064	[NT]	11	5.9	5.9	0	[NT]	[NT]
TAA	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
pH $_{Ox}$	pH units		INORG-064	[NT]	11	4.3	4.3	0	[NT]	[NT]
TPA	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
S_{KCl}	%w/w S	0.005	INORG-064	[NT]	11	<0.005	0.005	0	[NT]	[NT]
Ca_{KCl}	%w/w	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Mg_{KCl}	%w/w	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
S_P	%w/w	0.005	INORG-064	[NT]	11	0.008	<0.005	46	[NT]	[NT]
Ca_P	%w/w	0.005	INORG-064	[NT]	11	0.006	0.006	0	[NT]	[NT]
Mg_P	%w/w	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
a-ANC_E	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
SHCl	%w/w S	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
TSA	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
s-TAA	%w/w S	0.01	INORG-064	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
s-TPA	%w/w S	0.01	INORG-064	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
s-TSA	%w/w S	0.01	INORG-064	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
S_{POS}	%w/w S	0.005	INORG-064	[NT]	11	0.006	<0.005	18	[NT]	[NT]
a-S_{POS}	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
Ca_A	%w/w Ca	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
a-Ca_A	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
s-Ca_A	%w/w S	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Mg_A	%w/w Mg	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
a-Mg_A	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
s-Mg_A	%w/w S	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
ANC_E	% $CaCO_3$	0.01	INORG-064	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
s-ANC_E	%w/w S	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Fineness Factor			INORG-064	[NT]	11	2	2	0	[NT]	[NT]
S_{NAS}	%w/w S	0.005	INORG-064	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
a-S_{NAS}	moles H^+/t	5	INORG-064	[NT]	11	<5	<5	0	[NT]	[NT]
s-S_{NAS}	%w/w S	0.01	INORG-064	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
s-Net Acidity	%w/w S	0.01	INORG-064	[NT]	11	<0.01	<0.01	0	[NT]	[NT]

QUALITY CONTROL: sPOCAS						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
a-Net Acidity	moles H^+/t	5	INORG-064	[NT]	11	5.2	<5	4	[NT]	[NT]
Liming rate	kg $CaCO_3$/t	0.75	INORG-064	[NT]	11	<0.75	<0.75	0	[NT]	[NT]
Net Acidity (WA)	%w/w S	0.01	INORG-064	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	INORG-064	[NT]	11	5.2	<5	4	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	INORG-064	[NT]	11	<0.75	<0.75	0	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

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.

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: ~~XRG~~ HUNTINGDALE, ASS INVESTIGATION
Project No: 88978.00
DP Contact Person: NIZAM AHAMED
Prior Storage: esky / ~~fridge / shelved~~ (circle)

To: MPL Envirolab
16 – 18 Hayden Court
Myaree
Ph: 9317 2505

	Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes: 16PS+9	8HM	MAJOR ANIONS & CATIONS									NOTES
1	BH04	15/12/11	W	ESKY		✓		✓									
2	BH06	↓	↓	↓		✓		✓									
3	BH08					✓		✓									
4	BD1/15121T						✓										
	LOR (S)																
	LOR (W)																

mpl Laboratories ENVIROLAB GROUP
Job No.- 204686
Date Rec- 15/12
Time Rec- 17:00
Rec By - K.I
TAT Req - SAME 1 / 2 / 3 / STD
Temp - Cool / ambient
Cooling - Ice / Ice pack / None
Security Seal - Yes / No

LOR = Limit of Reporting, *As per Laboratory Method Detection Limit

Sampled By: _____ Relinquished By: _____ Sign: _____ Date/Time: _____
Received By: MPL Relinquished By: _____ Sign: RY Date/Time: 15/12

**** IMPORTANT: PLEASE SIGN AND DATE TO ACKNOWLEDGE RECIEPT OF SAMPLES AND RETURN BY EMAIL****

Send Results to:
Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522
Accounts: perth@douglaspartners.com.au

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 204686

Client Details

Client	Douglas Partners Perth
Attention	Nizam Ahamed
Address	36 O'Malley St, Osborne Park, WA, 6017

Sample Details

Your Reference	**88978.00 Huntingdale Ass Investigation**
Number of Samples	4 Water
Date samples received	15/12/2017
Date completed instructions received	15/12/2017

Analysis Details

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

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

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

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

Report Details

Date results requested by	02/01/2018
Date of Issue	02/01/2018

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
Joshua Lim, Operations Manager

Authorised By

Todd Lee, Laboratory Manager

Miscellaneous Inorganics					
Our Reference			204686-1	204686-2	204686-3
Your Reference	UNITS	PQL	BH04	BH06	BH08
Date Sampled			15/12/2017	15/12/2017	15/12/2017
Type of sample			Water	Water	Water
Date prepared	-		18/12/2017	18/12/2017	18/12/2017
Date analysed	-		18/12/2017	18/12/2017	18/12/2017
pH	pH Units		4.4	6.4	4.3
Electrical Conductivity (EC)	µS/cm	1	410	12,000	290
Total Dissolved Solids (grav)	mg/L	5	250	7,500	180
Total Suspended Solids	mg/L	5	120	39	16
Acidity as $CaCO_3$	mg/L	5	140	61	54

Ionic Balance					
Our Reference	UNITS	PQL	204686-1	204686-2	204686-3
Your Reference			BH04	BH06	BH08
Date Sampled			15/12/2017	15/12/2017	15/12/2017
Type of sample			Water	Water	Water
Date prepared	-		18/12/2017	18/12/2017	18/12/2017
Date analysed	-		18/12/2017	18/12/2017	18/12/2017
Calcium - Dissolved	mg/L	0.5	4.6	22	5.7
Potassium - Dissolved	mg/L	0.5	10	13	11
Magnesium - Dissolved	mg/L	0.5	3.7	220	4.8
Sodium - Dissolved	mg/L	0.5	61	2,200	31
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	11	180	<5
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	11	180	<5
Chloride	mg/L	1	57	3,800	43
Sulphate	mg/L	1	29	300	10
Ionic Balance	%		17	-0.49	24
Hardness as $CaCO_3$	mg/L	3	27	970	34

Nutrients in Water					
Our Reference	UNITS	PQL	204686-1	204686-2	204686-3
Your Reference			BH04	BH06	BH08
Date Sampled			15/12/2017	15/12/2017	15/12/2017
Type of sample			Water	Water	Water
Date prepared	-		18/12/2017	18/12/2017	18/12/2017
Date analysed	-		18/12/2017	18/12/2017	18/12/2017
Total Nitrogen	mg/L	0.1	7.4	4.5	6.8
TKN by Discrete Analyser	mg/L	0.1	6.3	4.5	4.1
NOx as N	mg/L	0.005	1.1	<0.25	3.0
Ammonia as N	mg/L	0.005	0.91	0.45	<0.25
Total Phosphorus	mg/L	0.05	<0.05	<0.05	1.1
Phosphate as P	mg/L	0.005	<0.25	<0.25	0.43

Dissolved Metals in Water					
Our Reference	UNITS	PQL	204686-1	204686-2	204686-3
Your Reference			BH04	BH06	BH08
Date Sampled			15/12/2017	15/12/2017	15/12/2017
Type of sample			Water	Water	Water
Date prepared	-		20/12/2017	20/12/2017	20/12/2017
Date analysed	-		20/12/2017	20/12/2017	20/12/2017
Aluminium-Dissolved	mg/L	0.01	1.9	0.67	1.7
Arsenic-Dissolved	mg/L	0.001	0.001	0.002	<0.001
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	0.0002
Chromium-Dissolved	mg/L	0.001	0.046	0.003	0.002
Iron-Dissolved	mg/L	0.01	19	0.08	1.1
Manganese-Dissolved	mg/L	0.005	0.15	<0.005	0.014
Nickel-Dissolved	mg/L	0.001	0.005	0.002	0.002
Selenium-Dissolved	mg/L	0.001	0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.015	0.009	0.015

Total Metals in water					
Our Reference	UNITS	PQL	204686-1	204686-2	204686-3
Your Reference			BH04	BH06	BH08
Date Sampled			15/12/2017	15/12/2017	15/12/2017
Type of sample			Water	Water	Water
Date digested	-		19/12/2017	19/12/2017	19/12/2017
Date analysed	-		19/12/2017	19/12/2017	19/12/2017
Aluminium-Total	mg/L	0.01	2.6	1.3	2.3
Arsenic-Total	mg/L	0.001	0.003	0.003	<0.001
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.049	0.005	0.004
Iron-Total	mg/L	0.01	20	0.19	1.2
Manganese-Total	mg/L	0.005	0.16	<0.005	0.015
Nickel-Total	mg/L	0.001	0.007	0.003	0.002
Selenium-Total	mg/L	0.001	0.001	0.001	<0.001
Zinc-Total	mg/L	0.001	0.006	0.004	0.014

Metals in Water - Low Level			
Our Reference	UNITS	PQL	204686-4
Your Reference			BD1/151217
Date Sampled			15/12/2017
Type of sample			Water
Date prepared	-		21/12/2017
Date analysed	-		21/12/2017
Arsenic-Dissolved	mg/L	0.001	0.002
Cadmium-Dissolved	mg/L	0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	0.048
Copper-Dissolved	mg/L	0.001	0.001
Lead-Dissolved	mg/L	0.001	<0.001
Mercury-Dissolved	mg/L	0.00005	<0.00005
Nickel-Dissolved	mg/L	0.001	0.006
Zinc-Dissolved	mg/L	0.001	0.003

Method ID	Methodology Summary
INORG-001	pH - Measured using pH meter and electrode base on APHA latest edition, Method 4500-H+. Please note that the results for water analyses may be indicative only, as analysis can be completed outside of the APHA recommended holding times. Soils are reported from a 1:5 water extract unless otherwise specified.
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-005	Acidity - determined by titration based on APHA latest edition, Method 2310 B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180±5°C
INORG-019	Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-5oC.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Total Nitrogen by colourimetric analysis based on APHA 4500-P J, 4500-NO3 F.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-062	TKN by calculation fromTotal Nitrogen and NOx using APHA methodology.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Metals in soil and water by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
METALS-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			18/12/2017	[NT]	[NT]	[NT]	[NT]	18/12/2017	[NT]
Date analysed	-			18/12/2017	[NT]	[NT]	[NT]	[NT]	18/12/2017	[NT]
pH	pH Units		INORG-001	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	<1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	<5	[NT]	[NT]	[NT]	[NT]	96	[NT]
Total Suspended Solids	mg/L	5	INORG-019	<5	[NT]	[NT]	[NT]	[NT]	96	[NT]
Acidity as $CaCO_3$	mg/L	5	INORG-005	<5	[NT]	[NT]	[NT]	[NT]	93	[NT]

QUALITY CONTROL: Ionic Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			18/12/2017	1	18/12/2017	18/12/2017		18/12/2017	[NT]
Date analysed	-			18/12/2017	1	18/12/2017	18/12/2017		18/12/2017	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	4.6	4.0	14	96	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	10	9.9	1	98	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	3.7	3.5	6	98	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	61	57	7	97	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	11	10	10	101	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	101	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	11	10	10	101	[NT]
Chloride	mg/L	1	INORG-081	<1	1	57	[NT]		98	[NT]
Sulphate	mg/L	1	INORG-081	<1	1	29	[NT]		98	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	27	24	12	[NT]	[NT]

QUALITY CONTROL: Nutrients in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			20/12/2017	[NT]	[NT]	[NT]	[NT]	18/12/2017	[NT]
Date analysed	-			18/12/2017	[NT]	[NT]	[NT]	[NT]	18/12/2017	[NT]
Total Nitrogen	mg/L	0.1	INORG-055	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
TKN by Discrete Analyser	mg/L	0.1	INORG-062	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	<0.005	[NT]	[NT]	[NT]	[NT]	114	[NT]
Ammonia as N	mg/L	0.005	INORG-057	<0.005	[NT]	[NT]	[NT]	[NT]	119	[NT]
Total Phosphorus	mg/L	0.05	METALS-020	<0.05	[NT]	[NT]	[NT]	[NT]	100	[NT]
Phosphate as P	mg/L	0.005	INORG-060	<0.005	[NT]	[NT]	[NT]	[NT]	95	[NT]

QUALITY CONTROL: Dissolved Metals in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	204686-2
Date prepared	-			20/12/2017	1	20/12/2017	20/12/2017		20/12/2017	20/12/2017
Date analysed	-			20/12/2017	1	20/12/2017	20/12/2017		20/12/2017	20/12/2017
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	1.9	1.9	0	88	#
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.001	0.002	67	97	97
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	97	99
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.046	0.047	2	90	89
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	19	19	0	99	89
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.15	0.15	0	95	94
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.005	0.006	18	96	90
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	101	101
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.015	0.009	50	96	89

QUALITY CONTROL: Total Metals in water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date digested	-			19/12/2017	[NT]	[NT]	[NT]	[NT]	19/12/2017	[NT]
Date analysed	-			19/12/2017	[NT]	[NT]	[NT]	[NT]	19/12/2017	[NT]
Aluminium-Total	mg/L	0.01	METALS-022	<0.01	[NT]	[NT]	[NT]	[NT]	100	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	106	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	<0.0001	[NT]	[NT]	[NT]	[NT]	101	[NT]
Chromium-Total	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	101	[NT]
Iron-Total	mg/L	0.01	METALS-022	<0.01	[NT]	[NT]	[NT]	[NT]	108	[NT]
Manganese-Total	mg/L	0.005	METALS-022	<0.005	[NT]	[NT]	[NT]	[NT]	106	[NT]
Nickel-Total	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	109	[NT]
Selenium-Total	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	112	[NT]
Zinc-Total	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	108	[NT]

QUALITY CONTROL: Metals in Water - Low Level					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			20/12/2017	[NT]	[NT]	[NT]	[NT]	20/12/2017	[NT]
Date analysed	-			20/12/2017	[NT]	[NT]	[NT]	[NT]	20/12/2017	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	97	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	[NT]	[NT]	[NT]	[NT]	97	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	90	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	95	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	96	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	[NT]	[NT]	[NT]	[NT]	92	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	96	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	[NT]	[NT]	[NT]	[NT]	96	[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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

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.

Report Comments

Percent recovery not available due to the analyte signal being much greater than the spike amount. An acceptable recovery was achieved for the LCS.

Note: Some nutrient results have raised pqls. In these cases the sample's high background colour required the sample to be diluted prior to analysis.

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 205396

Client Details

Client	Douglas Partners Perth
Attention	Nizam Ahamed
Address	36 O'Malley St, Osborne Park, WA, 6017

Sample Details

Your Reference	**88978**
Number of Samples	1 dried soil
Date samples received	07/12/2017
Date completed instructions received	10/01/2018
Location	Huntingdale,Garden ST-ASS

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	18/01/2018
Date of Issue	15/01/2018

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
Stacey Hawkins, Acid Soils Supervisor

Authorised By

Todd Lee, Laboratory Manager

sPOCAS		
Our Reference		205396-1
Your Reference	UNITS	DUP10
Date Sampled		06/12/2017
Type of sample		Dried soil
Date prepared	-	10/01/2018
Date analysed	-	15/01/2018
pH $_{kcl}$	pH units	5.9
TAA	moles H^+ /t	<5
pH $_{Ox}$	pH units	3.8
TPA	moles H^+ /t	87
S_{KCl}	%w/w S	0.010
Ca_{KCl}	%w/w	0.011
Mg_{KCl}	%w/w	0.044
S_P	%w/w	0.078
Ca_P	%w/w	0.12
Mg_P	%w/w	0.043
a-ANC_E	moles H^+ /t	NT
SHCl	%w/w S	NT
TSA	moles H^+ /t	86
s-TAA	%w/w S	<0.01
s-TPA	%w/w S	0.14
s-TSA	%w/w S	0.14
S_{POS}	%w/w S	0.067
a-S_{POS}	moles H^+ /t	42
Ca_A	%w/w Ca	0.11
a-Ca_A	moles H^+ /t	54
s-Ca_A	%w/w S	0.086
Mg_A	%w/w Mg	<0.005
a-Mg_A	moles H^+ /t	<5
s-Mg_A	%w/w S	<0.005
ANC_E	% $CaCO_3$	NT
s-ANC_E	%w/w S	NT
Fineness Factor		2
S_{NAS}	%w/w S	NT
a-S_{NAS}	moles H^+ /t	NT
s-S_{NAS}	%w/w S	NT
s-Net Acidity	%w/w S	0.069
a-Net Acidity	moles H^+ /t	43
Liming rate	kg $CaCO_3$ /t	3.2
Net Acidity (WA)	%w/w S	0.069
a-Net Acidity without ANCE	moles H^+ /t	43

sPOCAS		
Our Reference	UNITS	205396-1
Your Reference		DUP10
Date Sampled		06/12/2017
Type of sample		Dried soil
Liming rate without ANCE	kg $CaCO_3$ /t	3.2

Method ID	Methodology Summary
INORG-064	Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) using ASSMAC guidelines.

QUALITY CONTROL: sPOCAS						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			10/01/2018	[NT]	[NT]	[NT]	[NT]	10/01/2018	[NT]
Date analysed	-			15/01/2018	[NT]	[NT]	[NT]	[NT]	15/01/2018	[NT]
pH $_{kcl}$	pH units		INORG-064	[NT]	[NT]	[NT]	[NT]	[NT]	94	[NT]
TAA	moles H^+ /t	5	INORG-064	[NT]	[NT]	[NT]	[NT]	[NT]	88	[NT]
pH $_{Ox}$	pH units		INORG-064	[NT]	[NT]	[NT]	[NT]	[NT]	95	[NT]
TPA	moles H^+ /t	5	INORG-064	[NT]	[NT]	[NT]	[NT]	[NT]	92	[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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

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.

Appendix E

Calibration Certificate
Results of Survey by Registered Surveyors

AES
ACTIVE ENVIRONMENTAL SOLUTIONS

Calibration Report

Multi-Parameter Water Quality Instrument

Customer: Douglas
Contact: Rob

Manufacturer: YSI
Instrument: Professional Plus with Quatro cable
Serial #: 12A100573
Cable length: 1m

Item	Test	Pass	Comments
Battery	2 x Alkaline C-cells	✓	Voltage reading above 2.9V
	Battery Saver	✓	Automatically turns off after 60 minutes if not used
Connections	Condition	✓	Good, clean
Cable	Condition	✓	Clean, no tears
Display	Operation	✓	
Firmware	Version	✓	4.0.0
Keypad	Operational	✓	
Display	Screen	✓	
Unit	Condition, seals and O-rings	✓	
Monitor housing	Condition	✓	
pH			
Condition		✓	Good, clean
pH millivolts for pH7 calibration range 0 mV ± 50 mV		✓	
pH 4 mV range + 165 to + 180 from 7 buffer mV value		✓	175.30 mV
pH slope		✓	55 to 60 mV/pH, ideal 59mV
Response time < 90 seconds		✓	
Calibrated and conforms to manufacturer's specifications		✓	
ORP			
Condition		✓	Good, clean
Response time < 90 seconds		✓	
within ± 80mv of reference Zobell Reading		✓	
Calibrated and conforms to manufacturer's specifications		✓	variance range ± 20mV -2 mV
Conductivity			
Condition		✓	Good, clean
Temperature		✓	°C
Conductivity cell constant 5.0 ± 1.0 in GLP file		✓	
Clean sensor reads less than 3 uS/cm in dry air		✓	
Calibrated and conforms to manufacturer's specifications		✓	µs/cm
Dissolved Oxygen			
Condition		✓	Good, clean
DO sensor in use		✓	Galvanic
1.25 mil PE membrane (yellow membrane):		✓	
DO Sensor Value		✓	(min 4.31 uA - max 8.00 uA) Avg 6.15 uA
Calibrated and conforms to manufacturer's specifications		✓	ppm

This is to certify that the above instrument has been calibrated to the following specifications:

						Instrument Readings		
Parameter	**Standards**	**Reference**	**Calibration Point**	**Span**	**Units**	**Before**	**After**	**Units**
Temperature	Center 370 Thermometer	Room Temp	23.3	-0.3	°C	NA	23	°C
pH	pH 7.00	NF1971	7.03	-20.30	mV	7.03	7.01	pH
pH	pH 4.00	NF1636	4.00	155.00	mV	4.03	4.00	pH
Conductivity	2760 µs/cm at 25°C	NF2056	2760	GLP	4.95	2746	2760	µs/cm
ORP (Reference check only)	Zobell A & B	NG1334/1335	233	233	mV	234.9	234.9	mV
Zero Dissolved Oxygen	NaSO3 in distilled water	1504192304	0.0	NA	NA	0.1	0.0	%
100% Dissolved Oxygen	100% Air Saturation	Air	100.0	4.27	uA	89.1	100	%

Calibrated by: Gaurav Kanwar

Calibration Date: 01-Dec-17

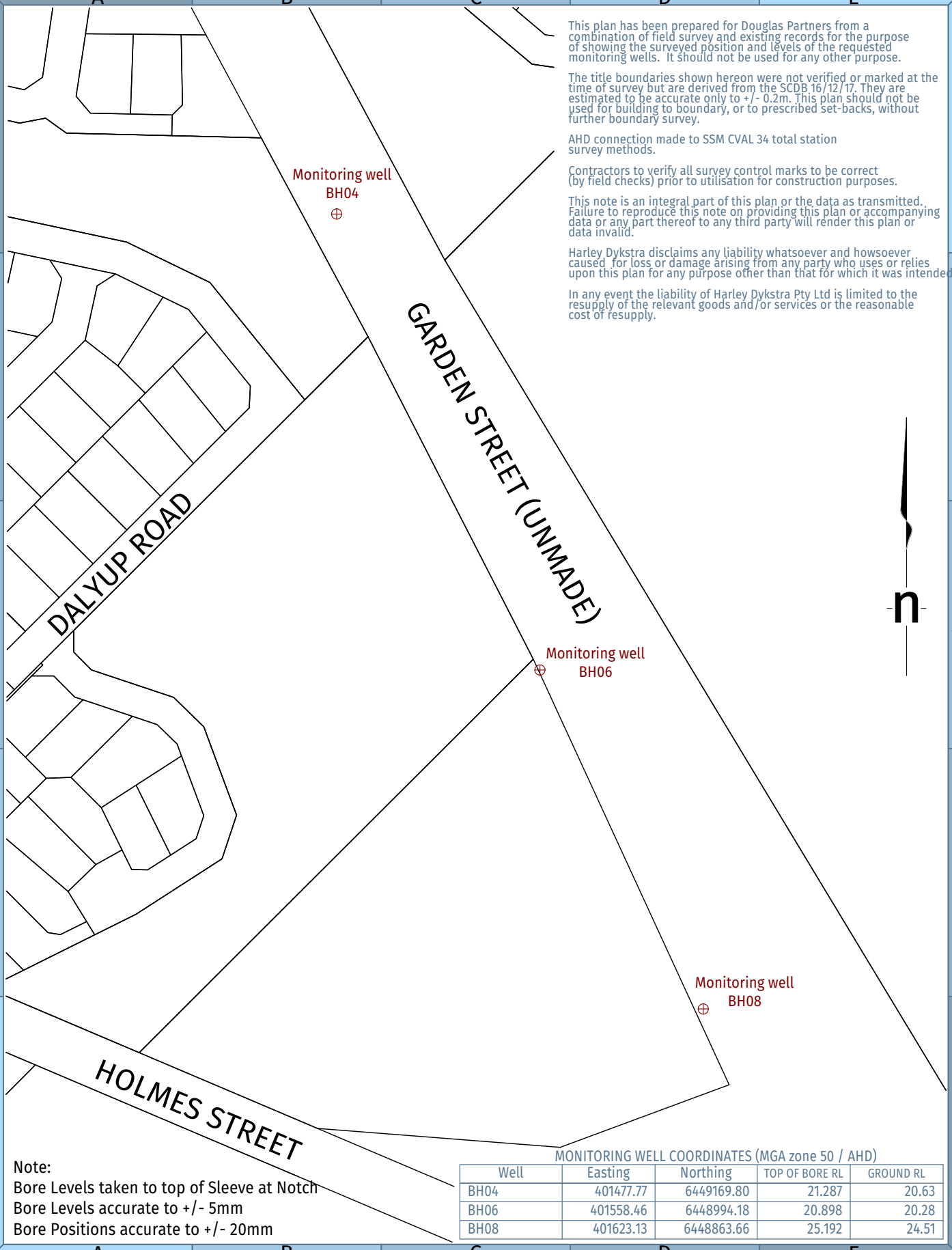
Next Due: 31-Dec-17

Melbourne	**Head Office**	2 Merchant Avenue	THOMASTOWN VIC 3074	T: +(613) 9464 2300	F: +(613) 9464 3421
Sydney	S14 Lvl 2	6-8 Holden Street	ASHFIELD NSW 2131	T: +(612) 9716 5966	F: +(612) 9716 5988
Perth	Unit 6	41 Holder Way	MALAGA WA 6090	T: +(618) 9249 5663	F: +(618) 9249 5362
Brisbane	Unit 17	23 Ashtan Place	BANYO QLD 4014	T: +(617) 3267 1433	F: +(617) 3267 3559

sales@aesolutions.com.au

ISO Certified 9001:2008

www.aesolutions.com.au



This plan has been prepared for Douglas Partners from a combination of field survey and existing records for the purpose of showing the surveyed position and levels of the requested monitoring wells. It should not be used for any other purpose.

The title boundaries shown hereon were not verified or marked at the time of survey but are derived from the SCDB 16/12/17. They are estimated to be accurate only to +/- 0.2m. This plan should not be used for building to boundary, or to prescribed set-backs, without further boundary survey.

AHD connection made to SSM CVAL 34 total station survey methods.

Contractors to verify all survey control marks to be correct (by field checks) prior to utilisation for construction purposes.

This note is an integral part of this plan or the data as transmitted. Failure to reproduce this note on providing this plan or accompanying data or any part thereof to any third party will render this plan or data invalid.

Harley Dykstra disclaims any liability whatsoever and howsoever caused for loss or damage arising from any party who uses or relies upon this plan for any purpose other than that for which it was intended.

In any event the liability of Harley Dykstra Pty Ltd is limited to the resupply of the relevant goods and/or services or the reasonable cost of resupply.

Note:
Bore Levels taken to top of Sleeve at Notch
Bore Levels accurate to +/- 5mm
Bore Positions accurate to +/- 20mm

MONITORING WELL COORDINATES (MGA zone 50 / AHD)

Well	Easting	Northing	TOP OF BORE RL	GROUND RL
BH04	401477.77	6449169.80	21.287	20.63
BH06	401558.46	6448994.18	20.898	20.28
BH08	401623.13	6448863.66	25.192	24.51

rev	details	approved	date
A	Original drawing		18-12-17

survey: CJV 15/12/17
cad file: 21440-01A.lcd
drawn: CJV 16/12/17
checked: AV 18/12/17
horiz datum: MGAz50
level datum: AHD
scale at A4 1 : 2000
all distances are in metres
0 20 40 60

description: Garden Street, Huntingdale
client: Douglas Partners Pty Ltd
drawing no: 21440-01A
plan type: Monitoring Well Survey

Harley Dykstra
PLANNING & SURVEY SOLUTIONS
HARLEY DYKSTRA PTY LTD
Level 1, 252 Fitzgerald Street, PERTH WA 6000
1/2 Hensbrook Loop, FORRESTDALE WA 6112
T: 08 9495 1947
E: metro@harleydykstra.com.au
ALBANY | BUNBURY | BUSSELTON | FORRESTDALE | PERTH