



Rottnest Island Authority
Tank 8, Oval and Golf Course Assessment
Fieldwork Report

12 September 2012

Executive summary

GHD Pty Ltd (GHD) was engaged by Rottneest Island Authority (RIA) to undertake field works necessary to prepare documentation on the planned water recycling scheme to meet the requirements of the Western Australian Department of Environment and Conservation (DEC) and the Department of Health (DoHWA). A Nutrient and Irrigation Management Plan (NIMP) will be submitted to the DEC with a request to upgrade/extend the current operating licence of the Waste Water Treatment Plant (WWTP), and a Recycled Water Quality Management Plan (RWQMP) will be submitted to DoHWA.

The purpose of the field investigations was to gain an understanding of the existing environmental setting at the golf course and sports oval and to realise the potential and constraints for the planned water recycling scheme.

The scope of works undertaken during the field investigations included:

- Installation of five (5) groundwater monitoring wells to enable a baseline assessment of groundwater conditions and a means of ongoing monitoring following implementation of the irrigation scheme;
- Installation of five (5) soil bore locations to record a log of soil profile and understand soil properties such as type, grain size and origin;
- Measurement of in-situ soil physical parameters of saturated hydraulic conductivity; and
- Collection of soil samples for laboratory analysis of:
 - Soil nutrients;
 - nutrient and water holding capacity to enable water and nutrient balance modelling of the water recycling scheme; and
 - Potential Acid Sulphate Soils (PASS) for assessment of the potential impact as a result of ground disturbance which may occur during the golf course upgrade works.

This report provides a detailed description of:

- the field works carried out;
- analytical results of soil and groundwater samples collected; and
- recommendations for avoiding PASS areas.

Soil encountered during drilling at the golf course and oval were generally sandy, with a thin topsoil layer of approximately 15 – 30 cm. Sands were fine to coarse grained, and gravel was present at most locations in the form of limestone or shells (or fragments thereof), particularly bivalves and some gastropods.

The depths to groundwater at the soil bore locations (located at current and future irrigation locations) ranged from 0.7 – 1.2 m bgl.

An Acid Sulphate Soil (ASS) investigation was undertaken within the Golf Course area of Rottneest Island, to assess whether acid sulphate soil were present in the vicinity of the proposed redevelopment works. The desktop review and field investigations indicated the probability of ASS is low.

The ASS testing carried out across the Golf Course was based on the understanding that excavation works as part of the redevelopment of the area will extend no deeper than 1 mbgl. As such, sampling was only carried out to a maximum depth of 2.2 mbgl. While it was

considered that the potential for ASS is low within the tested areas, GHD makes the following recommendations:

- To reduce disturbance of PASS, or material with the possibility of oxidation and potential generation of ASS, consideration should be given to minimising the need for dewatering activities associated with the construction;
- Should high risk ASS material be observed on the base of final excavations, treatment and validation sampling of these excavation surfaces may be required;
- Based on the field pH results collected at the site, there is a low risk for corrosion of concrete or steel structures. Monitoring of groundwater during dewatering should be undertaken as it will provide an indication of whether dewatering is oxidising surrounding soils and producing acidic conditions;
- Should excavation remove high risk PASS material, consideration should be given to offsite disposal of the soil. Disposal of PASS material should be to a licenced landfill that can accept PASS material; and
- If any high risk PASS material is retained on site for reuse (i.e. replacement of material into excavations), validation sampling to confirm the acidity levels following removal should be undertaken. Neutralisation of any acid generating soil may be required if reuse is proposed

The investigation works reported the following key findings:

- Soils encountered during drilling at the golf course and oval were generally sandy, with a thin topsoil layer;
- The geology was dominated by sand, limestone gravel and shells at all sites;
- The soils were generally classified as having low available water capacity, which indicates that the soils may have limited ability to retain water between irrigations.
- The soils have high pH (>8.5) indicating a high alkalinity which may restrict plant growth;
- The depths to groundwater at the soil bore locations (located at current and future irrigation locations) ranged from 0.7 – 1.2 m bgl. Groundwater was shallowest at the southern sites, closest to the hypersaline lakes;
- The hydraulic conductivities measured on site varied from 50-500 mm/h between locations. Most of the values obtained would be classed as high conductivity, as expected for sandy soil, which indicates that there is a risk that the soil will act as a poor filter for contaminant and nutrient removal when irrigated with effluent;
- With the exception of phosphorus, sulphate and zinc, analytical results reported all groundwater water quality parameters were within the suitable ranges as defined in the ANZECC 200 0 for both long and short term irrigation.

GHD has prepared a NIMP for the purpose of minimising the potential for environmental impact as a result of the application of nutrient-rich recycled water on the golf course and oval. The NIMP will be assessed by the DEC in conjunction with the works approval application for the new WWTP licence. The NIMP will also be used to determine licence conditions and reporting requirements for the operation of the WWTP

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1. Background

1.1 Project

The Rottneest Island Authority (RIA) is advancing plans to revitalise the island's approximately 22 hectare, nine (9) hole public golf course west of the Thomson Bay Settlement. The objective is to improve the existing facilities and to ensure that fairways and greens are green year-round by installing a new irrigation scheme supplied by treated wastewater from the Rottneest Island wastewater treatment plant (WWTP). The new irrigation scheme will also supply the approximately 1.83 hectare sports oval, located adjacent to the golf course.

1.2 Purpose of this report

GHD Pty Ltd (GHD) was engaged by RIA to undertake field works necessary to prepare documentation on the proposed recycled water irrigation scheme to meet the requirements of the Western Australian Department of Environment and Conservation (DEC) and the Department of Health (DoHWA). A Nutrient and Irrigation Management Plan (NIMP) will be prepared by GHD and submitted to the DEC with a request to upgrade/extend the current operating licence of the WWTP, whilst a Recycled Water Quality Management Plan (RWQMP) will also be prepared by GHD and submitted to DoHWA detailing how the irrigation system will be implemented and monitored.

The purpose of the field investigation works was to gain an understanding of the existing environmental setting at the golf course and sports oval and to realise the potential and constraints for the planned water recycling scheme.

This report details the field investigations undertaken between 29 to 28 June 2012 at the Rottneest golf course and sports oval to collect data for the NIMP and RWQMP.

1.3 Scope and limitations

The scope of works undertaken during the field investigations included:

- Installation of a total of nine (9) soil bore locations (five (5) locations to record a log of soil profile and understand soil properties such as type, grain size and origin and baseline geo-chemical properties collection of soil samples and a further four (4) locations for the assessment of Potential Acid Sulphate Soil (PASS));
- Installation of five (5) groundwater monitoring wells to enable a baseline assessment of groundwater conditions and a means of ongoing monitoring following implementation of the irrigation scheme; Sampling of each of the newly installed groundwater monitoring wells to provide an understanding of the groundwater conditions at the site and baseline data for comparison of on-going monitoring results;
- Measurement of in-situ soil physical parameters of saturated hydraulic conductivity; and
- Collection of soil samples for laboratory analysis of:
 - Soil nutrients;
 - nutrient and water holding capacity to enable water and nutrient balance modelling of the water recycling scheme; and
 - Potential Acid Sulphate Soils (PASS) for assessment of the potential impact as a result of ground disturbance which may occur during the golf course upgrade works.

This report: has been prepared by GHD for Rottnest Island Authority and may only be used and relied on by Rottnest Island Authority for the purpose agreed between GHD and the Rottnest Island Authority as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Rottnest Island Authority arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Rottnest Island Authority and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.4 Assumptions

GHD makes the following assumptions with regards to any comments or recommendations provided in this report:

- All data provided to GHD by RIA is accurate and acceptable. GHD has not undertaken a quality review of the data and undertaken no assessment of its suitability or completeness with respect to the assessment works carried out;
- Data received from third party sources (such as published or online information) is true, correct and up to date;
- Analytical results from samples collected are representative of the condition of the site. GHD has used best judgement to identify the most appropriate locations for soil; and
- groundwater sampling has been based on the information available as provided by RIA.

2. Field Investigation Program

2.1 Site description

The nine (9) hole golf course has been operating for over 50 years and covers an area of approximately 22 hectares (ha). The proposed upgrade of the golf course is a major project which includes reshaping the fairways and greens, installation of an irrigation system complete with weather station and automated control system, soil amendment, along with grass establishment on tees, fairways and greens. The existing course has grass fairways, and native bush and species of non-native trees exist in pockets of the golf course and at its edges. Two of the island's hypersaline lakes border the golf course: Garden Lake is directly to the south; and Herschel Lake is to the southwest. The golf course is surrounded by small hills to the north, east and west. A small ephemeral swamp is located in the north of the golf course. An ephemeral drainage line runs from this swamp south, winding through the course to Garden Lake.

The sports oval is planted with grass and native and exotic tree and shrub species border its edges. The oval is located on quite flat ground; elevations range from 1 to 2 m AHD between the west and east. Irrigation of the oval with treated wastewater from the waste water treatment plant (WWTP) has been occurring on an infrequent basis since 1996. The nearest water body to the oval is the small swamp in the north of the golf course. The Basin and Pinky's Beach are also nearby, located approximately 200 metres north of the oval over the sand dunes.

2.2 Intrusive works

Field investigations were carried out by a qualified GHD environmental engineer and environmental technician between 29 to 31 May 2012.

Groundwater monitoring well and soil bore locations were selected based on:

- The proposed areas of waste water application;
- Areas deemed appropriate for assessing representative soil properties; and
- Areas considered suitable for monitoring of groundwater standing water levels (SWLs) so that the inferred groundwater flow direction could be determined.

A map showing the locations of the various sample sites at the golf course and oval is provided in Figure 1.

2.3 Soil bores

As part of the investigation, GHD installed a total of nine (9) soil bores across the area. Five (5) soil bores (GCS01 through GCS05) were for the purpose of collecting soil samples. A further four (4) locations (RASS1 through RASS4) were later installed at the request of RIA for collection of Potential Acid Sulphate Soil (PASS) analysis.

Soil bores were situated on current and future irrigation areas at the oval and golf course. In most cases, the bores within the golf course were placed in the centre of fairways as to ensure the soil profile within the irrigation area was accurately profiled. Boreholes (GCS01 through GCS05) were drilled using a hand auger for approximately the first metre and then using a Geoprobe™ direct-

push method to a depth approximately two metres below the water table (Plate 1, Appendix A). Geological logs were recorded and samples were taken for each soil type encountered. Table 1 provides a summary of the soil bore locations, samples collected and the analytical suite.

Table 1 Sampling and Analytical

Bore ID	Sample depths	Analysis
GCS01	0 – 0.15	Physical Parameters
	0.15 – 0.5	Hold
	0.5 – 1.2	Hold
	1.2 – 3.0	Hold
GCS02	0 – 0.25	Hold
	0.25 – 3.0	Physical Parameters
GCS03	0 – 0.25	Hold
	0.25 – 3.0	Physical Parameters
GCS04	0 – 0.3	Physical Parameters
	0.3 – 0.7	Hold
	0.7 – 2.2	ASS
	2.2 – 2.5	Hold
	2.5 – 3.0	Hold
GCS05	0 – 0.2	Hold
	0.2 – 0.6	Physical Parameters
	0.6 – 1.0	Hold
	1.0 – 3.0	Hold
RASS1	0.3 – 0.6	ASS (pHf and pHfox) SPOCAS
	0.9 – 1.2	ASS (pHf and pHfox) SPOCAS
RASS2	0.2 – 0.5	ASS (pHf and pHfox) SPOCAS
	1.2 – 1.5	ASS (pHf and pHfox) SPOCAS
RASS3	0.2 – 0.7	ASS (pHf and pHfox) SPOCAS
	1.0 – 1.5	ASS (pHf and pHfox) SPOCAS
RASS4	0.4 – 0.6	ASS (pHf and pHfox) SPOCAS
	1.0 – 1.2	ASS (pHf and pHfox) SPOCAS

Physical parameters: Nutrients, Major cations (Na, Ca, K, Mg), Major anions (Cl, SO₄, HCO₃, CO₃), BOD, COD, acidity, major elements (Ammonium nitrogen, Nitrate, nitrite, nitrate nitrogen, nitrite nitrogen, potassium, phosphorus, nitrogen TKN) Trace elements (copper, zinc, manganese, iron, boron) organic carbon, salinity (chloride, electrical conductivity, sodium, total soluble salts), exchangeable cations, phosphorus, sulphur, Phosphorus Sorption Index, Phosphorus Buffer Index, wilting point, water at saturation, field capacity.

2.4 Permeameter

At each of the soil bore locations (GCS01 through GCS05), field measurements of saturated hydraulic conductivity were performed at soil bore sites using a Guelph Permeameter (Soilmoisture Equipment Corp.) and the method outlined in the Operation Manual. A photo of the permeameter in operation at Rottneest is shown below (Plate 2, Appendix A). Duplicate tests were performed at all sites, one test using 5 cm of head and one with 10 cm. Infiltration measurements were taken until the rate of infiltration stabilised (three consecutive infiltration measurements within 0.1 cm/min).

2.5 Groundwater Monitoring Well Installation

Groundwater monitoring wells (GCW01 through GCW05) were installed adjacent to soil bores, at the edge of the oval and the golf course fairways. A hollow-flight auger was used to drill each of the groundwater monitoring well locations. Wells were installed to at least two (2) metres below the water table and screened to approximately one (1) metre above the water table to account for seasonal variability in groundwater levels. Graded sand was used to backfill the bore holes and sealed using a bentonite and concrete slurry to prevent surface water infiltration to the wells. The wells were then completed using a standpipe. Following installation, each of the wells was developed by using compressed air until it was noted that the groundwater changed from milky to clear.

2.6 Groundwater Sampling

As part of GHD's field investigations at the golf course and oval, the five (5) newly installed groundwater monitoring wells were sampled to enable a baseline assessment of groundwater conditions and a means of ongoing monitoring following implementation of the irrigation scheme.

Groundwater samples were collected using a Micropurge Low-Flow system and submitted to the laboratory for analysis of the following suite of compounds:

- Total Petroleum Hydrocarbons (TPHs);
- Benzene, Toluene, Ethylbenzene and Xylene (BTEX);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Organochlorine Pesticides (OCPs);
- Polychlorinated Biphenols (PCBs);
- Heavy metals (Al, As, Cd, Cr, Cu, Ni, Pb and Zn);
- Nutrients – nitrate, nitrite, nitrogen, ammonia, and total phosphorus;
- Major anions and cations;
- Biological Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD); and
- Phenols.

In addition to groundwater samples, each of the monitoring wells was gauged and the groundwater depths recorded. Section 3.2 provides a summary of the groundwater sampling findings.

3. Results and analysis

3.1 Soils: physical and chemical properties

Soils encountered during drilling at the golf course and oval were generally sandy, with a thin topsoil layer of approximately 15 – 30 cm. Sands were fine to coarse grained, and gravel was present at most locations in the form of limestone or shells (or fragments thereof), particularly bivalves and some gastropods (Plate 3, Appendix A). Lithified soil layers (cemented sand) were also encountered at two locations (GCW02 and GCS04). Detailed borehole logs are provided in Appendix B. Although soil bores were located within approximately 10 m of monitoring wells, the geology was found to be slightly variable between corresponding sites, as shown in the soil layer summary table in Appendix B. Overall, the geology was dominated by sand, limestone gravel and shells at all sites.

Soil samples were analysed for their physical and chemical properties to determine the site's suitability for irrigation with recycled water. The water and nutrient holding capacity of the soil samples was assessed. Key laboratory results are presented in Table 2 and the complete analysis report is provided in Appendix C. With regard to the exchangeable cation results in the complete analysis report, it should be noted that although the cation exchange of all samples was high (in the range normally expected of clay soils), this result is likely to be linked to the high calcium content of the soil rather than indicating the presence of clay. The exchangeable sodium result for sample GCS03_0.25-3.0 was very high (18.9%) which would normally indicate sodic soil. Although this would be an issue for a clay soil irrigation site, it is thought that this is more likely linked with the high salt content of this particular sample. The chloride content of this sample was also very high, at 3 000 mg/kg. The source of this salt is likely to be the hypersaline lakes; in particular the GCS03 site was situated close to Herschel Lake. Given the sandy nature of the soils encountered at Rottneest, sodicity is not considered to be an issue for the irrigation of treated effluent at this site.

Table 2 Key results from soil Testing

g ^a Site [sample from depth range]	pH (in water)	PBI	Phosphorus – Colwell extraction (mg/kg)	AWC (mm/m)
GCS01 [0.15-0.5 m]	8.69	92.7	19	94
GCS02 [0.25-3.0 m]	9.40	615.0	8	91
GCS03 [0.25-3.0 m]	9.27	87.6	6	128
GCS04 [0-0.3 m]	8.57	210.4	33	65
GCS05 [0.2-0.6 m] (QA sample result)	9.18 (9.20)	114.1 (112.0)	9 (7)	69 (53)

^a EC = electrical conductivity, PBI = phosphorus buffer index, AWC = available water capacity, estimated as field capacity – wilting point

The physical properties of the soil samples collected at Rottneest can be used to assess the site suitability for effluent irrigation. Bond (2002) describes the soil properties that limit the potential for effluent irrigation. The results of soil testing at Rottneest have been compared to the limitations described by Bond (2002) and an assessment of potential limitations for the proposed Rottneest golf course and oval water recycling scheme is presented below.

The soil sampled indicates that they have a low available water capacity: Bond (2002) defines this as a moderate limitation if <200 mm/m. This indicates that the soils may have limited ability to retain water between irrigations and therefore require irrigating more frequently: this may restrict plant growth and increase the risk of nitrate and salt leaching to groundwater.

The soils have high pH (>8.5) indicating a high alkalinity which may restrict plant growth. Bond (2002) defines this as a moderate limitation if pH measured in CaCl₂ is between 6 - 8.5, which is equivalent to a pH measured in water of ~6.5 - 9 (Myers et al 1999).

The ability of the soils to adsorb phosphate is an important factor of consideration for effluent irrigation schemes. PBI is a measure of the adsorption potential of a particular soil, and can be interpreted along with the Colwell P result, which indicates extractable P in the soil (existing P in the soil). Soils with PBI in the range 71-140 are considered to have a low adsorption capacity and a critical Colwell P of 34 mg/kg (Gourley et al 2007). The critical Colwell P value is the concentration of P expected to produce 95% of maximum pasture yield (as indicated by the Victorian Department of Primary Industries). Effluent irrigated soils with low PBI need to be managed to avoid runoff or leaching of phosphate. GCS01 at the oval has a low PBI but the Colwell P is lower than the critical value which suggests that previously applied P was not excessive. The GCS03 and GCS05 samples also had low PBI and low Colwell P. GCS04 had a moderate PBI and the highest Colwell P of all soils sampled, but still below the critical value given by Gourley et al (2007). The GCS02 soil sample had a high PBI and very low Colwell P. It is not known why the PBI varied between sites so greatly, but the network of monitoring bores over the different parts of the site can be used in the future to assess the heterogeneity of impacts which may be an effect of the differences in soil conditions such as PBI. The potential for phosphorus leaching will be assessed in the NIMP using water and nutrient balance modelling which incorporates the laboratory results.

3.2 Groundwater

The depth to groundwater was estimated during soil bore and monitoring well drilling, and ranged from 0.6 – 2.5 metres below ground level (m bgl). The depths to groundwater at the soil bore locations (located at current and future irrigation locations) ranged from 0.7 – 1.2 m bgl, and are presented in Table 3. Groundwater was shallowest at the southern sites, closest to the hypersaline lakes.

Table 3 Depth to groundwater at soil bore locations

Soil bore site ID	Depth to groundwater (m bgl)
GCS01	1.2
GCS02	0.7
GCS03	0.7
GCS04	1.2
GCS05	1.1

Irrigation with effluent is generally not recommended on sites with a very shallow watertable (<1 – 2 m) (Bond 2002). The watertable at the Rottneest golf course and oval sites (as measured during the soil bore and monitoring well drilling) was very shallow; in some cases less than one metre below ground level. The seasonality of the groundwater depth needs to be established; the groundwater depths presented here are relevant to one time (early winter) in one year (2012). Shallow groundwater at effluent irrigation sites poses health and environmental risks. A separation between the irrigated surface and the watertable of two metres is recommended by the Department of Water (WQPN 22, 33) to limit waterlogging and control contamination of groundwater via soil filtration and microbial action.

3.3 Hydraulic conductivity

Data collected in the field using the permeameter were used to estimate saturated hydraulic conductivity of soil ~0.5 m below ground at the 5 soil bore locations. The results are displayed in Table 4 to one significant figure, to account for the uncertainties in this field measurement, and range from 50-500 mm/h. Bond (2002) identifies the ranges of hydraulic conductivities that may be limitations for effluent irrigation schemes: conductivities in the range 20-80 mm/h are considered a slight limitation due to the risk of soil waterlogging, and conductivities >80 mm/h are a moderate limitation because the soil will act as a poor filter for contaminant and nutrient removal. The hydraulic conductivities at GCS02-GCS04 are high, as expected for sandy/gravelly soils.

Table 4 Saturated hydraulic conductivity of soil

Site	Measured at depth (m bgl)	Average K Values (mm/h to 1 significant figure)
GCS01	0.3	90
GCS02	0.5	300
GCS03	0.5	200
GCS04	0.45	500
GCS05	0.5	50

3.4 Groundwater Results

Analytical results for groundwater samples collected are provided in **Appendix C**. Groundwater was analysed for physical parameters and a suite of organic and inorganic compounds. The results were compared to the ANZECC 2000 guidelines for Long and Short Term Irrigation, so that the baseline groundwater quality across the site could be understood. Analytical results reported one (1) location (GCW03) where sulphate was above the threshold criteria for Long Term Irrigation. Phosphorus was reported between the ranges of 0.23 and 0.82 mg/L which is above the Short term irrigation range of 0.8-12 mg/L and above the Long Term irrigation level of 0.05 mg/L. Zinc was reported in GCW02 above the Short Term Irrigation levels.

Laboratory results reported all organic compounds below the laboratory Limit of Reporting (LOR).

3.5 Acid Sulphate Soils

The Western Australia Department of Environment and Conservation (DEC) provides the regulatory framework for the identification and investigation of Acid Sulphate Soils (ASS) entitled *Identification and investigation of acid sulphate soils and acidic landscapes* May 2009.

In assessing the likelihood of ASS being present, the DEC recommends a staged tiered approach was adopted which involves:

- A review of DEC ASS risk maps as provided on the Landgate Shared Land Information Portal (SLIP);
- A site inspection and review of field indicators, such as water logged soils, peat or peaty soils, observations of unusually clear / milky blue-green surface water, iron staining, corrosion of structures, hydrogen sulfide odour or low soil pH;
- preliminary soil pH tests: measurement of soil pH (pHF), soil pH after rapid oxidation with hydrogen peroxide (pHFOX), and reaction rate (visual measure of vigorousness of reaction, on a scale of 1 (low) to 4 (extreme)); and
- laboratory analysis: to determine net acidity, a measure of existing and potential acidity, and acid neutralising capacity of soils.

3.5.1 Review of ASS Risk Areas

The Department of Environment and Conservation has compiled ASS risk maps for several regions of WA, however Rottnest Island has not been included in this dataset. GHD reviewed ASS risk maps provided by the Western Australia Shared Land Information Platform. The maps showed that portions of the Golf course and Oval were located within potential ASS risk areas.

A copy of the Risk Map is provided in **Figure 2**.

3.5.2 Intrusive Investigations

As the risk maps suggested the area was located within an ASS risk area, it was prudent to further assess the potential risk as specified in the requirements for the NIMP. Furthermore, due to the proposed excavation works as part of the development of the golf course, it was considered vital to assess the potential for ASS within low-lying areas.

The scope of work included:

- Identification of four (4) soil bore locations (RASS01 through RASS04) based on proximity to proposed excavation works as part of the golf course redevelopment (refer Figure 1);
- Drilling of boreholes using a Geoprobe™ direct-push method to a depth approximately 1.0 m below the identified water table;
- Collection of two (2) soil samples from each location (one (1) sample from the potentiometric surface of the groundwater and one (1) sample approximately 1.0 m below the groundwater);
- Transportation of samples to ALS under chain of custody (COC) documentation (refer **Appendix C**) where they were frozen within 24 hours of sampling. ALS is accredited by the National Association of Testing Authorities (NATA) for acid sulfate soil analysis.

Observations and analytical results are discussed below. Borelogs, displaying lithology, observations and soil samples collected are presented in **Appendix B**. Tabulated results, laboratory reports and COC documentation is provided in **Appendix C**.

3.5.3 Field Indicators

Potential field indicators of acid sulphate soil may include hydrogen sulphide or decayed vegetation odours, saturated black / grey sediments, and excessively clear surface water runoff.

During the field investigation program, evidence of such ASS indicators were not observed. The lithology encountered was generally sand and gravel with no indications of organic matter or odours noted, however in most cases the soil profile was noted to be saturated.

3.5.4 Field Screen

A pH screen was carried out in the laboratory as a preliminary indication of ASS. The test involved an initial measure of soil pH (pH_i) and the change in pH measured following rapid oxidation with hydrogen peroxide (pH_{FOX}). A change in pH of greater than 2 units ($\Delta pH > 2$) from the initial pH (pH_i) is a general indication of potential ASS. Table 5 provides a summary of the reaction results.

Table 5 ASS pH Test Results

Sample ID	pH (F)	pH (Fox)	ΔpH
RASS1-0.3-0.6	9.8	8	1.8
RASS1-0.9-1.2	9.8	8.3	1.5
RASS2-0.2-0.5	9.8	8.3	1.5
RASS2-1.2-1.5	9.9	8.3	1.6
RASS3-0.2-0.7	9.9	8.3	1.6
RASS3-1.0_1.5	9.9	8.3	1.6
RASS4-0.4_0.6	9.8	8.2	1.6
RASS4-1.0_1.2	9.9	8.2	1.7
GCS04-0.7_2.2	9.8	8.2	1.6

The preliminary ASS screen did not report any reactions > 2 pH units. Therefore it was considered that the probability of ASS was low.

3.5.5 SPOCAS Analysis

Suspension Peroxide Oxidation Combined Acidity & Sulphur (SPOCAS) testing was also carried out on each of the ASS samples collected. SPOCAS testing measures the actual acid and potential acid and sulphur available for oxidation. Table 6 provides a summary of the SPOCAS test results.

Table 6 SPOCAS Test Results

Sample ID	Titrateable Actual Acidity	Peroxide Oxidisable Sulphur	Excess Acid Neutralising Capacity	Net Acidity
Units	mole H^+ / t	% S	% $CaCO_3$	% S
RASS1-0.3-0.6	<2	0.14	76.6	<0.02
RASS1-0.9-1.2	<2	0.18	78.7	<0.02
RASS2-0.2-0.5	<2	0.09	74.1	<0.02
RASS2-1.2-1.5	<2	0.19	81.8	<0.02
RASS3-0.2-0.7	<2	0.12	79.2	<0.02

Sample ID	Titrateable Actual Acidity	Peroxide Oxidisable Sulphur	Excess Acid Neutralising Capacity	Net Acidity
RASS3-1.0_1.5	<2	0.2	81.8	<0.02
RASS4-0.4_0.6	<2	0.14	81.4	<0.02
RASS4-1.0_1.2	<2	0.18	78.4	<0.02
GCS04-0.7_2.2	<2	0.1	79.4	<0.02

Titrateable actual acidity provides an indication of the readily available soluble acid. The analytical results suggest that minimal amounts of soluble acid are present in the soil profile.

Peroxide Oxidisable Sulphur is a measure of the amount of sulphur which may be oxidised when exposed by excavation. The analytical results suggest that there is some potential for oxidisable sulphur to be present in the soil profile.

Excess Acid Neutralising Capacity is a measure of the soil's ability to neutralise acids in the soil. The analytical results suggest that the soil profile has significant neutralising capacity, if acid was present

Net Acidity is an indication of the final liming rate which would be required in order to neutralise acids if present. The analytical results suggest that liming would be minimal or not required due to the neutralising capacity of the soil.

4. Conclusions and Recommendations

4.1 Conclusions

4.1.1 Soil Physical Properties

Soils encountered during drilling at the golf course and oval were generally sandy, with a thin topsoil layer. The geology was dominated by sand, limestone gravel and shells at all sites. Soil samples were analysed for their physical and chemical properties to determine the site's suitability for irrigation with recycled water

The soils were generally classified as having low available water capacity, which indicates that the soils may have limited ability to retain water between irrigations. This is typical of sandy and gravelly soils.

The soils have high pH (>8.5) indicating a high alkalinity which may restrict plant growth.

The phosphorus retention capacity varied between soil samples taken at different locations and ranged from low to very high. The network of monitoring bores installed over the different parts of the site can be used in the future to assess the heterogeneity of impacts which may be an effect of the differences in soil conditions such as PBI.

The ability of the native soils to be used as an effluent irrigation site and support turf growing will be assessed using water and nutrient balance modelling during the development of the NIMP. The results will also be used to assess the likelihood for groundwater contamination with nutrients applied with the irrigation water.

4.1.2 Groundwater Depth

The depths to groundwater at the soil bore locations (located at current and future irrigation locations) ranged from 0.7 – 1.2 m bgl. Groundwater was shallowest at the southern sites, closest to the hypersaline lakes. The seasonality of the groundwater depth needs to be established by baseline monitoring over a period of at least six months before construction (and irrigation) of the golf course begins. Irrigation with effluent is generally not recommended on sites with a very shallow water table as it poses health and environmental risks. There is an increased risk of contamination of groundwater. This is to be assessed in the NIMP, which will recommend irrigation scheduling that matches inputs with uptake.

4.1.3 Hydraulic Conductivity

The hydraulic conductivities measured on site varied from 50-500 mm/h between locations. Most of the values obtained would be classed as high conductivity, as expected for sandy soil, which indicates that there is a risk that the soil will act as a poor filter for contaminant and nutrient removal when irrigated with effluent. This is to be assessed in the NIMP, which will recommend irrigation management that minimises the risk for environmental impact.

4.1.4 Groundwater Results

The groundwater quality at the golf course and oval bores was assessed in the field on 28 June 2012. The physical parameters measured in the field indicated that bores GCW02 and GCW03 had higher salinity than the other bores. These bores are located close to Garden and Herschel lakes respectively. Laboratory analysis reported chloride concentration in these bores (~10,000 mg/L) was also far greater than at the other monitoring locations (~1,000 mg/L). Historical monitoring of the hypersaline lakes suggests EC is in the order of 100,000 uS/cm and the groundwater quality variability between the near-lake bores (GCW02 and GCW03) and the others suggests groundwater-surface (lake) water connectivity. The Rottnest Island fresh groundwater lens probably meets the hypersaline lake water somewhere in the vicinity of the lake shore, but the exact location may be seasonally variable. It is likely that the direction of groundwater flow and the location of the freshwater-hypersaline water divide change with the seasons as the lake and groundwater levels rise and fall due to the impacts of rainfall and evaporation.

Concentrations of sulphate, phosphorus and zinc were reported above the ANZECC 2000 Long and Short Term Irrigation levels, however as the area is not subject to irrigation by waste water effluent, the concentrations are considered to be naturally occurring.

4.1.5 Potential Acid Sulphate Soils

A PASS investigation was undertaken within the Golf Course area of Rottnest Island, to assess whether acid sulphate soils were present in the vicinity of the proposed redevelopment works.

The desktop review and field investigations indicated the probability of ASS is low.

4.2 Actions

GHD has prepared a NIMP for the purpose of minimising the potential for environmental impact as a result of the application of nutrient-rich recycled water on the golf course and oval. The NIMP will be assessed by the DEC in conjunction with the works approval application for the new WWTP licence and used to determine licence conditions and reporting requirements for the operation of the WWTP

4.3 PASS Recommendations

The assessment concluded that the risk of encountering PASS is low. However, the PASS testing carried out across the Golf Course was based on the understanding that excavation works (as part of the redevelopment of the area) will not extend deeper than 1 mbgl. As such, PASS sampling was only carried out to a maximum depth of 2.2 mbgl. While it was considered that the potential for ASS is low within the tested areas, GHD makes the following recommendations:

- To reduce disturbance of PASS, or material with the possibility of oxidation and potential generation of ASS, consideration should be given to minimising the need for dewatering activities associated with the construction;
- Should high risk ASS material be observed on the base of final excavations, treatment and validation sampling of these excavation surfaces may be required;
- Based on the field pH results collected at the site, there is a low risk for corrosion of concrete or steel structures. Monitoring of groundwater during dewatering should be

undertaken as it will provide an indication of whether dewatering is oxidising surrounding soils and producing acidic conditions;

- Should excavation remove high risk PASS material, consideration should be given to offsite disposal of the soil. Disposal of PASS material should be to a licenced landfill that can accept PASS material; and
- If any high risk PASS material is retained on site for reuse (ie. replacement of material into excavations), validation sampling to confirm the acidity levels following removal should be undertaken. Neutralisation of any acid generating soil may be required if reuse is proposed

5. References

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Myers, B.J., Bond, W.J., Benyon, R.G., Falkiner, R.A., Polglase, P.J., Smith, C.J., Snow, V.O. & Theiveyanathan, S. 1999, Sustainable Effluent-Irrigated Plantations: An Australian Guideline, CSIRO Forestry and Forest Products, Canberra.

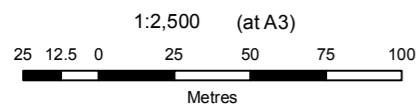
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Making Better Fertiliser Decisions for Grazed Pastures in Australia, Victorian Government Department of Primary Industries, Melbourne.

Figures

Figure 1 Sample Sites

Figure 2 ASS Risk Map



Map Projection: Transverse Mercator
 Horizontal Datum: Geocentric Datum of Australia (GDA)
 Grid: Map Grid of Australia 1994, Zone 50



LEGEND

Sampling Location Type

- Acid Sulfate Soil Sampling Location
- Monitoring Well Location
- Soil Bore Location

Road Type

- Sealed Road
- Vehicle Track
- Formal Pedestrian Track

Boardwalk

- Boardwalk
- Stairs
- Informal Pedestrian Track

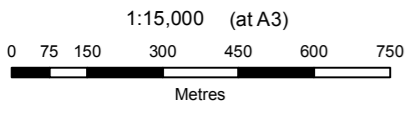


Rottnest Island Authority
 Rottnest Recycled Water Scheme
 Field Investigations : Golf Course & Oval

Job Number | 31-28991
 Revision | 0
 Date | 12 Sep 2012

Sampling Locations

Figure 1



Map Projection: Transverse Mercator
 Horizontal Datum: Geocentric Datum of Australia (GDA)
 Grid: Map Grid of Australia 1994, Zone 50



LEGEND

- Road Type
- Acid Sulfate Soil Risk
 - High to moderate risk
 - Moderate to low risk



Rottne Island Authority
 Rottne Recycled Water Scheme
 Field Investigations : Golf Course & Oval

Job Number	31-28991
Revision	0
Date	12 Sep 2012

Acid Sulphate Soil

Figure 2

Appendices

A. Photographs



Document Identification	Photograph 1
Description	Geoprobe Drilling Rig
Photograph Date	29 May 2012





**Document
Identification**

Photo 2

Description

Permeameter Testing

**Photograph
Date**

28 May 2012





**Document
Identification**

Photo 3

Description

Limstone Shells

**Photograph
Date**

29 May 2012



B. Bore Logs



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCS01

Page: 1 of 1

Client: Rottneest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 29/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hydraulic Hammer Total Depth (m): 3 Diameter (mm): 50	Easting: 361911.891 Northing: 6459473.342 Grid Ref: Elevation: 0 Logged by: L.Navarrete Checked by: A.Sutherland
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DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
0.0	HA				Ground Surface:				0.00	
			GCS01_0-0.15		GRASS	M	L	No odour noted throughout profile.	0.00	
			GCS01_0.15-0.5		SAND Dark brown, fine to medium grained, poorly graded, subrounded-subangular; some limestone gravel fine to medium grained, poorly graded, subangular-subrounded. Top soil	M	L		-0.15	
			GCS01_0.5-1.2		SAND Pale brown/pale yellow, fine to medium grained, poorly graded, subrounded-subangular; some shell fragments and limestone gravel fine to medium grained, fine to coarse grained, well graded, subangular-subrounded.	M	L		0.15	
			GCS01_0.5-1.2		SAND Pale yellow, fine to medium grained, poorly graded, subrounded-subangular; some shell fragments and limestone gravel fine to medium grained, fine to coarse grained, well graded, subangular-subrounded.	M	L		-0.50	
1.0				▼					0.50	
			GCS01_1.2-3.0		gravelly SAND Pale white, fine to coarse grained, well graded, subangular-subrounded becoming fine to medium grained, subrounded at 2.7m.	W	L		-1.20	
									1.20	
2.0										
3.0					Bottom of hole at 3.0m				-3.00	
									3.00	

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:		Moisture Abbreviations:	Consistency: Granular Soils	Cohesive Soils
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	D Dry	(VL) Very Loose	(VS) Very Soft
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	M Moist	(L) Loose	(ST) Stiff
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	W Wet	(MD) Medium Dense	(VST) Very Stiff
PD(x) Percussion Down Hole	H Hand Augering			(F) Firm
Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.				



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCS02
Page: 1 of 1

Client: Rottnest Island Authority	Drill Co: Ecoprobe	Easting: 361634.941
Project: Golf Course and Oval Assessment	Driller: S.Norrie	Northing: 6459107.39
Project No.: 3128991	Rig Type: Hydraulic Hammer	Grid Ref:
Location: Golf Course and Oval	Total Depth (m): 3	Elevation: 0
Date Drilled: 29/05/2012	Diameter (mm): 50	Logged by: L.Navarrete
to: 29/05/2012		Checked by: A.Sutherland

DRILLING					LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water					
0.0	HA				Ground Surface:				0.00
			GCS02_0-0.25		GRASS	D	VL	No odour noted throughout profile.	0.00
					SAND Brown/grey, fine to medium grained, poorly graded, subangular-subrounded. Top Soil	M	L		-0.25
					SAND Pale yellow becoming pale grey at 0.5m, fine to coarse grained, well graded, subangular-subrounded; some shells present.				0.25
1.0	Hydraulic Hammer								
			GCS02_0.25-3.0						
2.0									
3.0					Bottom of hole at 3.0m				-3.00
									3.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency: Granular Soils	Cohesive Soils
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	(VL) Very Loose	(VS) Very Soft
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	(D) Dense	(ST) Stiff
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	(L) Loose	(VST) Very Stiff
PD(x) Percussion Down Hole	H Hand Augering	(MD) Medium Dense	(F) Firm
Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.			



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCS03

Page: 1 of 1

Client: Rottnest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 29/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hydraulic Hammer Total Depth (m): 3 Diameter (mm): 50	Easting: 361476.558 Northing: 6459173.619 Grid Ref: Elevation: 0 Logged by: L.Ellis
to: 29/05/2012		Checked by: A.Sutherland

DRILLING					LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water					
0.0	HA				Ground Surface:				0.00
			GCS03_0-0.25		GRASS	M	L	Some organic matter present.	0.00
					SAND Brown, fine to medium grained, poorly graded, subrounded- subangular. Top soil				-0.25
					SAND Pale yellow, fine to coarse grained, subangular-subrounded, well graded: some shells present. Becoming pale grey and less shells with depth.			No odour noted throughout profile.	0.25
1.0	Hydraulic Hammer			▼		W	L		
			GCS03_0.25-3.0						
2.0									
3.0					Bottom of Hole at 3.0m				-3.00 3.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations: RW(x) Rotary Wash RT(x) Rotary Triple Tube PC(x) Percussion Cable Tool PD(x) Percussion Down Hole Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.	Moisture Abbreviations: D Dry M Moist W Wet	Consistency: Granular Soils (VL) Very Loose (D) Dense (L) Loose (VD) Very Dense (MD) Medium Dense Cohesive Soils (VS) Very Soft (ST) Stiff (S) Soft (VST) Very Stiff (F) Firm (H) Hard
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BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCS04
Page: 1 of 1

Client: Rottneest Island Authority	Drill Co: Ecoprobe	Easting: 361306.468
Project: Golf Course and Oval Assessment	Driller: S.Norrie	Northing: 6459406.004
Project No.: 3128991	Rig Type: Hydraulic Hammer	Grid Ref:
Location: Golf Course and Oval	Total Depth (m): 3	Elevation: 0
Date Drilled: 30/05/2012	Diameter (mm): 50	Logged by: L.Ellis
to: 30/05/2012		Checked by: A.Sutherland

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
0.0	HA				Ground Surface:				0.00	
	Hydraulic Hammer		GCS04_0-0.3		GRASS	M	L	Some organic matter present.	0.00	
			GCS04_0.3-0.7		silty SAND Brown, fine grained, poorly graded, subrounded-subangular. Top Soil		L		No odour noted throughout profile.	-0.30
			GCS04_0.7-2.2		SAND Pale yellow, fine to coarse grained becoming fine to medium grained with depth, subangular-subrounded, well graded; some shells and limestone gravel fine to coarse grained, well graded, subangular-subrounded.		W	0.30		
1.0			GCS04_2.2-2.5							
2.0			GCS04_2.5-3.0							
3.0					Bottom of hole at 3.0m				-3.00 3.00	

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency: Granular Soils	Cohesive Soils
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	(VL) Very Loose	(VS) Very Soft
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	(D) Dense	(ST) Stiff
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	(L) Loose	(VST) Very Stiff
PD(x) Percussion Down Hole	H Hand Augering	(MD) Medium Dense	(F) Firm
Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.			



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCS05
Page: 1 of 1

Client: Rottneest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 30/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hydraulic Hammer Total Depth (m): 3 Diameter (mm): 50	Easting: 361559.851 Northing: 6459535.104 Grid Ref: Elevation: 0 Logged by: L.Ellis
to: 30/05/2012		Checked by: A.Sutherland

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
0.0	HA				Ground Surface:				0.00	
			GCS05_0-0.2		GRASS	M	L	Some organic matter present - rootlets.	0.00	
					silty SAND Brown, fine grained, poorly graded, subrounded-subangular. Top Soil		L		No odour noted throughout profile.	-0.20
			GCS05_0.2-0.6		SAND Pale brown becoming pale yellow with depth, fine to medium grained, subangular-subrounded, poorly graded; some shells and limestone gravel fine to coarse grained, well graded, subangular-subrounded.		L		0.20	
			GCS05_0.6-1.0		SAND Pale brown becoming pale yellow with depth, fine to medium grained, subangular-subrounded, poorly graded; some shells and limestone gravel fine to coarse grained, well graded, subangular-subrounded. Strongly cemented.		L		-0.60	
1.0	Hydraulic Hammer			▼					0.60	
			GCS05_1.0-3.0		SAND Pale grey, fine to coarse grained, well graded, subrounded-subangular, some shells and shells fragments present.	W	L		-1.10	
2.0									1.10	
3.0					Bottom of hole at 3.0m				-3.00	
									3.00	

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations: RW(x) Rotary Wash RT(x) Rotary Triple Tube PC(x) Percussion Cable Tool PD(x) Percussion Down Hole Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.	PSC(x) Percussion Simultaneous Casing AS Augering - Solid Flight AH Augering - Hollow Flight H Hand Augering	Moisture Abbreviations: D Dry M Moist W Wet
Consistency: Granular Soils (VL) Very Loose (L) Loose (MD) Medium Dense	Cohesive Soils (D) Dense (VD) Very Dense	(VS) Very Soft (S) Soft (F) Firm (ST) Stiff (VST) Very Stiff (H) Hard



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCW01

Page: 1 of 1

Client: Rottneest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 29/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hollow Auger Total Depth (m): 4 Diameter (mm): 50	Easting: 361913.565 Northing: 6459465.973 Grid Ref: Elevation: 0 Logged by: L.Ellis
to: 29/05/2012		Checked by: A.Sutherland

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
0.0	HA								0.00	
			Cement			SAND Dark brown/pale yellow, fine to medium grained, subangular-subrounded, some limestone gravel, fine grained, poorly graded, subangular-subrounded.	D	L	Some roots present.	0.00
	AH		Bentonite			SAND Pale yellow, fine to coarse grained, well graded, subangular-subrounded, some shell fragments present.	M	L	No odour noted throughout profile.	-0.50 0.50
1.0										
2.0			Gravel							
3.0						SAND Pale yellow/grey, fine to medium grained, subangular-subrounded, some shell fragments present.	W	L		-3.00 3.00
4.0						Bottom of hole at 4.0m				-4.00 4.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:		Moisture Abbreviations:	Consistency: Granular Soils	Cohesive Soils
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	D Dry	(VL) Very Loose	(VS) Very Soft
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	M Moist	(L) Loose	(S) Soft
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	W Wet	(MD) Medium Dense	(VST) Very Stiff
PD(x) Percussion Down Hole	H Hand Augering			(F) Firm
Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.				



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCW02

Page: 1 of 1

Client: Rottneest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 29/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hollow Auger Total Depth (m): 3.5 Diameter (mm): 50	Easting: 361702.672 Northing: 6459106.46 Grid Ref: Elevation: 0 Logged by: L.Ellis Checked by: A.Sutherland
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DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
0.0	HA								0.00	
						Ground Surface:				0.00
			Cement + Bentonite		clayey SAND Dark brown, fine to medium grained, subangular-subrounded, poorly graded, low plasticity.	M	L	Some organic matter present.	-0.25	
					silty SAND Pale grey, fine to coarse grained, well graded, subrounded-subangular, some shells and shells fragments present.		L	No odour noted throughout profile.	0.25	
1.0	AH				Gravel		W			
2.0										
					LIMESTONE Pale white, well cemented.		H		-2.70	
					SAND Pale grey, fine to coarse grained, well graded, subrounded-subangular, some shells and shells fragments present.		L		-2.90	
3.0									-3.50	
					Bottom of hole at 3.5m				3.50	
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:		Moisture Abbreviations:	Consistency: Granular Soils	Cohesive Soils
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	D Dry	(VL) Very Loose (D) Dense	(VS) Very Soft (ST) Stiff
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	M Moist	(L) Loose (VD) Very Dense	(S) Soft (VST) Very Stiff
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	W Wet	(MD) Medium Dense	(F) Firm (H) Hard
PD(x) Percussion Down Hole	H Hand Augering			

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCW03

Page: 1 of 1

Client: Rottneest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 29/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hollow Auger Total Depth (m): 3.5 Diameter (mm): 50	Easting: 361443.818 Northing: 6459149.151 Grid Ref: Elevation: 0 Logged by: L.Ellis
to: 29/05/2012		Checked by: A.Sutherland

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
0.0	HA								0.00	
			Cement + Bentonite			SAND Dark brown, fine to medium grained, poorly graded, subangular-subrounded, some limestone gravel fine to medium grained, poorly graded, subangular-subrounded.	M	L	Some organic matter present - few roots.	0.00
						SAND Pale yellow, fine to coarse grained, well graded, subangular-subrounded, some limestone gravel fine to medium grained, poorly graded, subangular-subrounded.		L	No odour noted throughout profile.	-0.25 0.25
1.0	AH								-1.00 1.00	
				Gravel		gravelly SAND Pale grey, fine to coarse grained, well graded, subrounded-subangular, some limestone gravel fine to medium grained, poorly graded, subangular-subrounded.	W	L		
2.0										
3.0										
										-3.50 3.50
					Bottom of hole at 3.5m					
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:		Moisture Abbreviations:	Consistency: Granular Soils	Cohesive Soils
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	D Dry	(VL) Very Loose	(VS) Very Soft
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	M Moist	(L) Loose	(S) Soft
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	W Wet	(MD) Medium Dense	(VD) Very Dense
PD(x) Percussion Down Hole	H Hand Augering			(ST) Stiff
Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.				(VST) Very Stiff
				(H) Hard



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCW04

Page: 1 of 1

Client: Rottneest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 30/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hollow Auger Total Depth (m): 3.5 Diameter (mm): 50	Easting: 361309.215 Northing: 6459435.609 Grid Ref: Elevation: 0 Logged by: L.Ellis
to: 30/05/2012	Checked by: A.Sutherland	

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
0.0	HA					Ground Surface:				0.00
			Cement + Bentonite			silty SAND Brown, fine grained, subrounded-subangular, poorly graded, some small shells, shell fragments and limestone gravel fine grained, poorly graded, subangular-subrounded.	M	L	Some organic matter present - fine roots.	0.00
	AH					SAND Pale brown/grey, fine to medium grained, poorly graded, subrounded-subangular, some shell fragments present.		H	No odour noted throughout profile.	-0.50
						LIMESTONE Pale grey, well cemented.		W		-0.60
						silty SAND Pale brown/pale grey, fine to coarse grained, well graded, subangular-subrounded, some shells and limestone gravel fine grained poorly graded, subangular-subrounded.		L		-0.80
1.0				Gravel						-0.80
2.0										
3.0										
						Bottom of hole at 3.5m				-3.50
4.0										3.50

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:		Moisture Abbreviations:		Consistency:		Cohesive Soils	
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	D Dry	(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff	
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	M Moist	(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff	
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	W Wet	(MD) Medium Dense		(F) Firm	(H) Hard	
PD(x) Percussion Down Hole	H Hand Augering						

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.



BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: GCW05

Page: 1 of 1

Client: Rottneest Island Authority Project: Golf Course and Oval Assessment Project No.: 3128991 Location: Golf Course and Oval Date Drilled: 30/05/2012	Drill Co: Ecoprobe Driller: S.Norrie Rig Type: Hollow Auger Total Depth (m): 4.5 Diameter (mm): 50	Easting: 361567.198 Northing: 6459574.011 Grid Ref: Elevation: 0 Logged by: L.Ellis
to: 30/05/2012		Checked by: A.Sutherland

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA					SAND Brown, fine to medium grained, poorly graded, subrounded-angular, some shells, shell fragment and limestone fine grained, subangular- subrounded, poorly graded.	M	L	Some organic matter present.	0.00
			Cement							-0.30
			Bentonite			SAND Mottled brown and pale yellow, fine to coarse grained, well graded, subangular-subrounded, some shells, shell fragments and limestone fine grained, poorly graded, subangular-subrounded; becoming pale yellow with depth and less gravels.	W	L		0.30
1.0	AH									
			Gravel							
2.0										
3.0										
4.0										
						Bottom of hole at 4.5m				-4.50
										4.50
5.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:		Moisture Abbreviations:	Consistency:	Cohesive Soils
RW(x) Rotary Wash	PSC(x) Percussion Simultaneous Casing	D Dry	(VL) Very Loose	(VS) Very Soft
RT(x) Rotary Triple Tube	AS Augering - Solid Flight	M Moist	(L) Loose	(S) Soft
PC(x) Percussion Cable Tool	AH Augering - Hollow Flight	W Wet	(MD) Medium Dense	(D) Dense
PD(x) Percussion Down Hole	H Hand Augering			(VD) Very Dense
Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.				(ST) Stiff
				(VST) Very Stiff
				(F) Firm
				(H) Hard

C. Laboratory Reports and COC Documentation

CERTIFICATE OF ANALYSIS 124817

Client:

Rottnest Island Authority

PO Box 693

Fremantle

WA 6959

Attention: Helen Shortland-Jones

Sample log in details:

Your Reference:

No. of samples:

Date samples received:

Date completed instructions received:

Location:

Golf Course

5 waters

30/7/12

30/7/12

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:

6/08/12

Date of Preliminary Report:

Not Issued

Issue Date:

3/08/12

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Accredited for compliance with ISO/IEC 17025.

Tests not covered by NATA are denoted with *.

Results Approved By:



Tom Edwards
Micro Team Leader



Sandra Taylor
Assistant Lab Manager

MPL Reference: 124817
Revision No: R 00

Nutrients in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ----- -----	124817-1 GC1 30/07/2012 water	124817-2 GC2 30/07/2012 water	124817-3 GC3 30/07/2012 water	124817-4 GC4 30/07/2012 water	124817-5 OV1 30/07/2012 water
Total Nitrogen (Total N)	mg/L	8.0	8.4	7.8	7.5	20
Nitrate as N	mg/L	<0.005	<0.005	2.9	0.82	<0.005
Nitrite as N	mg/L	<0.005	<0.005	0.017	0.010	<0.005
Ammonia as N	mg/L	0.81	0.91	0.030	2.3	6.2
Total Phosphorus (Total P)	mg/L	1.0	1.1	1.4	1.5	1.9
Phosphate as P	mg/L	0.067	0.016	0.024	<0.005	0.018

Client Reference: **Golf Course**

Dissolved Metals in Water		124817-1	124817-2	124817-3	124817-4	124817-5
Our Reference:	UNITS	GC1	GC2	GC3	GC4	OV1
Your Reference	-----					
Date Sampled	-----	30/07/2012	30/07/2012	30/07/2012	30/07/2012	30/07/2012
Type of sample		water	water	water	water	water
Date prepared	-	1/8/12	1/8/12	1/8/12	1/8/12	1/8/12
Date analysed	-	1/8/12	1/8/12	1/8/12	1/8/12	1/8/12
Potassium	mg/L	160	350	63	27	68
Lead	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Cadmium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	<0.02	0.03	<0.02	<0.02	<0.02

Client Reference: Golf Course

Miscellaneous Inorganics	UNITS	124817-1	124817-2	124817-3	124817-4	124817-5
Our Reference:	-----	GC1	GC2	GC3	GC4	OV1
Your Reference	-----					
Date Sampled		30/07/2012	30/07/2012	30/07/2012	30/07/2012	30/07/2012
Type of sample		water	water	water	water	water
Date prepared	-	2/8/12	2/8/12	2/8/12	2/8/12	2/8/12
Date analysed	-	2/8/12	2/8/12	2/8/12	2/8/12	2/8/12
Chloride in water	mg/L	7,800	14,000	2,500	640	1,200

MPL Reference: 124817
 Revision No: R 00



Client Reference: Golf Course

Microbiological Testing						
Our Reference:	UNITS	124817-1	124817-2	124817-3	124817-4	124817-5
Your Reference	-----	GC1	GC2	GC3	GC4	OV1
Date Sampled	-----	30/07/2012	30/07/2012	30/07/2012	30/07/2012	30/07/2012
Type of sample		water	water	water	water	water
Date testing started	-	30/07/12	30/07/12	30/07/12	30/07/12	30/07/12
Date testing completed	-	1/08/12	1/08/12	1/08/12	1/08/12	1/08/12
Thermotolerant Coliforms	cfu/100mL	<10	20	30	<10	<10
E.Coli	cfu/100mL	<10	20	30	<10	<10

Method ID	Methodology Summary
INORG-055	Total Nitrogen by colourimetric analysis in accordance with APHA 4500-P J, 4500-NO3 F.
INORG-055	Nitrate by colourimetric analysis and calculation in accordance with APHA 21st ED 4500-NO3 F.
INORG-055	Nitrite by colourimetric analysis in accordance with APHA 21st ED 4500-NO2 B.
INORG-057	Ammonia by colourimetric analysis in accordance with APHA 21st ED 4500-NH3 F.
INORG-060	Total Phosphorus by colourimetric analysis in accordance with APHA 21st ED 4500-P J.
INORG-060	Phosphate by colourimetric analysis in accordance with APHA 21st ED 4500-P E.
METALS-020	Metals in soil and water by ICP-OES.
INORG-081	Chloride by Ion Exchange Chromatography in accordance with APHA 21st ED 4110B.
MICRO-001	Thermotolerant Coliforms: Microbial Water Analysis - in accordance with MICRO-001 (AS4276.7-2007). Recommended maximums based on NHMRC and ARMC Australian Drinking Water Guidelines.
MICRO-001	E. Coli: Microbial Water Analysis - in accordance with MICRO-001 (AS4276.7-2007). Recommended maximums based on NHMRC and ARMC Australian Drinking Water Guidelines.

Client Reference: Golf Course

QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Nutrients in Water						Base II Duplicate II %RPD		
Total Nitrogen (Total N)	mg/L	0.1	INORG-055	<0.1	[NT]	[NT]	LCS	112%
Ammonia as N	mg/L	0.005	INORG-057	<0.005	[NT]	[NT]	LCS	93%
Total Phosphorus (Total P)	mg/L	0.01	INORG-060	<0.01	[NT]	[NT]	LCS	98%
Phosphate as P	mg/L	0.005	INORG-060	<0.005	[NT]	[NT]	LCS	88%
Dissolved Metals in Water						Base II Duplicate II %RPD		
Date prepared	-			1/8/12	124817-2	1/8/12 1/8/12	LCS	1/8/12
Date analysed	-			1/8/12	124817-2	1/8/12 1/8/12	LCS	1/8/12
Potassium	mg/L	0.5	METALS-020	<0.5	124817-2	350 370 RPD: 6	LCS	99%
Lead	mg/L	0.03	METALS-020	<0.03	124817-2	<0.03 <0.03	LCS	106%
Cadmium	mg/L	0.01	METALS-020	<0.01	124817-2	<0.01 <0.01	LCS	106%
Copper	mg/L	0.01	METALS-020	<0.01	124817-2	<0.01 <0.01	LCS	105%
Chromium	mg/L	0.01	METALS-020	<0.01	124817-2	<0.01 <0.01	LCS	105%
Manganese	mg/L	0.01	METALS-020	<0.01	124817-2	<0.01 <0.01	LCS	106%
Nickel	mg/L	0.02	METALS-020	<0.02	124817-2	<0.02 <0.02	LCS	104%
Zinc	mg/L	0.02	METALS-020	<0.02	124817-2	0.03 0.03 RPD: 0	LCS	102%
Miscellaneous Inorganics						Base II Duplicate II %RPD		
Date prepared	-			2/8/12	124817-1	2/8/12 2/8/12	LCS	2/8/12
Date analysed	-			2/8/12	124817-1	2/8/12 2/8/12	LCS	2/8/12
Chloride in water	mg/L	1	INORG-081	<1	124817-1	7800 7700 RPD: 1	LCS	106%
Microbiological Testing								
Date testing started	-			30/7/12				
Date testing completed	-			1/8/12				
Thermotolerant Coliforms	cfu/100 mL	1	MICRO-001	<1				
E.Coli	cfu/100 mL	1	MICRO-001	<1				

MPL Reference: 124817
Revision No: R 00



Report Comments:

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

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.

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 a matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

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

Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and Speciated Phenols is acceptable.

Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EP1204381	Page	: 1 of 6
Client	: GHD PTY LTD	Laboratory	: Environmental Division Perth
Contact	: MR ASHLEY SUTHERLAND	Contact	: Scott James
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: ashley.sutherland@ghd.com	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 03 8687 8000	Telephone	: +61-8-9209 7655
Facsimile	: +61 03 8687 8111	Facsimile	: +61-8-9209 7600
Project	: Rottnest Island- Golf Course and Oval Assesment	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 31/28991	Date Samples Received	: 01-JUN-2012
C-O-C number	: ----	Issue Date	: 13-JUN-2012
Sampler	: L.E.	No. of samples received	: 9
Site	: ----	No. of samples analysed	: 9
Quote number	: ----		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Leanne Cooper	Acid Sulfate Soils Supervisor	Perth ASS

Environmental Division Perth
Part of the **ALS Laboratory Group**

10 Hod Way Malaga WA Australia 6090
Tel. +61-8-9209 7655 Fax. +61-8-9209 7600 www.alsglobal.com
A Campbell Brothers Limited Company



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- **ASS: EA003 (NATA Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Vigorous; 4 - Very Vigorous**
- **ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m³ in-situ soil, multiply reported results x wet bulk density of soil in t/m³.**
- **ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5**



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	RASS1-0.3-0.6	RASS1-0.9-1.2	RASS2-0.2-0.5	RASS2-1.2-1.5	RASS3-0.2-0.7
				31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00
				EP1204381-001	EP1204381-002	EP1204381-003	EP1204381-004	EP1204381-005
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	9.8	9.8	9.8	9.9	9.9
pH OX (23B)	----	0.1	pH Unit	8.0	8.3	8.3	8.3	8.3
EA029-B: Acidity Trail								
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titrateable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titrateable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.005	% pyrite S	<0.005	<0.005	<0.005	<0.005	<0.005
sulfidic - Titrateable Peroxide Acidity (s-23G)	----	0.005	% pyrite S	<0.005	<0.005	<0.005	<0.005	<0.005
sulfidic - Titrateable Sulfidic Acidity (s-23H)	----	0.005	% pyrite S	<0.005	<0.005	<0.005	<0.005	<0.005
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.005	% S	0.04	0.03	0.03	0.06	0.05
Peroxide Sulfur (23De)	----	0.005	% S	0.18	0.22	0.12	0.26	0.17
Peroxide Oxidisable Sulfur (23E)	----	0.005	% S	0.14	0.18	0.09	0.19	0.12
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	5	mole H+ / t	87	115	57	121	74
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.005	% Ca	0.24	0.21	0.22	0.24	0.22
Peroxide Calcium (23Wh)	----	0.005	% Ca	27.7	32.7	30.1	33.5	30.7
Acid Reacted Calcium (23X)	----	0.005	% Ca	27.5	32.5	29.9	33.2	30.5
acidity - Acid Reacted Calcium (a-23X)	----	5	mole H+ / t	13700	16200	14900	16600	15200
sulfidic - Acid Reacted Calcium (s-23X)	----	0.005	% S	22.0	26.0	23.9	26.6	24.4
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.005	% Mg	0.06	0.06	0.06	0.10	0.08
Peroxide Magnesium (23Tm)	----	0.005	% Mg	1.20	1.40	0.85	1.57	0.92
Acid Reacted Magnesium (23U)	----	0.005	% Mg	1.13	1.34	0.79	1.47	0.84
Acidity - Acid Reacted Magnesium (a-23U)	----	5	mole H+ / t	932	1100	651	1210	690
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.005	% S	1.49	1.76	1.04	1.93	1.11
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	76.6	78.7	74.1	81.8	79.2
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	15300	15700	14800	16400	15800
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	24.5	25.2	23.7	26.2	25.4
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				RASS1-0.3-0.6	RASS1-0.9-1.2	RASS2-0.2-0.5	RASS2-1.2-1.5	RASS3-0.2-0.7
				31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00
Compound	CAS Number	LOR	Unit	EP1204381-001	EP1204381-002	EP1204381-003	EP1204381-004	EP1204381-005
EA029-H: Acid Base Accounting - Continued								
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.14	0.18	0.09	0.19	0.12
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	87	115	57	121	74
Liming Rate excluding ANC	----	1	kg CaCO3/t	6	9	4	9	6



Analytical Results

Sub-Matrix: SOIL

				Client sample ID	RASS3-1.0_1.5	RASS4-0.4_0.6	RASS4-1.0_1.2	GCS04-0.7_2.2	----
				Client sampling date / time	31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00	30-MAY-2012 15:00	----
Compound	CAS Number	LOR	Unit	EP1204381-006	EP1204381-007	EP1204381-008	EP1204381-009	----	----
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit	9.9	9.8	9.9	9.8	----	----
pH OX (23B)	----	0.1	pH Unit	8.3	8.2	8.2	8.2	----	----
EA029-B: Acidity Trail									
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	----	----
Titrateable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	----	----
Titrateable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	----	----
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.005	% pyrite S	<0.005	<0.005	<0.005	<0.005	----	----
sulfidic - Titrateable Peroxide Acidity (s-23G)	----	0.005	% pyrite S	<0.005	<0.005	<0.005	<0.005	----	----
sulfidic - Titrateable Sulfidic Acidity (s-23H)	----	0.005	% pyrite S	<0.005	<0.005	<0.005	<0.005	----	----
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.005	% S	0.10	0.05	0.14	0.01	----	----
Peroxide Sulfur (23De)	----	0.005	% S	0.29	0.19	0.32	0.11	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.005	% S	0.20	0.14	0.18	0.10	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	5	mole H+ / t	123	86	111	63	----	----
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.005	% Ca	0.24	0.21	0.27	0.21	----	----
Peroxide Calcium (23Wh)	----	0.005	% Ca	35.6	29.2	32.9	36.2	----	----
Acid Reacted Calcium (23X)	----	0.005	% Ca	35.4	29.0	32.6	36.0	----	----
acidity - Acid Reacted Calcium (a-23X)	----	5	mole H+ / t	17600	14400	16300	18000	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.005	% S	28.3	23.2	26.1	28.8	----	----
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.005	% Mg	0.10	0.06	0.14	0.04	----	----
Peroxide Magnesium (23Tm)	----	0.005	% Mg	1.31	1.13	1.13	0.94	----	----
Acid Reacted Magnesium (23U)	----	0.005	% Mg	1.20	1.07	0.99	0.90	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	5	mole H+ / t	989	881	818	741	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.005	% S	1.58	1.41	1.31	1.19	----	----
EA029-F: Excess Acid Neutralising Capacity									
Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	81.8	81.4	78.4	79.4	----	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	16300	16300	15700	15900	----	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	26.2	26.1	25.1	25.4	----	----
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	----	----



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

				RASS3-1.0_1.5	RASS4-0.4_0.6	RASS4-1.0_1.2	GCS04-0.7_2.2	----
				31-MAY-2012 15:00	31-MAY-2012 15:00	31-MAY-2012 15:00	30-MAY-2012 15:00	----
Compound	CAS Number	LOR	Unit	EP1204381-006	EP1204381-007	EP1204381-008	EP1204381-009	----
EA029-H: Acid Base Accounting - Continued								
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.20	0.14	0.18	0.10	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	123	86	111	63	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	9	6	8	5	----



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EP1205271	Page	: 1 of 15
Client	: GHD PTY LTD	Laboratory	: Environmental Division Perth
Contact	: MR ASHLEY SUTHERLAND	Contact	: Scott James
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: ashley.sutherland@ghd.com	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 03 8687 8000	Telephone	: +61-8-9209 7655
Facsimile	: +61 03 8687 8111	Facsimile	: +61-8-9209 7600
Project	: 3128991 GOLF COURSE & OVAL ASSESSMENT	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 29-JUN-2012
C-O-C number	: ----	Issue Date	: 09-JUL-2012
Sampler	: LN	No. of samples received	: 6
Site	: Rottnest Island	No. of samples analysed	: 6
Quote number	: EN/005/09		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Agnes Szilagyi	Senior Organic Chemist	Perth Organics
Canhuang Ke	Metals Instrument Chemist	Perth Inorganics
Chas Tucker	Inorganic Chemist	Perth Inorganics
Cicelia Bartels	Metals Instrument Chemist	Perth Inorganics
Rassem Ayoubi	Senior Organic Chemist	Perth Organics
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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: WATER

				Client sample ID				
				Client sampling date / time				
				GCW01	GCW02	GCW03	GCW04	GCW05
				28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00
Compound	CAS Number	LOR	Unit	EP1205271-001	EP1205271-002	EP1205271-003	EP1205271-004	EP1205271-005
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	384	472	300	494	371
Total Alkalinity as CaCO3	----	1	mg/L	384	472	300	494	371
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	166	862	1380	294	151
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	789	9320	10800	2320	732
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	116	481	344	117	108
Magnesium	7439-95-4	1	mg/L	70	555	679	215	52
Sodium	7440-23-5	1	mg/L	463	4480	5140	1250	438
Potassium	7440-09-7	1	mg/L	49	195	233	54	36
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.02	0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L	0.007	0.004	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0001	0.0001	0.0001	0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.004	0.007	0.011	0.007	0.002
Nickel	7440-02-0	0.001	mg/L	0.013	0.034	0.014	0.006	0.007
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	0.016	0.022	9.40	0.021	0.010
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	3.48	0.87	0.38	0.17	2.81
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	0.05	0.05
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.01	<0.01	<0.01	2.78	0.47
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.01	<0.01	<0.01	2.83	0.52
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.49	0.23	0.60	0.82	0.82
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	33.4	290	339	81.4	31.2
Total Cations	----	0.01	meq/L	32.9	270	302	79.3	29.6
Ionic Balance	----	0.01	%	0.67	3.71	5.74	1.35	2.58



Analytical Results

Sub-Matrix: WATER

				Client sample ID				
				Client sampling date / time				
				GCW01	GCW02	GCW03	GCW04	GCW05
				28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00
Compound	CAS Number	LOR	Unit	EP1205271-001	EP1205271-002	EP1205271-003	EP1205271-004	EP1205271-005
EP026ST: Chemical Oxygen Demand (Sealed Tube)								
Chemical Oxygen Demand	----	5	mg/L	49	198	371	70	36
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	<2	<2	<2
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	1	µg/L	<1	<1	<1	<1	<1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDT	50-29-3	2	µg/L	<2	<2	<2	<2	<2
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Methoxychlor	72-43-5	2	µg/L	<2	<2	<2	<2	<2
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of DDD + DDE + DDT	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
Styrene	100-42-5	5	µg/L	<5	<5	<5	<5	<5
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
Isopropylbenzene	98-82-8	5	µg/L	<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: WATER

				Client sample ID				
				Client sampling date / time				
				GCW01	GCW02	GCW03	GCW04	GCW05
				28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00
Compound	CAS Number	LOR	Unit	EP1205271-001	EP1205271-002	EP1205271-003	EP1205271-004	EP1205271-005
EP074A: Monocyclic Aromatic Hydrocarbons - Continued								
n-Propylbenzene	103-65-1	5	µg/L	<5	<5	<5	<5	<5
1,3,5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	<5	<5	<5
sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	<5	<5	<5
tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	<5	<5	<5
p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	<5	<5	<5
n-Butylbenzene	104-51-8	5	µg/L	<5	<5	<5	<5	<5
EP074B: Oxygenated Compounds								
Vinyl Acetate	108-05-4	50	µg/L	<50	<50	<50	<50	<50
2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	<50	<50	<50
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	<50	<50	<50
2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	<50	<50	<50
EP074C: Sulfonated Compounds								
Carbon disulfide	75-15-0	5	µg/L	<5	<5	<5	<5	<5
EP074D: Fumigants								
2,2-Dichloropropane	594-20-7	5	µg/L	<5	<5	<5	<5	<5
1,2-Dichloropropane	78-87-5	5	µg/L	<5	<5	<5	<5	<5
cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	<5	<5	<5
trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	<5	<5	<5
1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	<5	<5	<5
EP074E: Halogenated Aliphatic Compounds								
Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	<50	<50	<50
Chloromethane	74-87-3	50	µg/L	<50	<50	<50	<50	<50
Vinyl chloride	75-01-4	50	µg/L	<50	<50	<50	<50	<50
Bromomethane	74-83-9	50	µg/L	<50	<50	<50	<50	<50
Chloroethane	75-00-3	50	µg/L	<50	<50	<50	<50	<50
Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	<50	<50	<50
1,1-Dichloroethene	75-35-4	5	µg/L	<5	<5	<5	<5	<5
Iodomethane	74-88-4	5	µg/L	<5	<5	<5	<5	<5
trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5	<5	<5	<5	<5
1,1-Dichloroethane	75-34-3	5	µg/L	<5	<5	<5	<5	<5
cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5	<5	<5	<5	<5
1,1,1-Trichloroethane	71-55-6	5	µg/L	<5	<5	<5	<5	<5
1,1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	<5	<5	<5
Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	<5	<5	<5
1,2-Dichloroethane	107-06-2	5	µg/L	<5	<5	<5	<5	<5
Trichloroethene	79-01-6	5	µg/L	<5	<5	<5	<5	<5
Dibromomethane	74-95-3	5	µg/L	<5	<5	<5	<5	<5



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	GCW01	GCW02	GCW03	GCW04	GCW05
				28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00
				EP1205271-001	EP1205271-002	EP1205271-003	EP1205271-004	EP1205271-005
EP074E: Halogenated Aliphatic Compounds - Continued								
1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	<5	<5	<5
1.3-Dichloropropane	142-28-9	5	µg/L	<5	<5	<5	<5	<5
Tetrachloroethene	127-18-4	5	µg/L	<5	<5	<5	<5	<5
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	<5	<5	<5
trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	<5	<5	<5
cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	<5	<5	<5
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	<5	<5	<5
1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	<5	<5	<5	<5
Pentachloroethane	76-01-7	5	µg/L	<5	<5	<5	<5	<5
1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	<5	<5	<5
Hexachlorobutadiene	87-68-3	5	µg/L	<5	<5	<5	<5	<5
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	5	µg/L	<5	<5	<5	<5	<5
Bromobenzene	108-86-1	5	µg/L	<5	<5	<5	<5	<5
2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	<5	<5	<5
4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	<5	<5	<5
1.3-Dichlorobenzene	541-73-1	5	µg/L	<5	<5	<5	<5	<5
1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	<5	<5	<5	<5
1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	<5	<5	<5	<5
1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	<5	<5	<5	<5
1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	<5	<5	<5
EP074G: Trihalomethanes								
Chloroform	67-66-3	5	µg/L	<5	<5	<5	<5	<5
Bromodichloromethane	75-27-4	5	µg/L	<5	<5	<5	<5	<5
Dibromochloromethane	124-48-1	5	µg/L	<5	<5	<5	<5	<5
Bromoform	75-25-2	5	µg/L	<5	<5	<5	<5	<5
EP074H: Naphthalene								
Naphthalene	91-20-3	7	µg/L	<7	<7	<7	<7	<7
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0



Analytical Results

Sub-Matrix: WATER

				Client sample ID				
				Client sampling date / time				
				GCW01	GCW02	GCW03	GCW04	GCW05
				28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00
Compound	CAS Number	LOR	Unit	EP1205271-001	EP1205271-002	EP1205271-003	EP1205271-004	EP1205271-005
EP075(SIM)A: Phenolic Compounds - Continued								
2,4,6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				GCW01	GCW02	GCW03	GCW04	GCW05
				28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00	28-JUN-2012 15:00
Compound	CAS Number	LOR	Unit	EP1205271-001	EP1205271-002	EP1205271-003	EP1205271-004	EP1205271-005
EP080: BTEXN - Continued								
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	<2	<2
Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	34.0	34.0	34.0	32.0	36.0
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.1	%	60.6	65.0	63.3	60.4	70.9
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.1	%	57.6	64.6	60.7	57.2	65.5
EP074S: VOC Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	104	102	106	111	111
Toluene-D8	2037-26-5	0.1	%	98.6	100	103	98.0	95.5
4-Bromofluorobenzene	460-00-4	0.1	%	95.6	94.4	98.8	96.1	94.6
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	27.4	34.9	31.8	32.7	31.5
2-Chlorophenol-D4	93951-73-6	0.1	%	60.2	67.3	65.8	67.9	67.4
2,4,6-Tribromophenol	118-79-6	0.1	%	77.0	84.6	87.9	80.8	87.7
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	50.8	68.9	60.1	62.6	67.4
Anthracene-d10	1719-06-8	0.1	%	90.9	80.5	85.2	86.3	88.7
4-Terphenyl-d14	1718-51-0	0.1	%	92.5	82.4	91.5	86.6	95.0
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	103	102	107	111	110
Toluene-D8	2037-26-5	0.1	%	99.1	101	102	98.8	95.8
4-Bromofluorobenzene	460-00-4	0.1	%	92.6	93.1	95.9	95.7	96.1



Analytical Results

Sub-Matrix: WATER

				Client sample ID	QA01				
				Client sampling date / time	28-JUN-2012 15:00				
Compound	CAS Number	LOR	Unit	EP1205271-006					
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1					
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1					
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	312					
Total Alkalinity as CaCO3	----	1	mg/L	312					
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1370					
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L	10900					
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	370					
Magnesium	7439-95-4	1	mg/L	714					
Sodium	7440-23-5	1	mg/L	5350					
Potassium	7440-09-7	1	mg/L	242					
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01					
Arsenic	7440-38-2	0.001	mg/L	<0.001					
Cadmium	7440-43-9	0.0001	mg/L	<0.0001					
Chromium	7440-47-3	0.001	mg/L	<0.001					
Copper	7440-50-8	0.001	mg/L	0.010					
Nickel	7440-02-0	0.001	mg/L	0.014					
Lead	7439-92-1	0.001	mg/L	<0.001					
Zinc	7440-66-6	0.005	mg/L	9.30					
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	0.39					
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L	<0.01					
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01					
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01					
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	0.71					
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L	342					
Total Cations	----	0.01	meq/L	316					
Ionic Balance	----	0.01	%	3.98					



Analytical Results

Sub-Matrix: WATER

				Client sample ID	QA01				
				Client sampling date / time	28-JUN-2012 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EP1205271-006	----	----	----	----
EP026ST: Chemical Oxygen Demand (Sealed Tube)									
Chemical Oxygen Demand	----	5	mg/L		422	----	----	----	----
EP030: Biochemical Oxygen Demand (BOD)									
Biochemical Oxygen Demand	----	2	mg/L		7	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	1	µg/L		<1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4,4'-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----
4,4'-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	----	----	----	----
4,4'-DDT	50-29-3	2	µg/L		<2	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	----	----	----	----
Methoxychlor	72-43-5	2	µg/L		<2	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
Styrene	100-42-5	5	µg/L		<5	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
Isopropylbenzene	98-82-8	5	µg/L		<5	----	----	----	----



Analytical Results

Sub-Matrix: WATER

Client sample ID
 Client sampling date / time

				QA01				
				28-JUN-2012 15:00				
Compound	CAS Number	LOR	Unit	EP1205271-006				
EP074A: Monocyclic Aromatic Hydrocarbons - Continued								
n-Propylbenzene	103-65-1	5	µg/L	<5				
1,3,5-Trimethylbenzene	108-67-8	5	µg/L	<5				
sec-Butylbenzene	135-98-8	5	µg/L	<5				
1,2,4-Trimethylbenzene	95-63-6	5	µg/L	<5				
tert-Butylbenzene	98-06-6	5	µg/L	<5				
p-Isopropyltoluene	99-87-6	5	µg/L	<5				
n-Butylbenzene	104-51-8	5	µg/L	<5				
EP074B: Oxygenated Compounds								
Vinyl Acetate	108-05-4	50	µg/L	<50				
2-Butanone (MEK)	78-93-3	50	µg/L	<50				
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50				
2-Hexanone (MBK)	591-78-6	50	µg/L	<50				
EP074C: Sulfonated Compounds								
Carbon disulfide	75-15-0	5	µg/L	<5				
EP074D: Fumigants								
2,2-Dichloropropane	594-20-7	5	µg/L	<5				
1,2-Dichloropropane	78-87-5	5	µg/L	<5				
cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5				
trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5				
1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5				
EP074E: Halogenated Aliphatic Compounds								
Dichlorodifluoromethane	75-71-8	50	µg/L	<50				
Chloromethane	74-87-3	50	µg/L	<50				
Vinyl chloride	75-01-4	50	µg/L	<50				
Bromomethane	74-83-9	50	µg/L	<50				
Chloroethane	75-00-3	50	µg/L	<50				
Trichlorofluoromethane	75-69-4	50	µg/L	<50				
1,1-Dichloroethene	75-35-4	5	µg/L	<5				
Iodomethane	74-88-4	5	µg/L	<5				
trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5				
1,1-Dichloroethane	75-34-3	5	µg/L	<5				
cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5				
1,1,1-Trichloroethane	71-55-6	5	µg/L	<5				
1,1-Dichloropropylene	563-58-6	5	µg/L	<5				
Carbon Tetrachloride	56-23-5	5	µg/L	<5				
1,2-Dichloroethane	107-06-2	5	µg/L	<5				
Trichloroethene	79-01-6	5	µg/L	<5				
Dibromomethane	74-95-3	5	µg/L	<5				



Analytical Results

Sub-Matrix: WATER

Client sample ID

QA01

Client sampling date / time

28-JUN-2012 15:00

Compound	CAS Number	LOR	Unit	EP1205271-006				
EP074E: Halogenated Aliphatic Compounds - Continued								
1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	----	----	----	----
1.3-Dichloropropane	142-28-9	5	µg/L	<5	----	----	----	----
Tetrachloroethene	127-18-4	5	µg/L	<5	----	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	----	----	----	----
trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	----	----	----	----
cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	----	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	----	----	----	----
1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	----	----	----	----
Pentachloroethane	76-01-7	5	µg/L	<5	----	----	----	----
1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	----	----	----	----
Hexachlorobutadiene	87-68-3	5	µg/L	<5	----	----	----	----
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	5	µg/L	<5	----	----	----	----
Bromobenzene	108-86-1	5	µg/L	<5	----	----	----	----
2-Chlorotoluene	95-49-8	5	µg/L	<5	----	----	----	----
4-Chlorotoluene	106-43-4	5	µg/L	<5	----	----	----	----
1.3-Dichlorobenzene	541-73-1	5	µg/L	<5	----	----	----	----
1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	----	----	----	----
1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	----	----	----	----
1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	----	----	----	----
1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	----	----	----	----
EP074G: Trihalomethanes								
Chloroform	67-66-3	5	µg/L	<5	----	----	----	----
Bromodichloromethane	75-27-4	5	µg/L	<5	----	----	----	----
Dibromochloromethane	124-48-1	5	µg/L	<5	----	----	----	----
Bromoform	75-25-2	5	µg/L	<5	----	----	----	----
EP074H: Naphthalene								
Naphthalene	91-20-3	7	µg/L	<7	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	----	----	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	----	----	----	----



Analytical Results

Sub-Matrix: WATER

Client sample ID

QA01

Client sampling date / time

28-JUN-2012 15:00

Compound	CAS Number	LOR	Unit	EP1205271-006				
EP075(SIM)A: Phenolic Compounds - Continued								
2,4,6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	----	----	----	----
2,4,5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----



Analytical Results

Sub-Matrix: **WATER**

				Client sample ID	QA01				
				Client sampling date / time	28-JUN-2012 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EP1205271-006	----	----	----	----
EP080: BTEXN - Continued									
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
Total Xylenes	1330-20-7	2	µg/L		<2	----	----	----	----
Sum of BTEX	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		34.0	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		67.5	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		60.3	----	----	----	----
EP074S: VOC Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.1	%		108	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		95.9	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		95.8	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		30.3	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		62.6	----	----	----	----
2,4,6-Tribromophenol	118-79-6	0.1	%		87.2	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		55.0	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%		81.7	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		84.4	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.1	%		108	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		95.6	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		93.7	----	----	----	----



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	27.4	136.2
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	50.0	146.3
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	26.8	153.4
EP074S: VOC Surrogates			
1,2-Dichloroethane-D4	17060-07-0	62.3	133.9
Toluene-D8	2037-26-5	74.5	124.3
4-Bromofluorobenzene	460-00-4	63.9	118.5
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	67.2
2-Chlorophenol-D4	93951-73-6	29.4	119.5
2,4,6-Tribromophenol	118-79-6	10.0	130.8
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	33.8	130.7
Anthracene-d10	1719-06-8	42.7	126.5
4-Terphenyl-d14	1718-51-0	40.5	142.4
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	60.5	141.2
Toluene-D8	2037-26-5	73.4	126
4-Bromofluorobenzene	460-00-4	59.6	125.3



Report of Analysis

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TW12-04936

Client:

GHD PTY LTD
PO BOX 3106
ADELAIDE TERRACE
PERTH WA 6832

Order Number: 3128991
Report Date: 26-June-2012
Received Date: 06-June-2012

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Analysis	Unit	TW12-04936.001 GCS01_0.15-0.5 SOIL	TW12-04936.003 GCS02_0.25-3.0 SOIL	TW12-04936.005 GCS03_0.25-3.0 SOIL	TW12-04936.006 GCS04_0-0.3 SOIL
Organic Nitrogen	mg/kg	720	650	710	960
ACIDITY					
pH - Water	pH units	8.69	9.40	9.27	8.57
MAJOR ELEMENTS					
Ammonium Nitrogen	mg/kg	1.0	0.75	0.80	1.5
Nitrate + Nitrite	mg/kg	15	4	1	2
Nitrate Nitrogen	mg/kg	15	4	1	2
Nitrite Nitrogen	mg/kg	<1	<1	<1	<1
Potassium	mg/kg	15	6	55	18
Phosphorus - Colwell extr	mg/kg	19	8	6	33
Nitrogen	mg/kg	738	654	716	966
Total Kjeldahl Nitrogen	mg/kg	723	650	715	964
SECONDARY ELEMENTS					
Calcium Carbonate	%	82	97	96	87
Calcium	mg/kg	4150	3950	3790	4650
Magnesium	mg/kg	160	147	319	104
TRACE ELEMENTS					
Copper	mg/kg	<0.1	<0.1	<0.1	0.1
Zinc	mg/kg	0.5	0.6	0.3	0.7
Manganese	mg/kg	<1	<1	<1	<1
Iron	mg/kg	7.9	1.5	3.2	7.2
Boron	mg/kg	2.0	0.4	1.2	0.8
ORGANIC MATTER					
Organic Carbon	%	1.4	<0.3	<0.3	1.9
SALINITY					
Chloride	mg/kg	110	140	3000	69
Electrical Conductivity	dS/m	0.17	0.14	1.81	0.13
Sodium	mg/kg	129	115	1160	123
Total Soluble Salts	%	0.06	0.05	0.62	0.04
EXCHANGEABLE CATIONS					
Cation Exchange	meq/100g	22.7	21.5	26.8	24.7
Exchangeable Sodium	meq/100g	0.56	0.50	5.06	0.54
Exchangeable Sodium Percent	%	2.5	2.3	18.9	2.2
Exchangeable Potassium	meq/100g	0.04	0.01	0.14	0.05
Exchangeable Potassium Percent	%	0.2	<0.1	0.5	0.2
Exchangeable Calcium	meq/100g	20.8	19.7	19.0	23.3

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Report of Analysis

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TW12-04936

Analysis	Unit	TW12-04936.001 GCS01_0.15-0.5 SOIL	TW12-04936.003 GCS02_0.25-3.0 SOIL	TW12-04936.005 GCS03_0.25-3.0 SOIL	TW12-04936.006 GCS04_0-0.3 SOIL
Exchangeable Calcium Percent	%	91.5	91.9	70.7	94.2
Exchangeable Magnesium	meq/100g	1.33	1.22	2.65	0.86
Exchangeable Magnesium Percent	%	5.9	5.7	9.9	3.5
Exchangeable Aluminium	meq/100g	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Exchangeable Aluminium Percent	%	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Calcium/Magnesium Ratio		15.60	16.15	7.14	26.95
WET CHEMISTRY					
Phosphorus	mg/kg	811	301	277	580
Sulphur	mg/kg	1130	1560	1730	944
OTHER					
Phosphorus Buffer Index		92.7	615.0	87.6	210.4
P Sorption Index		22	24	23	20
As Received Moisture	%	10.8	22.1	18.9	7.9
PHYSICAL TESTS					
Calcium Chloride treated Category		1	1	1	1
Water treated Category		3	3	2	3
Large Particles <20mm >10mm	%	7.5	6.1	2.1	0.5
Large Particles >20mm	%	0.8	<0.1	<0.1	<0.1
Bulk Density	kg/L	1	1	1	1
Subcontracted Analysis					
Field Capacity	%	15.8	13.4	24.0	12.3
Wilting Point	%	6.4	4.3	11.2	5.8
Water at Saturation	%	33.8	36.4	39.3	43.0

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TW12-04936

Analysis	Unit	TW12-04936.007 GCS05_0.2-0.6 SOIL	TW12-04936.009 QAGC_1 SOIL		
Organic Nitrogen	mg/kg	830	730		
ACIDITY					
pH - Water	pH units	9.18	9.20		
MAJOR ELEMENTS					
Ammonium Nitrogen	mg/kg	1.0	1.0		
Nitrate + Nitrite	mg/kg	6	5		
Nitrate Nitrogen	mg/kg	5	5		
Nitrite Nitrogen	mg/kg	<1	<1		
Potassium	mg/kg	11	5		
Phosphorus - Colwell extr	mg/kg	9	7		
Nitrogen	mg/kg	833	739		
Total Kjeldahl Nitrogen	mg/kg	827	734		
SECONDARY ELEMENTS					
Calcium Carbonate	%	95	94		
Calcium	mg/kg	4090	4090		
Magnesium	mg/kg	162	149		
TRACE ELEMENTS					
Copper	mg/kg	<0.1	<0.1		
Zinc	mg/kg	0.7	0.3		
Manganese	mg/kg	<1	<1		
Iron	mg/kg	2.0	2.0		
Boron	mg/kg	0.6	0.4		
ORGANIC MATTER					
Organic Carbon	%	0.4	0.4		
SALINITY					
Chloride	mg/kg	29	27		
Electrical Conductivity	dS/m	0.10	0.09		
Sodium	mg/kg	94	93		
Total Soluble Salts	%	0.03	0.03		
EXCHANGEABLE CATIONS					
Cation Exchange	meq/100g	22.3	22.1		
Exchangeable Sodium	meq/100g	0.41	0.40		
Exchangeable Sodium Percent	%	1.8	1.8		
Exchangeable Potassium	meq/100g	0.03	0.01		
Exchangeable Potassium Percent	%	0.1	<0.1		
Exchangeable Calcium	meq/100g	20.5	20.5		
Exchangeable Calcium Percent	%	92.0	92.5		
Exchangeable Magnesium	meq/100g	1.35	1.24		
Exchangeable Magnesium Percent	%	6.0	5.6		
Exchangeable Aluminium	meq/100g	Not Applicable	Not Applicable		
Exchangeable Aluminium Percent	%	Not Applicable	Not Applicable		
Calcium/Magnesium Ratio		15.20	16.51		
WET CHEMISTRY					

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Report of Analysis

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TW12-04936

Analysis	Unit	TW12-04936.007 GCS05_0.2-0.6 SOIL	TW12-04936.009 QAGC_1 SOIL		
Phosphorus	mg/kg	299	289		
Sulphur	mg/kg	1130	1070		
OTHER					
Phosphorus Buffer Index		114.1	112.0		
P Sorption Index		26	26		
As Received Moisture	%	13.9	13.1		
PHYSICAL TESTS					
Calcium Chloride treated Category		1	1		
Water treated Category		3	3		
Large Particles <20mm >10mm	%	2.3	5.3		
Large Particles >20mm	%	<0.1	<0.1		
Bulk Density	kg/L	1	1		
Subcontracted Analysis					
Field Capacity	%	11.6	9.6		
Wilting Point	%	4.7	4.3		
Water at Saturation	%	37.6	37.3		

Results are on an 'air dried' basis.

Analysed Between 06/06/2012 - 26/06/2012

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Method of Analysis			
Analysis	Unit	Det.Lim.	Method
Phosphorus	mg/kg	10	MIN001
Sulphur	mg/kg	10	MIN001
Copper	mg/kg	0.1	SOL001/9/10/12
Zinc	mg/kg	0.1	SOL001/9/10/12
Manganese	mg/kg	1.0	SOL001/9/10/12
Iron	mg/kg	1.0	SOL001/9/10/12
Boron	mg/kg	0.2	SOL001/13
Ammonium Nitrogen	mg/kg	0.05	SOL030
Chloride	mg/kg	1	SOL030
Nitrate + Nitrite	mg/kg	1	SOL030
Nitrate Nitrogen	mg/kg	1	SOL030
Nitrite Nitrogen	mg/kg	1	SOL030
pH - Water	pH units	0.01	SOL003/SOL001/2
Electrical Conductivity	dS/m	0.01	SOL003/SOL001/2
Calcium Carbonate	%	1	SOL004
Sodium	mg/kg	1	SOL044
Potassium	mg/kg	1	SOL044
Calcium	mg/kg	1	SOL044
Magnesium	mg/kg	1	SOL044
Cation Exchange	meq/100g	0.01	SOL044
Exchangeable Sodium	meq/100g	0.01	SOL044
Exchangeable Sodium Percent	%	0.1	SOL044
Exchangeable Potassium	meq/100g	0.01	SOL044
Exchangeable Potassium Percent	%	0.1	SOL044
Exchangeable Calcium	meq/100g	0.01	SOL044
Exchangeable Calcium Percent	%	0.1	SOL044
Exchangeable Magnesium	meq/100g	0.01	SOL044
Exchangeable Magnesium Percent	%	0.1	SOL044
Exchangeable Aluminium	meq/100g	0.01	SOL044
Exchangeable Aluminium Percent	%	0.1	SOL044
Calcium/Magnesium Ratio		0.01	SOL044
Organic Carbon	%	0.3	CAR002/SOL002/1
Phosphorus - Colwell extr	mg/kg	1	SOL005/001/4
Phosphorus Buffer Index		0.1	SOL014
P Sorption Index		1	SOL026
Calcium Chloride treated Category			AS4419-2003 Appendix G
Water treated Category			AS4419-2003 Appendix G

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TW12-04936

Field Capacity	%	0.1	
Wilting Point	%	0.1	
Water at Saturation	%	0.1	
Large Particles <20mm >10mm	%	0.1	
Large Particles >20mm	%	0.1	
Nitrogen	mg/kg	300	PRN002
Organic Nitrogen	mg/kg	1	PRN001/SOL030
Total Kjeldahl Nitrogen	mg/kg	1	
As Received Moisture	%	0.1	
Bulk Density	kg/L		SOL029
Total Soluble Salts	%	0.01	SOL003/SOL001/2

The analyses presented in the report refer exclusively to the samples analysed.

The presented report can only be reproduced in its entirety.



Keegan Roache - PSW Section Manager

For and on behalf of SGS Australia Pty Ltd

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Report of Analysis

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TW12-04936

Client:

GHD PTY LTD
PO BOX 3106
ADELAIDE TERRACE
PERTH WA 6832

Order Number: 3128991
Report Date: 16-August-2012
Received Date: 06-June-2012

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Analysis	Unit	TW12-04936.001 GCS01_0.15-0.5 SOIL	TW12-04936.003 GCS02_0.25-3.0 SOIL	TW12-04936.005 GCS03_0.25-3.0 SOIL	TW12-04936.006 GCS04_0-0.3 SOIL
Organic Nitrogen	mg/kg	720	650	710	960
ACIDITY					
pH - Water	pH units	8.69	9.40	9.27	8.57
MAJOR ELEMENTS					
Ammonium Nitrogen	mg/kg	1.0	0.75	0.80	1.5
Nitrate + Nitrite	mg/kg	15	4	1	2
Nitrate Nitrogen	mg/kg	15	4	1	2
Nitrite Nitrogen	mg/kg	<1	<1	<1	<1
Potassium	mg/kg	15	6	55	18
Phosphorus - Colwell extr	mg/kg	19	8	6	33
Nitrogen	mg/kg	738	654	716	966
Total Kjeldahl Nitrogen	mg/kg	723	650	715	964
SECONDARY ELEMENTS					
Calcium Carbonate	%	82	97	96	87
Calcium	mg/kg	4150	3950	3790	4650
Magnesium	mg/kg	160	147	319	104
TRACE ELEMENTS					
Copper	mg/kg	<0.1	<0.1	<0.1	0.1
Zinc	mg/kg	0.5	0.6	0.3	0.7
Manganese	mg/kg	<1.0	<1.0	<1.0	<1.0
Iron	mg/kg	7.9	1.5	3.2	7.2
Boron	mg/kg	2.0	0.4	1.2	0.8
ORGANIC MATTER					
Organic Carbon	%	1.4	<0.3	<0.3	1.9
SALINITY					
Chloride	mg/kg	110	140	3000	69
Electrical Conductivity	dS/m	0.17	0.14	1.81	0.13
Sodium	mg/kg	129	115	1160	123
Total Soluble Salts	%	0.06	0.05	0.62	0.04
EXCHANGEABLE CATIONS					
Cation Exchange	meq/100g	22.7	21.5	26.8	24.7
Exchangeable Sodium	meq/100g	0.56	0.50	5.06	0.54
Exchangeable Sodium Percent	%	2.5	2.3	18.9	2.2
Exchangeable Potassium	meq/100g	0.04	0.01	0.14	0.05
Exchangeable Potassium Percent	%	0.2	<0.1	0.5	0.2
Exchangeable Calcium	meq/100g	20.8	19.7	19.0	23.3

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Report of Analysis

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TW12-04936

Analysis	Unit	TW12-04936.001 GCS01_0.15-0.5 SOIL	TW12-04936.003 GCS02_0.25-3.0 SOIL	TW12-04936.005 GCS03_0.25-3.0 SOIL	TW12-04936.006 GCS04_0-0.3 SOIL
Exchangeable Calcium Percent	%	91.5	91.9	70.7	94.2
Exchangeable Magnesium	meq/100g	1.33	1.22	2.65	0.86
Exchangeable Magnesium Percent	%	5.9	5.7	9.9	3.5
Exchangeable Aluminium	meq/100g	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Exchangeable Aluminium Percent	%	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Calcium/Magnesium Ratio		15.60	16.15	7.14	26.95
WET CHEMISTRY					
Phosphorus	mg/kg	811	301	277	580
Sulphur	mg/kg	1130	1560	1730	944
OTHER					
Phosphorus Buffer Index		92.7	615.0	87.6	210.4
P Sorption Index		22	24	23	20
Air Dry Moisture	%	0.7	0.4	0.5	1.0
PHYSICAL TESTS					
Calcium Chloride treated Category		1	1	1	1
Water treated Category		3	3	2	3
Large Particles <20mm >10mm	%	7.5	6.1	2.1	0.5
Large Particles >20mm	%	0.8	<0.1	<0.1	<0.1
Bulk Density	g/L	1200	1000	1000	1200
Subcontracted Analysis					
Field Capacity	%	15.8	13.4	24.0	12.3
Wilting Point	%	6.4	4.3	11.2	5.8
Water at Saturation	%	33.8	36.4	39.3	43.0

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TW12-04936

Analysis	Unit	TW12-04936.007 GCS05_0.2-0.6 SOIL	TW12-04936.009 QAGC_1 SOIL		
Organic Nitrogen	mg/kg	830	730		
ACIDITY					
pH - Water	pH units	9.18	9.20		
MAJOR ELEMENTS					
Ammonium Nitrogen	mg/kg	1.0	1.0		
Nitrate + Nitrite	mg/kg	6	5		
Nitrate Nitrogen	mg/kg	5	5		
Nitrite Nitrogen	mg/kg	<1	<1		
Potassium	mg/kg	11	5		
Phosphorus - Colwell extr	mg/kg	9	7		
Nitrogen	mg/kg	833	739		
Total Kjeldahl Nitrogen	mg/kg	827	734		
SECONDARY ELEMENTS					
Calcium Carbonate	%	95	94		
Calcium	mg/kg	4090	4090		
Magnesium	mg/kg	162	149		
TRACE ELEMENTS					
Copper	mg/kg	<0.1	<0.1		
Zinc	mg/kg	0.7	0.3		
Manganese	mg/kg	<1.0	<1.0		
Iron	mg/kg	2.0	2.0		
Boron	mg/kg	0.6	0.4		
ORGANIC MATTER					
Organic Carbon	%	0.4	0.4		
SALINITY					
Chloride	mg/kg	29	27		
Electrical Conductivity	dS/m	0.10	0.09		
Sodium	mg/kg	94	93		
Total Soluble Salts	%	0.03	0.03		
EXCHANGEABLE CATIONS					
Cation Exchange	meq/100g	22.3	22.1		
Exchangeable Sodium	meq/100g	0.41	0.40		
Exchangeable Sodium Percent	%	1.8	1.8		
Exchangeable Potassium	meq/100g	0.03	0.01		
Exchangeable Potassium Percent	%	0.1	<0.1		
Exchangeable Calcium	meq/100g	20.5	20.5		
Exchangeable Calcium Percent	%	92.0	92.5		
Exchangeable Magnesium	meq/100g	1.35	1.24		
Exchangeable Magnesium Percent	%	6.0	5.6		
Exchangeable Aluminium	meq/100g	Not Applicable	Not Applicable		
Exchangeable Aluminium Percent	%	Not Applicable	Not Applicable		
Calcium/Magnesium Ratio		15.20	16.51		
WET CHEMISTRY					

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TW12-04936

Analysis	Unit	TW12-04936.007 GCS05_0.2-0.6 SOIL	TW12-04936.009 QAGC_1 SOIL		
Phosphorus	mg/kg	299	289		
Sulphur	mg/kg	1130	1070		
OTHER					
Phosphorus Buffer Index		114.1	112.0		
P Sorption Index		26	26		
Air Dry Moisture	%	0.5	0.5		
PHYSICAL TESTS					
Calcium Chloride treated Category		1	1		
Water treated Category		3	3		
Large Particles <20mm >10mm	%	2.3	5.3		
Large Particles >20mm	%	<0.1	<0.1		
Bulk Density	g/L	1100	1100		
Subcontracted Analysis					
Field Capacity	%	11.6	9.6		
Wilting Point	%	4.7	4.3		
Water at Saturation	%	37.6	37.3		

Results are on an 'air dried' basis.

Analysed Between 06/06/2012 - 16/08/2012

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Method of Analysis			
Analysis	Unit	Det.Lim.	Method
Phosphorus	mg/kg	10	MIN001
Sulphur	mg/kg	10	MIN001
Copper	mg/kg	0.1	SOL001/9/10/12
Zinc	mg/kg	0.1	SOL001/9/10/12
Manganese	mg/kg	1.0	SOL001/9/10/12
Iron	mg/kg	1.0	SOL001/9/10/12
Boron	mg/kg	0.2	SOL001/13
Ammonium Nitrogen	mg/kg	0.05	SOL030
Chloride	mg/kg	1	SOL030
Nitrate + Nitrite	mg/kg	1	SOL030
Nitrate Nitrogen	mg/kg	1	SOL030
Nitrite Nitrogen	mg/kg	1	SOL030
pH - Water	pH units	0.01	SOL003/SOL001/2
Electrical Conductivity	dS/m	0.01	SOL003/SOL001/2
Calcium Carbonate	%	1	SOL004
Sodium	mg/kg	1	SOL044
Potassium	mg/kg	1	SOL044
Calcium	mg/kg	1	SOL044
Magnesium	mg/kg	1	SOL044
Cation Exchange	meq/100g	0.01	SOL044
Exchangeable Sodium	meq/100g	0.01	SOL044
Exchangeable Sodium Percent	%	0.1	SOL044
Exchangeable Potassium	meq/100g	0.01	SOL044
Exchangeable Potassium Percent	%	0.1	SOL044
Exchangeable Calcium	meq/100g	0.01	SOL044
Exchangeable Calcium Percent	%	0.1	SOL044
Exchangeable Magnesium	meq/100g	0.01	SOL044
Exchangeable Magnesium Percent	%	0.1	SOL044
Exchangeable Aluminium	meq/100g	0.01	SOL044
Exchangeable Aluminium Percent	%	0.1	SOL044
Calcium/Magnesium Ratio		0.01	SOL044
Organic Carbon	%	0.3	CAR002/SOL002/1
Phosphorus - Colwell extr	mg/kg	1	SOL005/001/4
Phosphorus Buffer Index		0.1	SOL014
P Sorption Index		1	SOL026
Calcium Chloride treated Category			AS4419-2003 Appendix G
Water treated Category			AS4419-2003 Appendix G

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TW12-04936

Field Capacity	%	0.1	
Wilting Point	%	0.1	
Water at Saturation	%	0.1	
Large Particles <20mm >10mm	%	0.1	
Large Particles >20mm	%	0.1	
Nitrogen	mg/kg	300	PRN002
Organic Nitrogen	mg/kg	1	PRN001/SOL030
Total Kjeldahl Nitrogen	mg/kg	1	
Total Soluble Salts	%	0.01	SOL003/SOL001/2
Bulk Density	g/L		SOL029
Air Dry Moisture	%	0.1	

The analyses presented in the report refer exclusively to the samples analysed.

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Keegan Roache - PSW Section Manager

For and on behalf of SGS Australia Pty Ltd

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Report of Analysis

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TW12-04936

Client:

GHD PTY LTD
PO BOX 3106
ADELAIDE TERRACE
PERTH WA 6832

Order Number: 3128991
Report Date: 04-July-2012
Received Date: 06-June-2012

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Analysis	Unit	TW12-04936.001 GCS01_0.15-0.5 SOIL	TW12-04936.003 GCS02_0.25-3.0 SOIL	TW12-04936.005 GCS03_0.25-3.0 SOIL	TW12-04936.006 GCS04_0-0.3 SOIL
Organic Nitrogen	mg/kg	720	650	710	960
ACIDITY					
pH - Water	pH units	8.69	9.40	9.27	8.57
MAJOR ELEMENTS					
Ammonium Nitrogen	mg/kg	1.0	0.75	0.80	1.5
Nitrate + Nitrite	mg/kg	15	4	1	2
Nitrate Nitrogen	mg/kg	15	4	1	2
Nitrite Nitrogen	mg/kg	<1	<1	<1	<1
Potassium	mg/kg	15	6	55	18
Phosphorus - Colwell extr	mg/kg	19	8	6	33
Nitrogen	mg/kg	738	654	716	966
Total Kjeldahl Nitrogen	mg/kg	723	650	715	964
SECONDARY ELEMENTS					
Calcium Carbonate	%	82	97	96	87
Calcium	mg/kg	4150	3950	3790	4650
Magnesium	mg/kg	160	147	319	104
TRACE ELEMENTS					
Copper	mg/kg	<0.1	<0.1	<0.1	0.1
Zinc	mg/kg	0.5	0.6	0.3	0.7
Manganese	mg/kg	<1	<1	<1	<1
Iron	mg/kg	7.9	1.5	3.2	7.2
Boron	mg/kg	2.0	0.4	1.2	0.8
ORGANIC MATTER					
Organic Carbon	%	1.4	<0.3	<0.3	1.9
SALINITY					
Chloride	mg/kg	110	140	3000	69
Electrical Conductivity	dS/m	0.17	0.14	1.81	0.13
Sodium	mg/kg	129	115	1160	123
Total Soluble Salts	%	0.06	0.05	0.62	0.04
EXCHANGEABLE CATIONS					
Cation Exchange	meq/100g	22.7	21.5	26.8	24.7
Exchangeable Sodium	meq/100g	0.56	0.50	5.06	0.54
Exchangeable Sodium Percent	%	2.5	2.3	18.9	2.2
Exchangeable Potassium	meq/100g	0.04	0.01	0.14	0.05
Exchangeable Potassium Percent	%	0.2	<0.1	0.5	0.2
Exchangeable Calcium	meq/100g	20.8	19.7	19.0	23.3

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TW12-04936

Analysis	Unit	TW12-04936.001 GCS01_0.15-0.5 SOIL	TW12-04936.003 GCS02_0.25-3.0 SOIL	TW12-04936.005 GCS03_0.25-3.0 SOIL	TW12-04936.006 GCS04_0-0.3 SOIL
Exchangeable Calcium Percent	%	91.5	91.9	70.7	94.2
Exchangeable Magnesium	meq/100g	1.33	1.22	2.65	0.86
Exchangeable Magnesium Percent	%	5.9	5.7	9.9	3.5
Exchangeable Aluminium	meq/100g	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Exchangeable Aluminium Percent	%	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Calcium/Magnesium Ratio		15.60	16.15	7.14	26.95
WET CHEMISTRY					
Phosphorus	mg/kg	811	301	277	580
Sulphur	mg/kg	1130	1560	1730	944
OTHER					
Phosphorus Buffer Index		92.7	615.0	87.6	210.4
P Sorption Index		22	24	23	20
Air Dry Moisture	%	0.7	0.4	0.5	1.0
PHYSICAL TESTS					
Calcium Chloride treated Category		1	1	1	1
Water treated Category		3	3	2	3
Large Particles <20mm >10mm	%	7.5	6.1	2.1	0.5
Large Particles >20mm	%	0.8	<0.1	<0.1	<0.1
Bulk Density	kg/L	1	1	1	1
Subcontracted Analysis					
Field Capacity	%	15.8	13.4	24.0	12.3
Wilting Point	%	6.4	4.3	11.2	5.8
Water at Saturation	%	33.8	36.4	39.3	43.0

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TW12-04936

Analysis	Unit	TW12-04936.007 GCS05_0.2-0.6 SOIL	TW12-04936.009 QAGC_1 SOIL		
Organic Nitrogen	mg/kg	830	730		
ACIDITY					
pH - Water	pH units	9.18	9.20		
MAJOR ELEMENTS					
Ammonium Nitrogen	mg/kg	1.0	1.0		
Nitrate + Nitrite	mg/kg	6	5		
Nitrate Nitrogen	mg/kg	5	5		
Nitrite Nitrogen	mg/kg	<1	<1		
Potassium	mg/kg	11	5		
Phosphorus - Colwell extr	mg/kg	9	7		
Nitrogen	mg/kg	833	739		
Total Kjeldahl Nitrogen	mg/kg	827	734		
SECONDARY ELEMENTS					
Calcium Carbonate	%	95	94		
Calcium	mg/kg	4090	4090		
Magnesium	mg/kg	162	149		
TRACE ELEMENTS					
Copper	mg/kg	<0.1	<0.1		
Zinc	mg/kg	0.7	0.3		
Manganese	mg/kg	<1	<1		
Iron	mg/kg	2.0	2.0		
Boron	mg/kg	0.6	0.4		
ORGANIC MATTER					
Organic Carbon	%	0.4	0.4		
SALINITY					
Chloride	mg/kg	29	27		
Electrical Conductivity	dS/m	0.10	0.09		
Sodium	mg/kg	94	93		
Total Soluble Salts	%	0.03	0.03		
EXCHANGEABLE CATIONS					
Cation Exchange	meq/100g	22.3	22.1		
Exchangeable Sodium	meq/100g	0.41	0.40		
Exchangeable Sodium Percent	%	1.8	1.8		
Exchangeable Potassium	meq/100g	0.03	0.01		
Exchangeable Potassium Percent	%	0.1	<0.1		
Exchangeable Calcium	meq/100g	20.5	20.5		
Exchangeable Calcium Percent	%	92.0	92.5		
Exchangeable Magnesium	meq/100g	1.35	1.24		
Exchangeable Magnesium Percent	%	6.0	5.6		
Exchangeable Aluminium	meq/100g	Not Applicable	Not Applicable		
Exchangeable Aluminium Percent	%	Not Applicable	Not Applicable		
Calcium/Magnesium Ratio		15.20	16.51		
WET CHEMISTRY					

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TW12-04936

Analysis	Unit	TW12-04936.007 GCS05_0.2-0.6 SOIL	TW12-04936.009 QAGC_1 SOIL		
Phosphorus	mg/kg	299	289		
Sulphur	mg/kg	1130	1070		
OTHER					
Phosphorus Buffer Index		114.1	112.0		
P Sorption Index		26	26		
Air Dry Moisture	%	0.5	0.5		
PHYSICAL TESTS					
Calcium Chloride treated Category		1	1		
Water treated Category		3	3		
Large Particles <20mm >10mm	%	2.3	5.3		
Large Particles >20mm	%	<0.1	<0.1		
Bulk Density	kg/L	1	1		
Subcontracted Analysis					
Field Capacity	%	11.6	9.6		
Wilting Point	%	4.7	4.3		
Water at Saturation	%	37.6	37.3		

Results are on an 'air dried' basis.

Analysed Between 06/06/2012 - 04/07/2012

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Method of Analysis			
Analysis	Unit	Det.Lim.	Method
Phosphorus	mg/kg	10	MIN001
Sulphur	mg/kg	10	MIN001
Copper	mg/kg	0.1	SOL001/9/10/12
Zinc	mg/kg	0.1	SOL001/9/10/12
Manganese	mg/kg	1.0	SOL001/9/10/12
Iron	mg/kg	1.0	SOL001/9/10/12
Boron	mg/kg	0.2	SOL001/13
Ammonium Nitrogen	mg/kg	0.05	SOL030
Chloride	mg/kg	1	SOL030
Nitrate + Nitrite	mg/kg	1	SOL030
Nitrate Nitrogen	mg/kg	1	SOL030
Nitrite Nitrogen	mg/kg	1	SOL030
pH - Water	pH units	0.01	SOL003/SOL001/2
Electrical Conductivity	dS/m	0.01	SOL003/SOL001/2
Calcium Carbonate	%	1	SOL004
Sodium	mg/kg	1	SOL044
Potassium	mg/kg	1	SOL044
Calcium	mg/kg	1	SOL044
Magnesium	mg/kg	1	SOL044
Cation Exchange	meq/100g	0.01	SOL044
Exchangeable Sodium	meq/100g	0.01	SOL044
Exchangeable Sodium Percent	%	0.1	SOL044
Exchangeable Potassium	meq/100g	0.01	SOL044
Exchangeable Potassium Percent	%	0.1	SOL044
Exchangeable Calcium	meq/100g	0.01	SOL044
Exchangeable Calcium Percent	%	0.1	SOL044
Exchangeable Magnesium	meq/100g	0.01	SOL044
Exchangeable Magnesium Percent	%	0.1	SOL044
Exchangeable Aluminium	meq/100g	0.01	SOL044
Exchangeable Aluminium Percent	%	0.1	SOL044
Calcium/Magnesium Ratio		0.01	SOL044
Organic Carbon	%	0.3	CAR002/SOL002/1
Phosphorus - Colwell extr	mg/kg	1	SOL005/001/4
Phosphorus Buffer Index		0.1	SOL014
P Sorption Index		1	SOL026
Calcium Chloride treated Category			AS4419-2003 Appendix G
Water treated Category			AS4419-2003 Appendix G

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TW12-04936

Field Capacity	%	0.1	
Wilting Point	%	0.1	
Water at Saturation	%	0.1	
Large Particles <20mm >10mm	%	0.1	
Large Particles >20mm	%	0.1	
Nitrogen	mg/kg	300	PRN002
Organic Nitrogen	mg/kg	1	PRN001/SOL030
Total Kjeldahl Nitrogen	mg/kg	1	
Total Soluble Salts	%	0.01	SOL003/SOL001/2
Bulk Density	kg/L		SOL029
Air Dry Moisture	%	0.1	

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Keegan Roache - PSW Section Manager

For and on behalf of SGS Australia Pty Ltd

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P ISOTHERM RESULTS

Client: GHD
 Laboratory No: TW12-04936.001

Marking: GCS01_0.15-0.5

Colwell P mg/kg 18.59

P Sorbed = a x Equilibrium P Conc.^b

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
25	2.15035	2.5	0.215	41.44	50.30
50	3.55212	5	0.355	65.04	61.34
100	10.5937	10	1.059	108.00	94.48
250	61.3233	25	6.132	207.27	189.16
500	201.976	50	20.198	316.61	303.04
750	383.437	75	38.344	385.15	390.45
1000	604.129	100	60.413	414.46	467.33

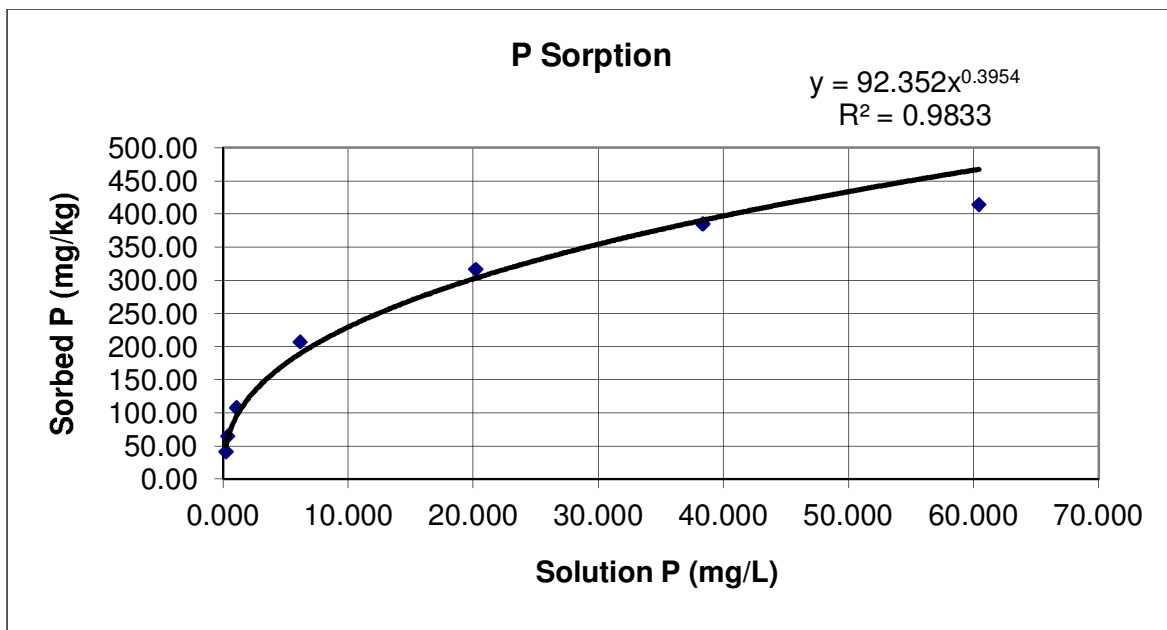
a	92.352
b	0.395
R ²	0.983

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
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P Sorbed mg/kg Estimated

70	92	174	230	302	434
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P ISOTHERM RESULTS

Client: GHD
 Laboratory No: TW12-04936.003

Marking: GCS02_0.25-3.0

Colwell P mg/kg	7.64
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$$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$$

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
25	0.823498	2.5	0.082	31.82	32.82
50	2.07796	5	0.208	55.56	51.00
100	7.46967	10	0.747	100.17	93.79
250	61.4931	25	6.149	196.15	255.95
500	159.083	50	15.908	348.56	402.47
750	218.48	75	21.848	539.16	468.11
1000	338.718	100	33.872	668.92	576.81

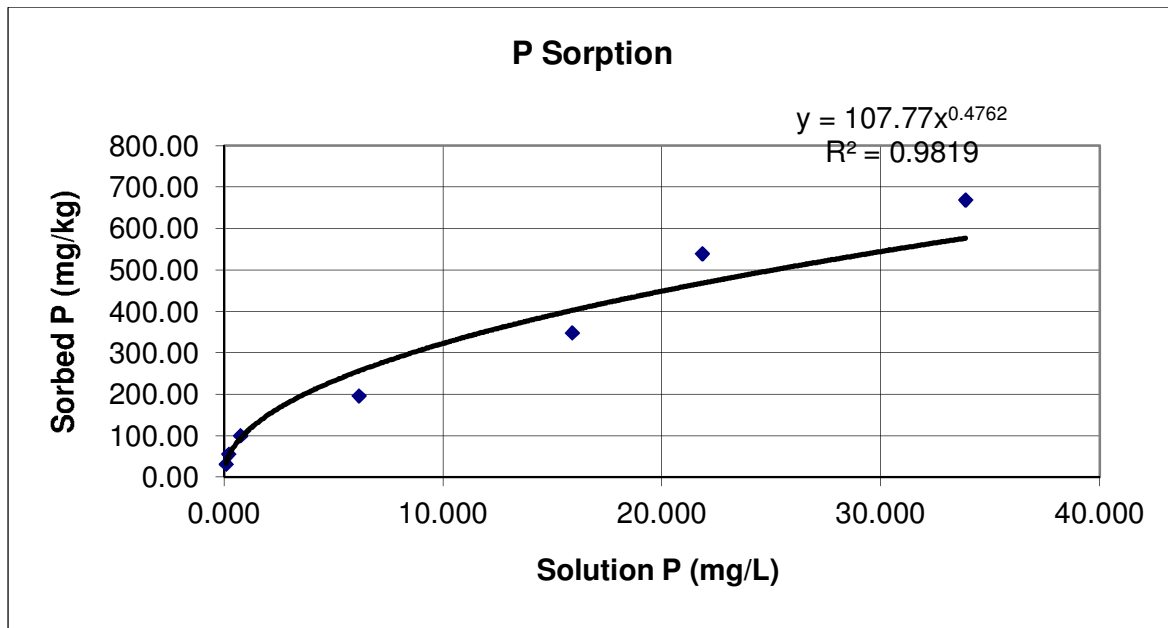
a	107.771
b	0.476
R ²	0.982

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
-----	---	---	----	----	----

P Sorbed mg/kg Estimated

77	108	232	323	449	694
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P ISOTHERM RESULTS

Client: GHD
 Laboratory No: TW12-04936.005

Marking: GCS03_0.25-3.0

Colwell P mg/kg 5.54

$$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$$

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
25	0.677287	2.5	0.068	29.86	36.30
50	1.49747	5	0.150	54.04	48.12
100	7.34465	10	0.734	98.20	84.68
250	63.8345	25	6.383	191.71	182.62
500	242.561	50	24.256	262.98	293.49
750	439.324	75	43.932	316.22	362.47
1000	557.009	100	55.701	448.53	394.38

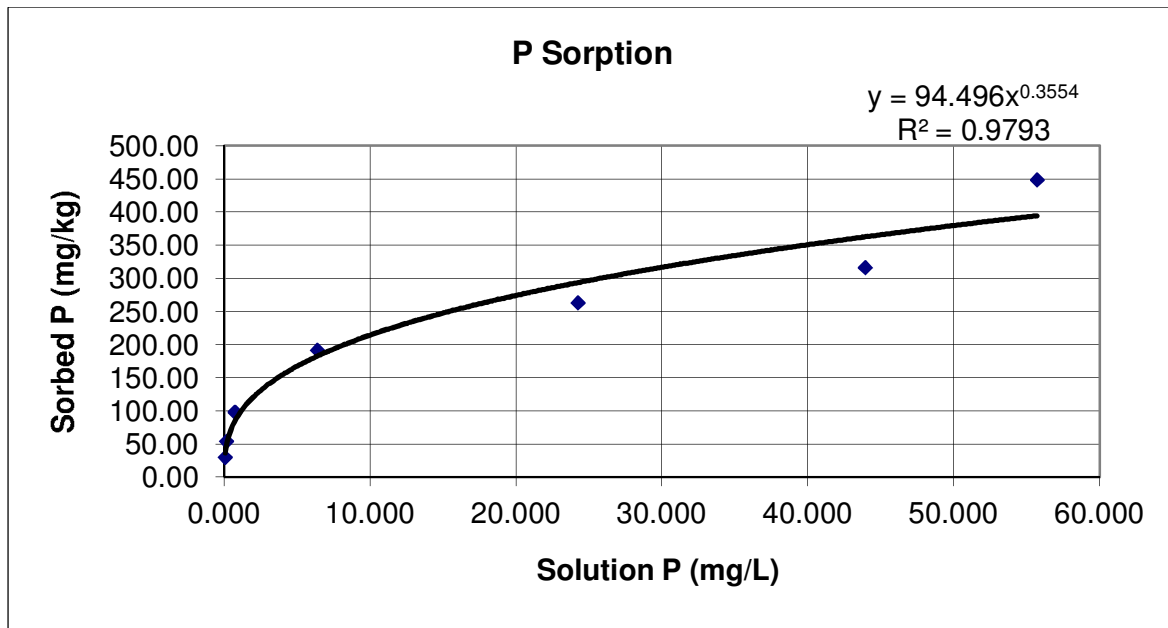
a	94.496
b	0.355
R ²	0.979

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
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P Sorbed mg/kg Estimated

74	94	167	214	274	380
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P ISOTHERM RESULTS

Client: GHD
 Laboratory No: TW12-04936.006

Marking: GCS04_0-0.3

Colwell P mg/kg	32.58
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$$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$$

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
25	1.97194	2.5	0.197	55.61	57.81
50	4.70545	5	0.471	77.87	77.97
100	13.9758	10	1.398	118.60	113.37
250	74.8155	25	7.482	207.76	201.87
500	232.771	50	23.277	299.81	298.25
750	423.487	75	42.349	359.09	366.40
1000	622.178	100	62.218	410.40	418.23

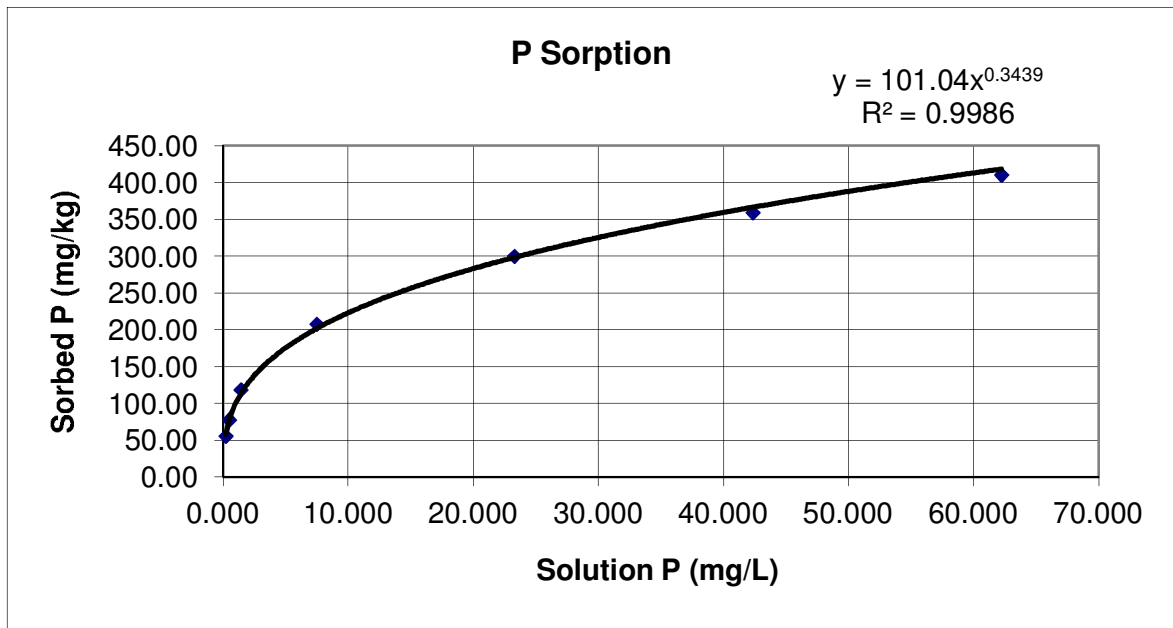
a	101.043
b	0.344
R ²	0.999

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
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P Sorbed mg/kg Estimated

80	101	176	223	283	388
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P ISOTHERM RESULTS

Client: GHD
 Laboratory No: TW12-04936.007

Marking: GCS05_0.2-0.6

Colwell P mg/kg 9.14

$$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$$

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
25	1.22147	2.5	0.122	32.92	41.85
50	2.12388	5	0.212	57.02	51.87
100	7.76559	10	0.777	101.37	85.82
250	56.304	25	5.630	202.84	185.19
500	196.743	50	19.674	312.40	301.02
750	389.069	75	38.907	370.07	392.26
1000	588.543	100	58.854	420.60	460.65

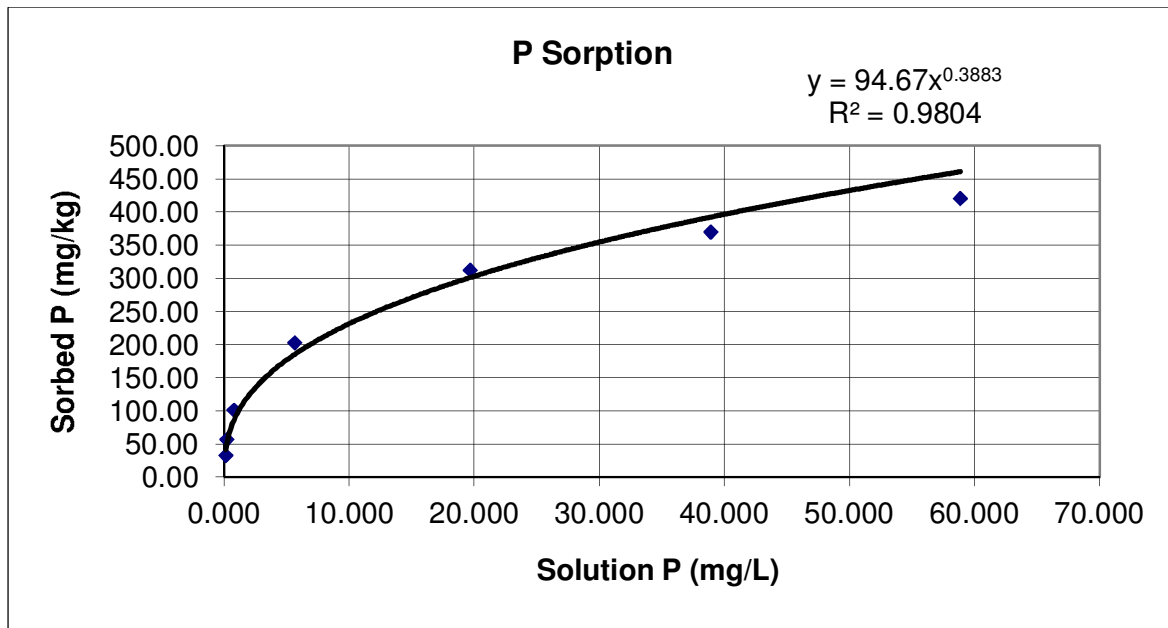
a	94.670
b	0.388
R ²	0.980

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
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P Sorbed mg/kg Estimated

72	95	177	231	303	432
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P ISOTHERM RESULTS

Client: GHD
 Laboratory No: TW12-04936.009

Marking: QAGC_1

Colwell P mg/kg	7.44
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$P \text{ Sorbed} = a \times \text{Equilibrium P Conc.}^b$
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Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
25	1.46833	2.5	0.147	30.97	43.17
50	2.00036	5	0.200	55.44	48.72
100	7.1996	10	0.720	100.24	80.42
250	56.0587	25	5.606	201.38	179.53
500	200.209	50	20.021	307.23	295.44
750	398.256	75	39.826	359.18	386.68
1000	596.689	100	59.669	410.75	452.96

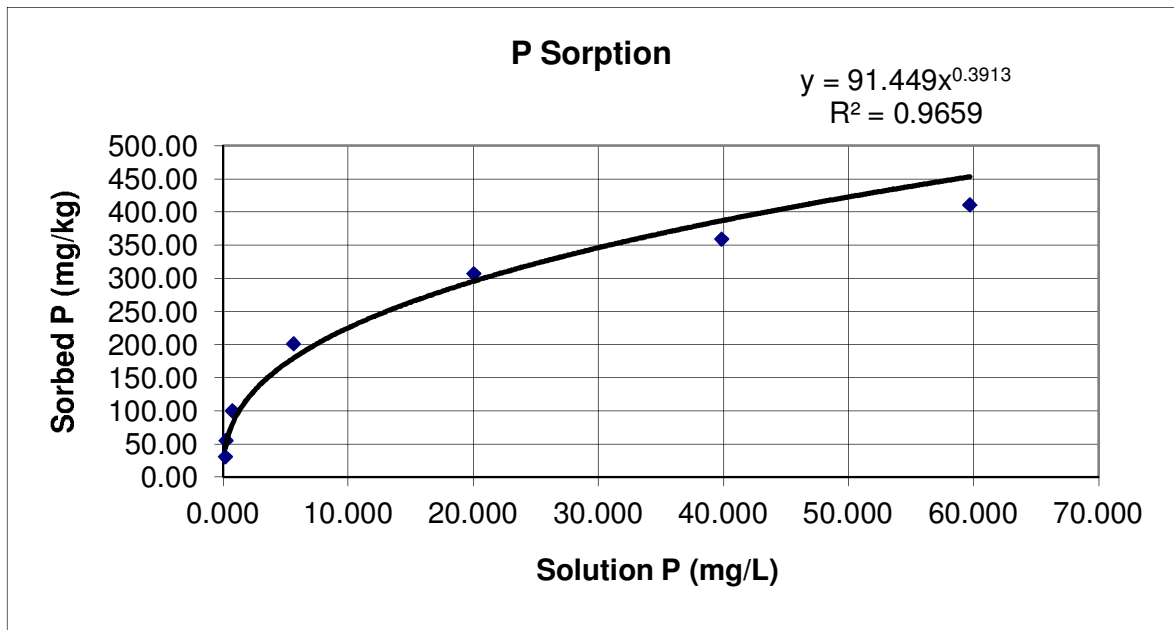
a	91.449
b	0.391
R ²	0.966

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
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P Sorbed mg/kg Estimated

70	91	172	225	295	423
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SAMPLE RECEIPT ADVICE

Laboratory Job N° TW12-04936

Client : GHD PTY LTD
PO BOX 3106
ADELAIDE TERRACE
PERTH WA 6832

Received: 06-Jun-2012

OrderNo : 3128991

Fax: 08 64448403

Email: wayne.schafer@ghd.com

The following samples were received for analysis at our Toowoomba laboratory on the date indicated.

PLEASE CHECK SAMPLE MARKINGS - THESE WILL BE SHOWN ON YOUR REPORT OF ANALYSIS.

If there are any discrepancies please respond to this email and modifications will be made before issuing your results

Estimated reporting date: 14-Jun-2012

Tests:

Moisture and Ash by Leco TGA
Minerals in Solid Sample (MIN001)
Trace Metals in Soil (SOL001/9/10/12)
Boron in Soil (SOL001/13)
NOx, NH4,NO3 and CL by H2O Extract in Soil (SOL030)
Bulk Density of Soil
Calcium Carbonate % in Soil
pH-EC of Soil (SOL003/SOL001/2)
Apparent Exch Cations in Soil by NH4AC (SOL044)
Organic Matter in Soil (Walkley-Black) (CAR002/SOL002/1)
Phosphorus/Potassium by Colwell Extraction in Soil (SOL005/001/4)
Phosphorus Buffer Index of Soil
The Determination and Calculation of P Isotherm of Soils (SOL027)(Add Colwell P)
P Sorption Index of Soil (SOL026)
Dispersibility (AS4419)
Plant Available Water Content
Total Salinity of Water Calculation from EC
Large Particles
Nitrogen in Soil by Leco (PRN002)
Organic Nitrogen in Soil, Fertilizer, Manure

Comments:

Except by special arrangement, samples, if drawn, will not be retained by the Company for more than three months.

We welcome and appreciate your feed back.

SGS Food & Agriculture Laboratory
214 McDougall Street Toowoomba QLD 4350 Tel. (61-7) 4633 0599 Fax (61-7) 4633 0711
SGS Australia Pty. Ltd. trading as SGS Australasia Member of the SGS Group.

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PLEASE CHECK SAMPLE MARKINGS - THESE WILL BE SHOWN ON YOUR REPORT OF ANALYSIS.

If there are any discrepancies please respond to this email and modifications will be made before issuing your results

Estimated reporting date: 14-Jun-2012

Tests:

Total Kjeldahl Nitrogen in Soil

Samples:

Lab Id:	ClientID	Sampled	Product
TW12-04936.001	GCS01_0.15-0.5 SOIL	29/05/12	
TW12-04936.002	GCS01_0.5-1.2 HOLD SOIL	29/05/12	
TW12-04936.003	GCS02_0.25-3.0 SOIL	29/05/12	
TW12-04936.004	GCS03_0-0.25 HOLD SOIL	29/05/12	
TW12-04936.005	GCS03_0.25-3.0 SOIL	29/05/12	
TW12-04936.006	GCS04_0-0.3 SOIL	30/05/12	
TW12-04936.007	GCS05_0.2-0.6 SOIL	30/05/12	
TW12-04936.008	GCS05_1-3 HOLD SOIL	30/05/12	
TW12-04936.009	QAGC_1 SOIL	30/05/12	

Comments:

Except by special arrangement, samples, if drawn, will not be retained by the Company for more than three months.

We welcome and appreciate your feed back.

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SGS Australia Pty. Ltd. trading as SGS Australasia Member of the SGS Group.

D. Laboratory Results Summary Tables

Field ID	GCS04-0.7_2.2	RASS1-0.3-0.6	RASS1-0.9-1.2	RASS2-0.2-0.5	RASS2-1.2-1.5	RASS3-0.2-0.7	RASS3-1.0_1.5	RASS4-0.4_0.6	RASS4-1.0_1.2
LocCode	GCS04	RASS1	RASS1	RASS2	RASS2	RASS3	RASS3	RASS4	RASS4
Sampled Date-Time	30/05/2012	31/05/2012	31/05/2012	31/05/2012	31/05/2012	31/05/2012	31/05/2012	31/05/2012	31/05/2012

Method Name	ChemName	Units	EQL									
EA029-A: pH Measurements	pHKCL	pH Unit	0.1	9.8	9.8	9.8	9.8	9.9	9.9	9.9	9.8	9.9
	pHOX	pH Unit	0.1	8.2	8	8.3	8.3	8.3	8.3	8.3	8.2	8.2
EA029-B: Acidity Trail	s-TAA	% pyrite S	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	s-TPA	% pyrite S	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	s-TSA	% pyrite S	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	TAA	mole H+/t	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	TPA	mole H+/t	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EA029-C: Sulfur Trail	TSA	mole H+/t	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	a-SPOS	mole H+/t	5	63	87	115	57	121	74	123	86	111
	SKCl	% S	0.005	0.01	0.04	0.03	0.03	0.06	0.05	0.1	0.05	0.14
	SP	% S	0.005	0.11	0.18	0.22	0.12	0.26	0.17	0.29	0.19	0.32
EA029-D: Calcium Values	SPOS	% S	0.005	0.1	0.14	0.18	0.09	0.19	0.12	0.2	0.14	0.18
	a-CaA	mole H+/t	5	18,000	13,700	16,200	14,900	16,600	15,200	17,600	14,400	16,300
	CaA	% Ca	0.005	36	27.5	32.5	29.9	33.2	30.5	35.4	29	32.6
	CaKCL	% Ca	0.005	0.21	0.24	0.21	0.22	0.24	0.22	0.24	0.21	0.27
	CaP	% Ca	0.005	36.2	27.7	32.7	30.1	33.5	30.7	35.6	29.2	32.9
EA029-E: Magnesium Values	sCaA	% S	0.005	28.8	22	26	23.9	26.6	24.4	28.3	23.2	26.1
	a-MgA	mole H+/t	5	741	932	1100	651	1210	690	989	881	818
	MgA	% Mg	0.005	0.9	1.13	1.34	0.79	1.47	0.84	1.2	1.07	0.99
	MgKCL	% Mg	0.005	0.04	0.06	0.06	0.06	0.1	0.08	0.1	0.06	0.14
	MgP	% Mg	0.005	0.94	1.2	1.4	0.85	1.57	0.92	1.31	1.13	1.13
EA029-F: Excess Acid Neutralising Capacity	s-MgA	% S	0.005	1.19	1.49	1.76	1.04	1.93	1.11	1.58	1.41	1.31
	a-ANCE	mole H+/t	10	15,900	15,300	15,700	14,800	16,400	15,800	16,300	16,300	15,700
	ANCE	% CaCO3	0.02	79.4	76.6	78.7	74.1	81.8	79.2	81.8	81.4	78.4
	s-ANCE	% S	0.02	25.4	24.5	25.2	23.7	26.2	25.4	26.2	26.1	25.1
EA029-H: Acid Base Accounting	a-NetAcidity	mole H+/t	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	LR	kg CaCO3/t	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	s-NetAcidity	% S	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Liming Rate excluding ANC	kg CaCO3/t	1	5	6	9	4	9	6	9	6	8
	Net Acidity excluding ANC (sulfur units)	% S	0.02	0.1	0.14	0.18	0.09	0.19	0.12	0.2	0.14	0.18

GHD



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		Name	Signature	Name	Signature	Date
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