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SGEO PN 108571

**MARGATE STP GROUNDWATER MONITORING BORE INSTALLATION &
INITIAL MONITORING EVENT: NOVEMBER 2014.**

DRU POINT ESPLANADE, MARGATE.



Drilling MAGW3

CLIENT: TasWater
PREPARED BY: John Sloane
DATE: 31 December 2014

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1 INTRODUCTION

TasWater engaged Sloane Geoscience Pty. Ltd. (SGEO) to install and develop three groundwater monitoring bores for the Margate Sewage Treatment Plant (STP) at Dru Point, Margate. SGEO were also to conduct an initial groundwater monitoring event (GME), sample the two STP lagoons and report on groundwater and effluent analysis results.

SGEO had previously recommended groundwater monitoring bore locations as part of a groundwater monitoring plan (GMP) for the Margate site, reported to TasWater as:

- SGEO PN 105110. *Groundwater Monitoring Plan: Margate Wastewater Treatment Plant.* (25 September 2013)

The GMP, which recommended three monitoring bores (**MAGW1-3**) at locations shown in **Figure 1**, was subsequently approved by the Tasmanian Environment Protection Authority (EPA).

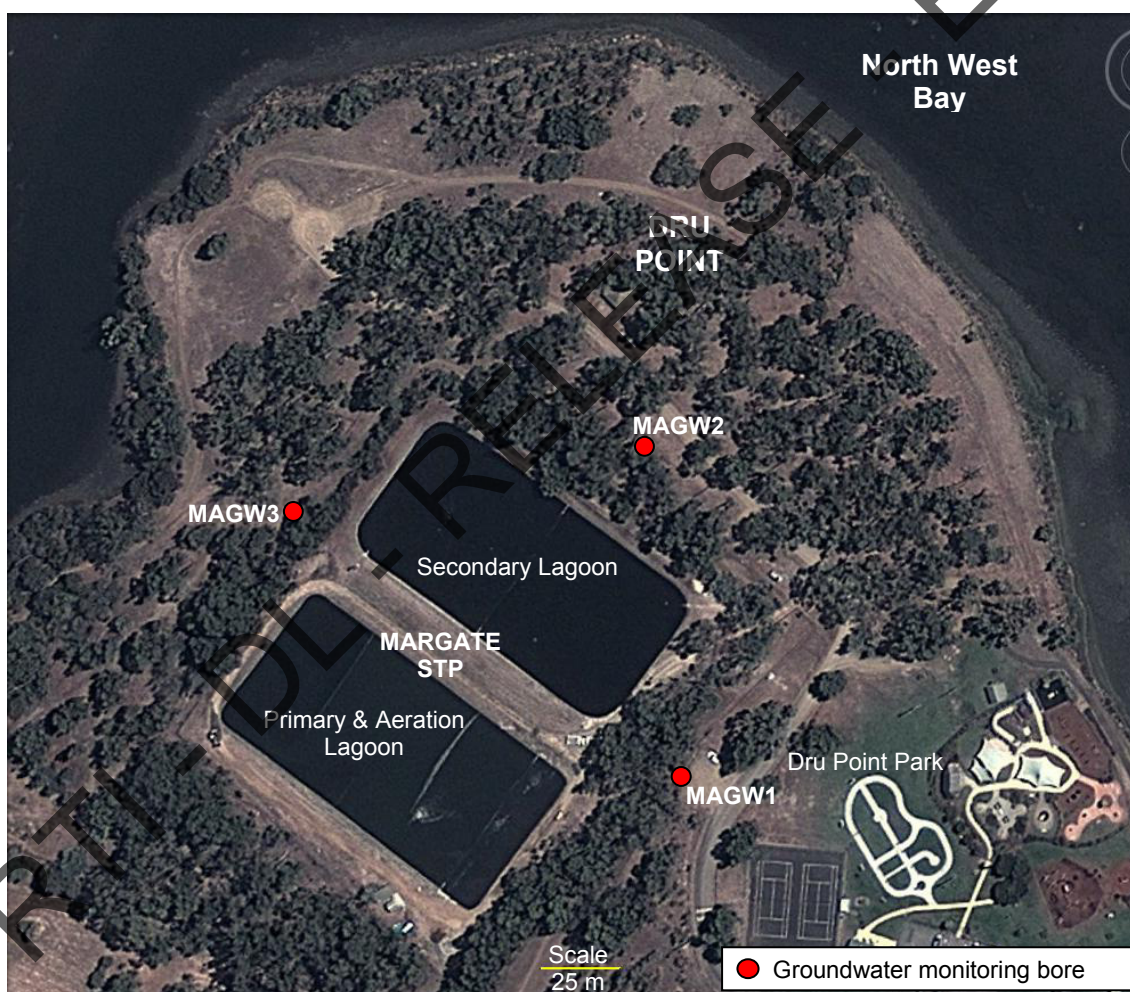


Figure 1: Margate STP groundwater monitoring bore locations.

2 BACKGROUND

2.1 TOPOGRAPHY & DRAINAGE

The Margate STP is located on the Dru Point headland at the northern end of the Esplanade, Margate. The site has an altitude of about 5 m AHD and a total area of about 1.5 ha and consists of an aeration and primary treatment lagoon and a secondary lagoon, each about 0.5 ha in area. The STP is relatively close to North West Bay which surrounds the Dru Point Headland and is about 70-120 m to the north, NE and NW. Surface drainage is indistinct, mainly influenced by a very low overall slope of about 1.5 degrees to the northwest and largely controlled by Dru Point Park access road and track table drains.

2.2 GEOLOGY

Mineral Resources Tasmania Digital Geology 1:25000 information indicates that the STP site is predominantly underlain by Cenozoic (Tertiary-Quaternary) alluvial sediments broadly described as '*Deposits of extremely weathered dolerite and Parmeener clasts, pebble to small boulder size and with clayey matrix*'. There are fringe areas of Tertiary age basalt bedrock on the northern, northwestern and northeastern sides of Dru Point.

2.3 GROUNDWATER

The Department of Primary Industries, Parks, Water and Environment (DPIPWE) Groundwater Information Access Portal (GIAP) indicates that the nearest recorded bore location is about 0.5 km to the SW. Records indicate that the bore was drilled to a depth of 29 m in Permian age mudstone bedrock and had an initial yield of 0.44 L/sec but was capped, presumably due to either an inadequate amount of groundwater for the required purpose or inadequate water quality. The nearest possible aquifer of potential domestic or agricultural importance therefore appears to be within areas underlain by Permian age sedimentary bedrock to the SW.

3 SITE INVESTIGATIONS

3.1 INVESTIGATION STANDARDS & GUIDELINES

SGEO conducts groundwater monitoring bore installation and testing, and subsequent sampling, with reference to the following:

- Minimum construction requirements for water bores in Australia, Edition 2, S19.0 Monitoring Bores. Land and Water Biodiversity Committee, September 2003.
- AS 5667.1:1998: Water Quality-Sampling. Part 1. Guidance on the design of sampling programs, sampling techniques, and the preservation and handling of samples. Standards Australia.
- AS 5667.112-1998: Water Quality-Sampling, Part II: Guidance on the sampling of groundwater. Standards Australia 1998.
- Geoscience Australia Record 2009/27: Groundwater Sampling and Analysis – A Field Guide.

3.2 SITE SELECTION

The three prospective groundwater monitoring bore sites were initially selected as part of the GMP assessment. Prior to investigations and specific site selections, SGEO conducted a Dial Before You Dig search to determine the location of any underground services in the vicinity of the proposed drilling sites. The search revealed that proposed drill sites were clear of underground services and SGEO subsequently inspected the site to select final bore locations. On-site checking of these final locations was conducted by Archers Underground Services on 6 October 2014, to confirm the absence of any underground services.

Due to the presence of recorded aboriginal archaeological sites in the Dru Point headland area, on the advice of the Kingborough Council SGEO inspected bore hole locations with representatives of Aboriginal Heritage Tasmania (AHT) on 6 October 2014. The sites were subsequently approved by AHT.

SGEO liaised with Kingborough Council Works Manager J. Wisby, about the proposed site investigations and subsequently inspected the sites with him for final approval on 8 October 2014.

3.3 DRILLING METHODS

Groundwater monitoring bores **MAGW1-3** were drilled and installed on 12-14 December 2014 at locations shown in **Figure 1**. Bores were drilled with a truck-mounted Hydrapower drill rig operated by KMR Drilling Pty. Ltd. The holes were advanced using 150 mm diameter hollow augers. If auger refusal occurred, the drilling method was changed to either 125 mm blade bit or down-hole hammer. During drilling, disturbed or split-tube samples were obtained at regular intervals and drill holes were logged from material samples, moisture content and drilling rate. Detailed bore logs are presented in **Appendix A**, with material descriptions in general accordance with: AS1726-1993 *Geotechnical Site Investigations* and Mineral Resources Tasmania Unpublished Report 1980/1 *Notes on engineering logging of soils and rocks*.

3.4 DRILLING INVESTIGATION RESULTS

Essentially similar soil materials were encountered in **MAGW1-3**. The following summarises soil profiles:

A thin surface horizon of light brownish grey to pale brown silty sand was initially encountered overlying yellowish brown and high plasticity sandy clay at a depth of about 0.3-0.4 m. Below this, at depths ranging from about 1.1-1.4 m to 1.6-3.5 m, were yellowish brown to dark yellowish brown horizons predominantly consisting of dolerite derived clayey and gravelly sand and sandy and gravelly clay with some dolerite cobbles. Hollow auger refusal occurred in these materials at 2.1 m in **MAGW1** and 2.5 m in **MAGW2**, necessitating a change to down-hole hammer and blade bit drilling. However, as the materials were relatively thin in **MAGW3**, the hollow auger was able to penetrate them and drilling of this hole continued using this method.

The high plasticity and predominantly reddish brown to dusky red silty clay materials that were encountered at depths ranging from about 1.6 m in **MAGW3** to 3.5 m in **MAGW1** were interpreted to be extremely weathered basalt bedrock. These materials extended to hole termination depths ranging from 12.0 m in **MAGW3**, where hollow auger refusal occurred, to 16.5 m in **MAGW2**. The material was described as extremely low strength rock, with patches of very low strength, highly weathered rock in places at depth. Hollow auger cores of this material were obtained from **MAGW3**, allowing clear observation of relict texture and rock defects, including some vesicle and joint infillings.

Groundwater seepage was encountered in all holes and was interpreted to occur at about 9.2-9.5 m, in extremely or highly weathered basalt. Interpreted aquifer intervals ranged from about 9.5-10.0 m in **MAGW1** to about 9.4-11.6 m in **MAGW3**, where very soft and gritty material was encountered towards the base of the hole. The aquifer interval in **MAGW2** was difficult to interpret due to the low yield. The aquifer was confined in all holes.

3.5 MONITORING BORE INSTALLATION

Drilling was terminated at a depth that was at least 2.0 m below the initial aquifer intersection, unless auger refusal occurred before this depth. Investigation holes were completed as groundwater monitoring bores by installing 50 mm diameter slotted PVC screens inside the hollow auger drill stem. The slotted screens, with blank casing above, were installed to cover the interpreted aquifer intervals in each hole and the hollow auger casing was subsequently withdrawn. Graded filter sand was introduced around each screen, to a level about 0.5 m above the screen. A bentonite seal, which extended to the ground surface, was installed above the sand. Bores were completed with 150 mm diameter screw-down metal covers surrounded by concrete and flush with the ground surface.

Monitoring bore construction details are graphically presented in the detailed SGEO Groundwater Monitoring Bore Logs presented in **Appendix A**.

3.6 MONITORING BORE DEVELOPMENT

Monitoring bores were developed by surging and pumping on 13-14 November 2014. The purpose of bore development is to remove the effects of drilling disturbance, improve bore yield and reduce groundwater turbidity. Bore development and installation details are summarised in the SGEO monitoring bore installation and development records that are presented in **Appendix B**, together with the groundwater test equipment calibration record.

During development, the groundwater was extremely turbid initially and very slow to clear, requiring total purge volumes of 110-175 L before the groundwater turbidity was

reduced to an acceptable level for future sampling. Estimated steady state bore yields varied from a very low yield of about 12 L/hr for **MAGW2** to 100 L/hr for **MAGW1** and 175 L/hr for **MAGW3**. Initial field testing of groundwater quality indicated that extremely saline groundwater was present in all bores.

3.7 GROUNDWATER SAMPLING

The standing water level (SWL) was initially measured and groundwater monitoring bores were purged and sampled on 27 November 2014, under low flow conditions, using a variable flow submersible pump. Samples were obtained after periodic checking of groundwater parameters to ensure that they were stable. Field-tested groundwater parameters included electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), pH, and temperature. Groundwater sampling records, in which basic bore details and final field-test parameters are documented, are presented in **Appendix C**. Samples were also obtained from STP **Lagoon 1** and **Lagoon 2**, to enable chemical comparison of these samples with results from the adjacent monitoring bores.

Groundwater samples for dissolved nutrient analysis were field-filtered to 45 micron. Samples were submitted to the TasWater Selfs Point laboratory for chemical and bacteriological analysis. Groundwater analysis results are presented in **Appendix D**.

3.8 QUALITY ASSURANCE/QUALITY CONTROL

For quality assurance and control (QA/QC) purposes, groundwater samples were obtained with decontaminated equipment using fresh nitrile gloves and the water test equipment was calibrated earlier in the day, prior to sampling. A short-range thermometer and EC 2,760 $\mu\text{S}/\text{cm}$, TDS 2,000 mg/L and pH 6.88 calibration standards were used for calibration. The test equipment calibration record is presented in **Appendix C**.

For QC in relation to groundwater analysis data a duplicate sample **DUP01** was obtained from Margate STP bore **MAGW3**. Analysis results for these samples have been assessed using relative percentage differences (RPDs) with RPD acceptance criteria, related to the laboratory limit of reporting (LOR) for the primary sample, adopted as follows:

- Result less than 10 x LOR – no limit for RPD.
- Result 10-20 x RPD – RPD less than or equal to 50%
- Result greater than 20 x LOR – RPD less than or equal to 20%

The assessment of the November 2014 GME duplicate and original sample results presented in **Appendix D** indicates a satisfactory QC result.

4 GROUNDWATER & STP LAGOON EFFLUENT QUALITY ASSESSMENT

4.1 GUIDELINES & METHODOLOGY

The Tasmanian State Policy on Water Quality Management 1997, also referred to as the Water Quality Policy (WQP), provides a framework for both the development of ambient water quality objectives and the management and regulation of point and diffuse sources of emissions to surface waters and groundwater. Appropriate PEVs for a particular site are determined after initially evaluating salinity. This then indicates which set of water quality guideline values should be used for assessment purposes. Although the WQP assigns drinking water as a PEV where the salinity is less than 1,000 mg/L TDS, SGEO adopt the Australian Drinking Water Guidelines limit of 1,200 mg/L TDS as the drinking water limit.

Direct comparison of groundwater results with ANZECC or other aquatic ecosystem default trigger values (DTVs) is only relevant where monitoring bores are very close to surface waters and there is some chance of direct discharge. ANZECC indicates that aquatic ecosystem DTVs are appropriate for comparison with concentrations measured in the receiving water body itself, rather than those specifically measured in groundwater. An exceedance of a trigger value by a contaminant in groundwater therefore does not necessarily mean that the contaminant is causing ecological harm.

In the subsequent groundwater and STP lagoon effluent quality assessment sections, analysis results have been compared with water quality guideline values from the following references:

- National Health and Medical Research Council/National Resources Management Ministerial Council (2011): *Australian Drinking Water Guidelines 6, Version 2.0. (ADWG)*.
- Australian & New Zealand Environment & Conservation Council: *Guidelines for Fresh & Marine Water Quality. (ANZECC)*.

Note also that guideline values provided in the National Environment Protection Council, 1999: *National Environment Protection (Assessment of Site Contamination) Measure (NEPM)* defer to ADWG and ANZECC guideline values.

Groundwater salinity categories used in this report have been based on the following table, with EC and TDS ranges derived from ANZECC root zone salinity (ECse) data, assuming a sandy loam soil profile.

Root Zone Salinity ECse (dS/m)	Electrical Conductivity EC (µS/cm)	Total Dissolved Solids (mg/L)	Water salinity category	Plant salt tolerance suitability group
<0.95	<625	<420	Very low	Sensitive
0.95-1.9	625-1,400	420-1000	Low	Moderately sensitive
1.9-4.5	1,400-3,250	1000-2200	Medium	Moderately tolerant
4.5-7.7	3,250-5,600	2200-3750	High	Tolerant
7.7-12.2	5,600-8,800	3750-5900	Very High	Very tolerant
>12.2	>8,800	>5900	Extreme	Generally too saline

The following ADWG salinity (TDS) descriptors have also been used:

TDS (mg/L)	ADWG drinking water quality descriptor
<600	good
600-900	fair
900-1200	poor
>1200	unacceptable

4.2 GROUNDWATER MONITORING CONTEXT

Judging from the monitoring bore installation information, the Margate STP is underlain by extremely weathered basalt which predominantly occurs as silty clay to depths of at least 12.0-16.5 m. Monitoring bores **MAGW1-3** intersect groundwater at a relatively consistent depth of about 9.2-9.5 m in weathered basalt. The groundwater is confined by the overlying silty clay material with an aquifer head of about 4.1-5.6 m.

4.3 GROUNDWATER QUALITY ASSESSMENT

Groundwater field-test results are presented in **Appendix C**, with groundwater analysis results in **Appendix D**. For initial assessment, principal PEVs are considered to be irrigation and stock water only, as the salinity of the groundwater is greater than 1200 mg/L TDS. Consequently, initial GME results have only been compared with relevant ANZECC guideline values in **Table 1**. Groundwater quality assessment explanatory notes are presented in **Appendix E**. The following assessment comments for the November 2014 GME are restricted to those considered noteworthy:

- Groundwater levels from the ground surface varied from about 3.7 m in **MAGW1** to about 5.3 m in **MAGW3**. The groundwater is confined with estimated aquifer heads ranging from about 4.1 m in **MAGW3** to about 5.6 m in **MAGW1** and **MAGW2**.
- The groundwater in all bores was extremely saline, with TDS results ranging from 12500 mg/L for **MAGW3** to 14100 mg/L for **MAGW2**. The results indicate that the groundwater would be too saline for irrigation purposes and would also be essentially unsuitable for livestock drinking water. The salinity of the groundwater in **MAGW1** and **MAGW3** is at the upper end of the livestock suitability range, theoretically suitable only for sheep but with an associated loss of production and animal health. The groundwater in **MAGW2** is too saline for livestock water.
- The groundwater in all bores is slightly acidic, with results ranging from pH 5.4 (**MAGW3**) to Ph 6.1 (**MAGW1**).
- Total N results (0.19-0.24 mg/L) were very low for all bores. Total P results were also very low for **MAGW1** (0.31 mg/L) and **MAGW3** (0.18 mg/L) but the result for **MAGW2** (1.1 mg/L) was slightly elevated. However, in the absence of a correspondingly elevated Total N result no significance is attached to this latter result, which may to some extent have been affected by sample turbidity.
- Bacteriological test results were less than the laboratory limits of reporting, apart from a very low thermotolerant coliform result of 20 cfu/100 mL from **MAGW1**. No significance is attached to this very low result which might have resulted from cross contamination either from bore installation or during the groundwater sampling and sample handling process.

4.4 STP LAGOON EFFLUENT QUALITY ASSESSMENT

- The salinity of the samples from STP **Lagoon 1** (540 mg/L TDS) and **Lagoon 2** (518 mg/L TDS) indicates the presence of very low salinity effluent in both lagoons.
- Elevated Total N results were obtained from **Lagoon 1** (69.0 mg/L) and **Lagoon 2** (53.0 mg/L) samples, with N predominantly present in **Lagoon 1** as ammonia N with organic N present to a lesser extent. Ammonia N was predominantly present in the **Lagoon 2** sample. Total N and ammonia results significantly exceeded ANZECC marine DTVs for slightly disturbed ecosystems whereas nitrite N and nitrate N exceeded DTVs to a lesser extent.

TABLE 1.
GROUNDWATER ANALYSIS ASSESSMENT SUMMARY: MARGATE STP

Analyte	Sample ID:	MAGW1	MAGW2	MAGW3	ANZEC 2000		
	Date Sampled	27/11/14	27/11/14	27/11/14	IRRIGATION		LIVESTOCK DRINKING
		27/11/14	27/11/14	27/11/14	STV (Short-term)	LTV (Long-term)	
Standing Water Level	(m)	3.83	3.55	5.14			
Temperature	(°C)	15.6	14.5	15.6			
pH	(pH Units)	6.1	5.8	5.4	**6.0-8.5		
Dissolved Oxygen (field test)	(mg/L)	8.9	7.8	2.4			
Conductivity	(µS/cm)	19,100	20,200	18,900			
*ECse	(dS/m)	26.3	27.8	26.0	⁽¹⁾ <0.95 - >12.2		
TDS	(mg/L)	12,700	14,100	12,500			⁽²⁾ 2,000-13,000
Alkalinity CO3	(mg CaCO3/L)	<2	<2	<2			
Alkalinity HCO3	(mg CaCO3/L)	101	73	16			
Chloride	(mg/L)	6,600	7,180	6,680			
Sulphate	(mg/L)	395	402.0	387.0			
NH3-N	(mg/L)	<0.005	0.019	<0.005			
NH3 (=NH3-N x 1.21)	(mg/L)	<0.006	0.023	<0.006			
NO3-N	(mg/L)	0.022	0.004	0.037			
NO3(=NO3-N x 4.43)	(mg/L)	0.097	0.018	0.164			400-1,500
NO2-N	(mg/L)	<0.002	<0.002	<0.002			
NO2(=NO2-N x 3.29)	(mg/L)	<0.007	<0.007	<0.007			30
PO4-P	(mg/L)	0.280	0.011	0.073			
Total N	(mg/L)	0.19	0.24	0.24	25-125 ^a	5	
Total P	(mg/L)	0.31	1.1	0.180	0.8-12.0 ^a	0.05 ^b	
Calcium (Total)	(mg/L)	283	446	247			
Potassium (Total)	(mg/L)	16.2	14.8	14.2			
Magnesium (Total)	(mg/L)	838	1,030	893			
Sodium (Total)	(mg/L)	2,620	2,380	2,440			
Thermotolerant Coliforms	(cfu/100ml)	20	<10	<10	⁽⁵⁾ 10-10,000		100
E. Coli	(/100ml)	<10	<10	<10			
Enterolert	(/100ml)	<10	<10	<10			

Results shading has been applied in the following order, with shadings higher in the order overriding those lower.

	Exceeds ADWG health-based guideline value or aesthetic guideline range.
	Exceeds ANZECC irrigation or livestock drinking guideline value, or upper value of a guideline range.
	Exceeds ADWG aesthetic guideline value.
	Within ANZECC irrigation or livestock drinking guideline range, requiring further suitability assessment depending on use.

Table 2
Surface Water Analysis Assessment Summary: Margate STP

Analyte	Sample ID:	Lagoon 1	Lagoon 2	ADWG 2011	ANZEC 2000			
	Date Sampled	27/11/14	27/11/14	DRINKING WATER	AQUATIC ECOSYSTEMS (marine)	IRRIGATION STV (Short-term)	LTV (Long-term)	LIVESTOCK DRINKING
Conductivity	(µS/cm)	995	1,070					
*ECse	(dS/m)	1.4	1.5			(1)<0.95	>12.2	
TDS	(mg/L)	540	518	(600-1200)				(2)2,000-13,000
Alkalinity CO3	(mg CaCO3/L)	<2	<2					
Alkalinity HCO3	(mg CaCO3/L)	223	220					
Chloride	(mg/L)	168	146.0					
Sulphate	(mg/L)	38.8	34.9					
NH3-N	(mg/L)	49.000	45.000					
NH3 (=NH3-N x 1.21)	(mg/L)	59.290	54.450	(0.5)	0.91			
NO3-N	(mg/L)	0.005	0.060		0.005			
NO3(=NO3-N x 4.43)	(mg/L)	0.022	0.266	50				400-1,500
NO2-N	(mg/L)	0.009	0.130		0.005			
NO2(=NO2-N x 3.29)	(mg/L)	0.030	0.428	3				30
PO4-P	(mg/L)	7.0	8.4		0.01			
Total N	(mg/L)	69.00	53.00		0.12	25-125 ^a	5	
Total P	(mg/L)	10	9.4		0.025	0.8-12.0 ^a	0.05 ^b	
Calcium (Dissolved)	(mg/L)	14.4	14.3					
Potassium (Total)	(mg/L)	20.0	18.2					
Magnesium (Total)	(mg/L)	12.60	11.2					
Sodium (Total)	(mg/L)	116	106					
Thermotolerant Coliforms	(cfu/100ml)	430,000 est	380			(6)10-10,000		100
E. Coli	(cfu/100ml)	430,000 est	380	0				
Enterococci	(cfu/100ml)	28,000	150					

Results shading has been applied in the following order, with shadings higher in the order overriding those lower, if applicable.

- Exceeds ADWG health-based guideline value or aesthetic guideline range.
- Exceeds ANZECC irrigation or livestock drinking guideline value, or upper value of a guideline range.
- Exceeds ADWG aesthetic guideline value.
- Within ANZECC irrigation or livestock drinking guideline range, requiring further suitability assessment depending on use.
- Exceeds ANZECC aquatic ecosystem DTV or NEPM GIL.

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- Elevated and relatively similar Total P results were obtained from **Lagoon 1** (10.0 mg/L) and **Lagoon 2** (9.4 mg/L) samples, with P predominantly present in **Lagoon 1** as dissolved reactive P and, to a lesser extent, organic P with dissolved reactive P predominantly present in **Lagoon 2**. Results exceeded the ANZECC long-term irrigation guideline value but were within the short-term irrigation suitability range, although towards the upper end of this range. Total P and dissolved reactive P results significantly exceeded ANZECC marine DTVs for slightly disturbed ecosystems.
- Bacteriological test results indicated significantly elevated thermotolerant coliform and E. coli results of 430,000 cfu/100 mL from **Lagoon 1**, contrasting with much lower corresponding results of 380 cfu/100 mL for **Lagoon 2**.
- Hydrogeochemical assessment of groundwater and STP lagoon results, presented in **Figure 2** as a Piper plot of major anion and cation results, demonstrates that the groundwater in **MAGW1-3** is chemically distinct from the STP lagoon effluents. This, together with the very low groundwater nutrient results, indicates that there is no evidence of STP leakage.

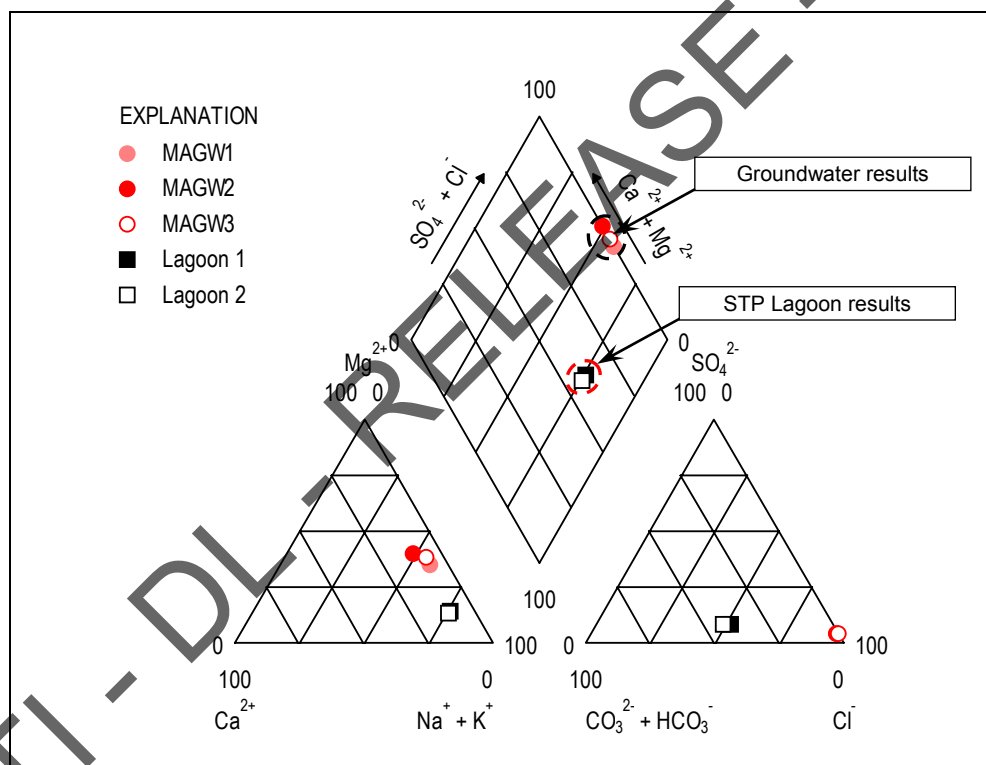


Figure 2: Piper plot for Margate November 2014 GME groundwater and STP lagoon analysis results.

5 CONCLUSIONS & RECOMMENDATIONS

5.1 CONCLUSIONS

Three groundwater monitoring bores (**MAGW1-3**) have now been successfully installed at downgradient sites adjacent to the Margate STP. Installation information has indicated that the site is underlain by extremely weathered basalt that predominantly consists of silty clay to depths of at least 12.0-16.5 m. In addition, within the weathered basalt an aquifer has been identified as underlying the site at a depth of about 9.2-9.5 m. The groundwater is confined by overlying silty clay with an estimated aquifer head varying from about 4.1 m in **MAGW3** to 5.6 m in **MAGW1** and **MAGW2**.

Results from an initial groundwater monitoring event have indicated that extremely saline and slightly acidic groundwater is present in the aquifer that is intersected by the three groundwater monitoring bores at the site. In relation to PEVs, due to the extreme salinity the groundwater is unsuitable for irrigation and essentially unsuitable even for livestock drinking water. Very low to low nutrient analysis results were obtained from the initial groundwater monitoring event.

Grab sample analysis results from the two Margate STP lagoons, taken during groundwater sampling, indicated very high Total N (69 mg/L) and Total P (10.0 mg/L) levels from **Lagoon 1**. Results from **Lagoon 2** indicated that STP treatment had resulted in a 23% reduction in Total N and a 6% reduction in Total P, with a noticeable reduction in organic N and organic P. There was a significant reduction in bacteriological results between **Lagoon 1** and **Lagoon 2** with thermotolerant coliforms and E. coli results reducing from 430,000 cfu/100mL to 380 cfu/100mL.

Hydrogeochemical assessment of groundwater and STP lagoon analysis results has demonstrated that the groundwater in **MAGW1-3** is chemically distinct from the STP lagoon effluents. This, together with the very low groundwater nutrient results, indicates that there is no evidence of STP leakage.

5.2 RECOMMENDATIONS

We recommend that:

- Six-monthly GMEs should be initially conducted for the three monitoring bores at the Margate STP. The sampling frequency should be reviewed after one year.
- Groundwater analysis parameters should consist of EC, TDS, Total N, ammonia N, nitrite N, nitrate N, Total P, dissolved reactive P, thermotolerant coliforms, E. coli and enterococci. The analysis parameters should be reviewed after one year.
- Groundwater monitoring and assessment should be conducted by a suitably experienced hydrogeologist in accordance with appropriate environmental standards and guidelines.

D.J. Sloane BSc (Hons)



[31 December 2014]

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Glossary

Confined aquifer: Confined aquifers are those where the water level in the bore rises above the depth that the aquifer was struck during drilling. The aquifer is therefore under pressure, with a piezometric or aquifer head equivalent to the difference between these two levels.

Development: This involves cleaning by surging and pumping the bore after installation to remove drilling disturbance. This minimises the turbidity of groundwater samples.

GME: Groundwater monitoring event.

Monitoring bore: Monitoring bores are specifically installed for monitoring groundwater quality. They are generally drilled to intersect the first aquifer level within the soil or bedrock. Slotted 50 mm diameter PVC pipe is usually installed at the aquifer level and sealed above it with bentonite. This ensures discrete sampling of the aquifer interval.

Nitrate: This is calculated from the nitrate N value by multiplying it by 4.43 to give nitrate (as nitrate).

Nutrient: This term broadly refers to Total nitrogen (N), ammonia N, nitrite N and nitrate N and Total phosphorous (P).

Organic N: Determined from the difference between the Total N result and the sum of the ammonia N, nitrite N and nitrate N results.

Organic P: Determined from the difference between the Total P result and the dissolved reactive P result.

PEV: Protected environmental value.

Purging: Purging refers to extraction of groundwater from a bore to remove any stagnant water and ensure that the sample is obtained from direct aquifer inflow. This is often conducted by removing three times the volume of water in the bore prior to taking the sample. However, additional purging may be required to ensure minimal sample turbidity.

RWS: Recycled Water Scheme

WQP: State Policy on Water Quality Management 1997, also known as the Water Quality Policy.

SWL: This is the standing water level (SWL) in the bore, measured from the top of the bore standpipe.

Unconfined aquifer: Unconfined aquifers are those in direct contact with the atmosphere. The SWL in the bore is usually about the same depth that the aquifer was intersected during drilling.

STP: Sewage Treatment Plant

Appendix A:

Explanation sheet for engineering logs.
Groundwater monitoring bore logs.

RTI - DL - RELEASE - EPA

SGEO - Sloane Geoscience Pty. Ltd.
Engineering & Environmental Geologists

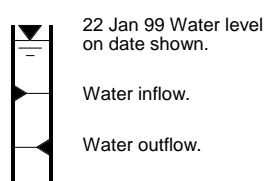
EXPLANATION SHEET FOR ENGINEERING LOGS.

Borehole, Auger and Excavation log

Penetration



Water



Notes - samples and tests

- UD50** Undisturbed sample 50mm diameter.
- ST35** Split tube sample 35mm diameter.
- D** Disturbed sample.
- N** Standard penetrometer blow count for 300mm.
- SV** Shear vane test.
- PP** Pocket penetrometer (kPa)
- 1/2/6** SPT blows per 150mm
- N=8** SPT penetration resistance (300m)

Material classification

Based on Unified Soil Classification System.
 In Graphic Log materials are represented by clear contrasting symbols for each project.

Material description

Colour: Ref. Munsell Soil Colour Charts (2000 edition)

Lesser components:
 'trace' <3%
 'some' 5% to 12%

Moisture content

- D** Dry, looks and feels dry.
- M** Moist, no free water on hand when remolding.
- W** Wet, free water on hand when remolding.
- LL** Liquid limit.
- PL** Plastic limit.
- PI** Plasticity index.

eg:

M>PL Moist, moisture content greater than plastic limit.

Consistency

- | | | |
|------------|-------------|-----------|
| | | (kPa) |
| VS | Very soft. | < 25 |
| S | Soft. | 25 - 50 |
| F | Firm. | 50 - 100 |
| St | Stiff | 100 - 200 |
| VSt | Very Stiff. | 200 - 400 |
| H | Hard. | >400 |
| Fb | Friable. | |

Density index

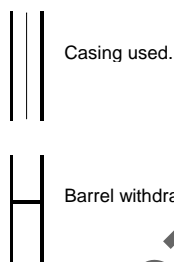
- | | | |
|-----------|--------------|----------|
| | | (%) |
| VL | Very loose. | 0 - 15 |
| L | Loose. | 15 - 35 |
| MD | Medium dense | 35 - 65 |
| D | Dense | 65 - 85 |
| VD | Very dense | 85 - 100 |

Pedal structure

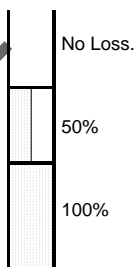
- | <u>Term</u> | <u>Size of peds</u> | <u>Shape of peds</u> |
|------------------|---|--|
| BLOCKY | >60mm | BULKY equally developed along three axis. |
| CLODDY | 20 - 60mm | ELONGATED Developed mainly along axis normal to ground surface. |
| NUTTY | 6 - 20mm | |
| GRANULAR | 0.6 - 6mm | LENTICULAR Lenticular, platy or wedge shaped (sharp corners). |
| PRISMATIC | Representative dimension stated in description | |
| SHATTERED | Generally <10mm; range of dimensions stated in description. | |

Cored Borehole log

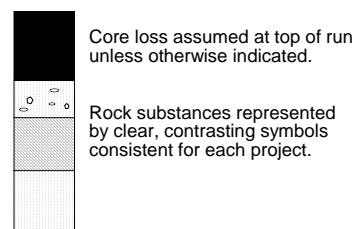
Case - Lift



Fluid Loss



Graphic Log



Weathering

- Fr** Fresh
- SW** Slightly weathered.
- MW** Moderately weathered
- HW** Highly weathered.
- EW** Extremely weathered.

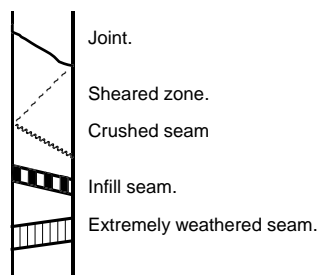
Strength

- | | | |
|-----------|-----------------|---|
| | | Point load strength index I ₅ (50) (MPa) |
| EL | Extremely low. | < 0.03 |
| VL | Very low. | 0.03 - 0.1 |
| L | Low. | 0.1 - 0.3 |
| M | Medium. | 0.3 - 1.0 |
| H | High. | 1.0 - 3.0 |
| VH | Very High. | 3.0 - 10.0 |
| EH | Extremely high. | >10 |

Note: x on log is test result

Significant defects

Significant defects shown graphically



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 Environmental, Engineering & Groundwater Geologists

hole no.:

MAGW1

sheet: **1** of: **1**

ENGINEERING LOG - Groundwater Monitoring Bore Hole

Project : **108571 - Groundwater Monitoring Bore Installation** Location : **Dru Point Road, Margate. Margate STP.**

Co-ordinates : 522498mE 5236327mN GDA94 Drill type : Hydrapower Scout Hole Commenced : 12/11/14
 R.L. : Unknown Drill method : Hollow Flight Auger/Down-hole Hammer Hole Completed : 12/11/14
 Inclination : Vertical Drill fluid : N/A Logged by : DJS
 Diameter : 150mm/100mm Contractor : KMR Drilling Checked by : JRB

penetration 1 2 3	water	Bore Diagram		depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	additional observations & test/sample intervals
		'H' cap locked well cap	'Gatic' well cover							
				0.0		SM	Silty SAND: Fine; light brownish grey (10YR 6/2); approx. 40% silt.	M	VD	
				0.5		CH-CL	Sandy CLAY: Medium to high plasticity; yellowish brown (10YR 5/4); approx. 30% fine-coarse sand.	M<PL	St	D 0.5m
				1.0		SP	Clay & Gravelly SAND: Fine-coarse; yellowish brown (10YR 5/6); approx. 20% clay, approx. 20% dolerite gravel with some cobbles. (<i>Highly weathered dolerite</i>).	M	VD	D 1.0m
				1.5		CL	Sandy & Gravelly CLAY: Medium plasticity; dark yellowish brown (10YR 4/6); approx. 40% fine-coarse sand; approx. 15% fine-coarse dolerite gravel with some cobbles.	M	VH	D 1.5m
				2.0		GP	Sandy & Clayey GRAVEL: Fine-coarse dolerite; dark yellowish brown (10YR 4/6); approx. 25% fine-coarse sand; approx. 20% clay. Some cobbles/boulders.	M	VH	D 2.0m
				3.0						D 3.0m SEDIMENTS
				4.0		CH	Silty CLAY: High plasticity; dark reddish brown (5YR 3/4) to yellowish red (5YR 4/6) and very dusky red (2.5YR 2.5/2); approx. 30% silt; some fine-medium sand.	M>PL	VSt	D 4.0m D 5.0m D 6.0m
				6.0						D 6.0m
				8.0						D 8.0m
				10.0						D 10.0m
				11.0						D 11.0m
				12.0						D 12.0m
				13.0						D 13.0m
				14.0						D 14.0m
				14.0			TERMINATED: 14.00 m Required Depth			
				16.0						
				18.0						
				20.0						

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hole no.:

MAGW2

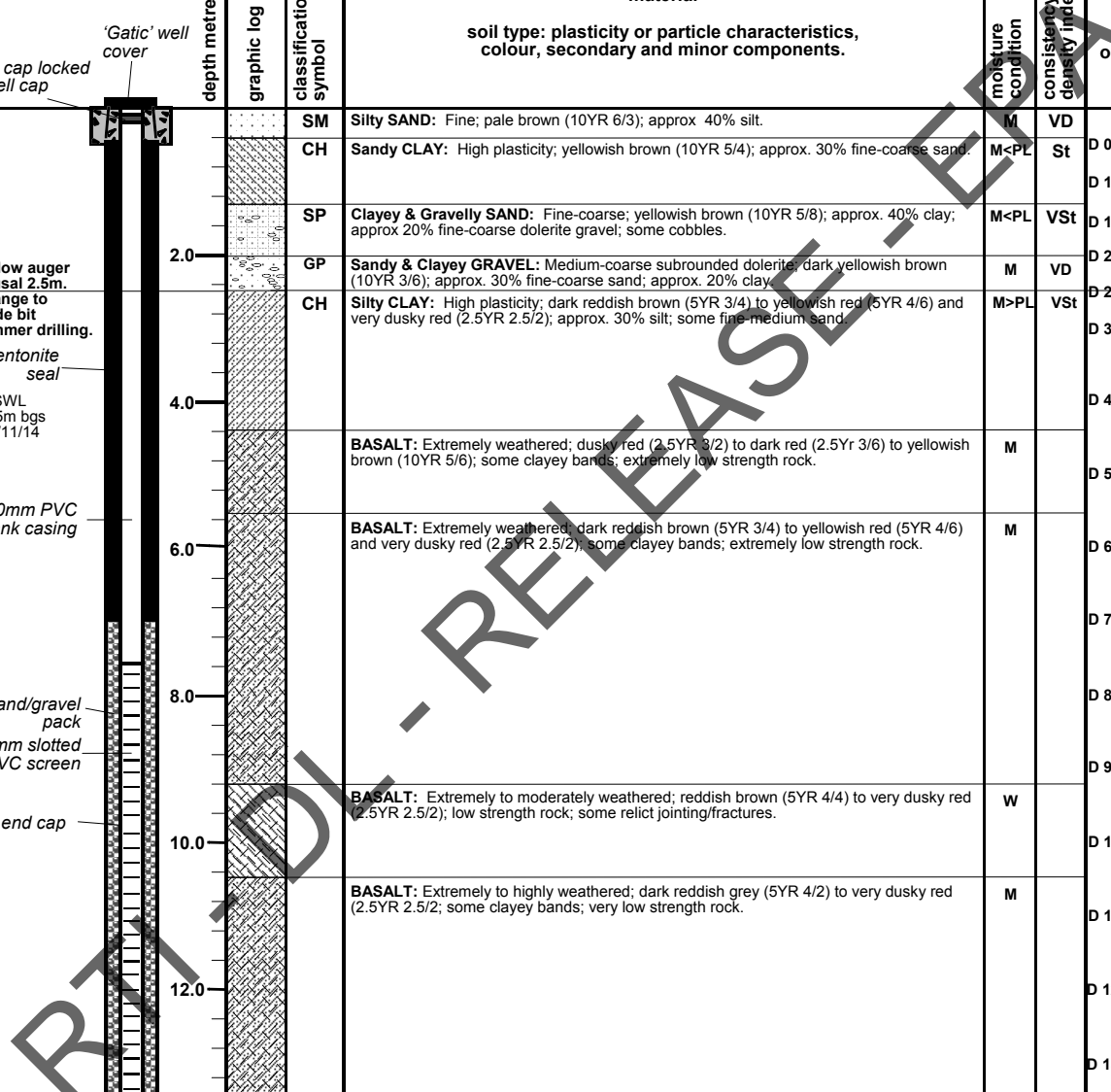
sheet: **1** of: **1**

ENGINEERING LOG - Groundwater Monitoring Bore Hole

Project : **108571 - Groundwater Monitoring Bore Installation** Location : **Dru Point Road, Margate.**
Margate STP.

Co-ordinates : 522474mE 5236436mN GDA94	Drill type : Hydrapower Scout	Hole Commenced : 13/11/14
R.L. : Unknown	Drill method : Hollow Flight Auger/Down-hole Hammer	Hole Completed : 13/11/14
Inclination : Vertical	Drill fluid : N/A	Logged by : DJS
Diameter : 150mm/100mm	Contractor : KMR Drilling	Checked by : JRB

penetration 1 2 3	water	Bore Diagram		depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	additional observations & test/sample intervals
		'H' cap locked well cap	'Gatic' well cover							
						SM	Silty SAND: Fine; pale brown (10YR 6/3); approx. 40% silt.	M	VD	
						CH	Sandy CLAY: High plasticity; yellowish brown (10YR 5/4); approx. 30% fine-coarse sand.	M<PL	St	D 0.5m
						SP	Clayey & Gravelly SAND: Fine-coarse; yellowish brown (10YR 5/8); approx. 40% clay; approx 20% fine-coarse dolerite gravel; some cobbles.	M<PL	VSt	D 1.0m D 1.5m
				2.0		GP	Sandy & Clayey GRAVEL: Medium-coarse subrounded dolerite, dark yellowish brown (10YR 3/6); approx. 30% fine-coarse sand; approx. 20% clay.	M	VD	D 2.0m
						CH	Silty CLAY: High plasticity; dark reddish brown (5YR 3/4) to yellowish red (5YR 4/6) and very dusky red (2.5YR 2.5/2); approx. 30% silt; some fine-medium sand.	M>PL	VSt	D 2.5m D 3.0m
				4.0			BASALT: Extremely weathered; dusky red (2.5YR 3/2) to dark red (2.5Yr 3/6) to yellowish brown (10YR 5/6); some clayey bands; extremely low strength rock.	M		D 4.0m D 5.0m
							BASALT: Extremely weathered; dark reddish brown (5YR 3/4) to yellowish red (5YR 4/6) and very dusky red (2.5YR 2.5/2); some clayey bands; extremely low strength rock.	M		D 6.0m D 7.0m D 8.0m D 9.0m
				8.0			BASALT: Extremely to moderately weathered; reddish brown (5YR 4/4) to very dusky red (2.5YR 2.5/2); low strength rock; some relict jointing/fractures.	W		D 10.00m
							BASALT: Extremely to highly weathered; dark reddish grey (5YR 4/2) to very dusky red (2.5YR 2.5/2); some clayey bands; very low strength rock.	M		D 11.00m D 12.00m D 13.00m D 14.00m
				12.0			BASALT: Highly weathered; dark reddish grey (2.5YR 4/1); some clayey bands; low to very low strength rock.	M		D 15.00m D 16.00m
				16.0			TERMINATED: 16.50 m Required Depth			
				18.0						
				20.0						



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hole no.:
MAGW3
 sheet: 1 of 1

ENGINEERING LOG - Groundwater Monitoring Bore Hole

Project : **108571 - Groundwater Monitoring Bore Installation** Location : **Dru Point Road, Margate. Margate STP.**

Co-ordinates : 522373mE 5236413mN GDA94 Drill type : Hydrapower Scout Hole Commenced : 12/11/14
 R.L. : Unknown Drill method : Hollow Flight Auger/Down-hole Hammer Hole Completed : 13/11/14
 Inclination : Vertical Drill fluid : N/A Logged by : DJS
 Diameter : 150mm/100mm Contractor : KMR Drilling Checked by : JRB

penetration	water	Bore Diagram	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density in cpx	additional observations & test/sample intervals
1 2 3									
			2.0		SM	Silty SAND: Fine; pale brown (10YR 6/3); approx 40% silt.	M	VD	
					CH	Sandy CLAY: Medium to high plasticity; yellowish brown (10YR 5/4); approx. 30% fine-coarse sand.	M<PL	St	D 0.5m
					SC	Clayey & Gravelly SAND: Fine-coarse; yellowish brown (10YR 5/8); approx. 25% clay; approx. 25% fine-coarse gravel with some dolerite cobbles.	M<PL	VSt	D 1.0m
			2.0		CH	Silty CLAY: High plasticity; dark reddish brown (5YR 3/4) to yellowish red (5YR 4/6) and very dusky red (2.5YR 2.5/2); approx. 30% silt; some fine-medium sand.	M	VSt	D 1.5m D 2.0m D 2.5m D 3.0m D 3.5m D 4.0m D 5.0m
			6.0			BASALT: Extremely weathered; dark reddish brown (2.5YR 3/3), dusky red (10R 3/2), brownish yellow (10YR 6/6) and very dark greyish brown (10YR 3/2); some clayey seams; relict texture and joint infills. Extremely low strength rock.	M		UD 50 5.5-6.25m
			8.0						D 6.0m UD 50 7.0-7.75m
			10.0			BASALT: Extremely weathered; very dusky red (2.5YR 2.5/2); some subhorizontal relict jointing. Extremely to very low strength rock.	W		D 8.0m D 9.00m UD 50 9.25-10.00m
			12.0			BASALT: Highly to extremely weathered; dark reddish grey (5YR 4/2) to very dusky red (2.5YR 2.5/2); sandy. Very low strength rock.	M		D 11.00m UD 50 11.50-12.00m (No sample returned)
			12.0			TERMINATED: 12.00 m Hollow auger refusal.			
			14.0						
			16.0						
			18.0						
			20.0						

Appendix B:

Groundwater monitoring bore installation & development records.
Water test equipment calibration record.

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**MARGATE STP
GROUNDWATER MONITORING BORE INSTALLATION & DEVELOPMENT RECORDS**

BORE ID	MAGW1	MAGW2	MAGW3
Bore Installation Record			
Coordinates (GDA94)	55 0522498mE 5236327mN	55 0522474mE 5236436mN	55 0522373mE 5236413mN
Date Installed	12-Nov-14	13-Nov-14	13-Nov-14
Installer	SGEO/KMR	SGEO/KMR	SGEO/KMR
Installation Report	SGEO PN 108571: <i>Margate STP Groundwater Monitoring Bore Installation, November 2014.</i>	SGEO PN 108571: <i>Margate STP Groundwater Monitoring Bore Installation, November 2014.</i>	SGEO PN 108571: <i>Margate STP Groundwater Monitoring Bore Installation, November 2014.</i>
Bore Type	Monitoring bore	Monitoring bore	Monitoring bore
Depth (m) from standpipe top	13.950	16.380	11.600
Approx Standpipe stick up (m)	-0.09	-0.1	-0.16
Standpipe RL (m AHD)	Unknown	Unknown	Unknown
Diameter (mm)	50	50	50
Aquifer Interval (m bgs) approx.	9.5-10.0	9.2-10.5	9.4-11.5
Screen Interval (m bgs)	8.0-14.0	7.5-16.5	7.8-11.8
Gravel/sand pack interval (m bgs)	7.5-14.0	7.0-16.5	7.0-11.8
Seal (bentonite/grout) interval (m bgs)	0.0-7.5	0.0-7.0	0.0-7.0
Aquifer rock/sediment type	Extremely weathered dolerite	Extremely weathered dolerite	Extremely weathered dolerite
Estimated continuous yield (L/hr)	100	12	240
Bore Development Record			
Date	13-Nov-14	14-Nov-14	14-Nov-14
Developed by	John Sloane	John Sloane	John Sloane
Development Method	Surging/Pumping	Surging/Pumping	Surging/Pumping
Time Commenced	16:05	8:30	9:40
SWL (m) - from standpipe top	3.680	4.150	4.980
RL watertable	Unknown	Unknown	Unknown
Estimated aquifer head (m)	5.7	5.0	4.2
Bore Water Volume (L)	20.1	24.0	13.0
Development purge volume (L)	100	150	175
Estimated continuous yield (L/hr)	100	12	240
Final Test			
Time	17:00	10:40	10:10
Conductivity (mS/cm)	17100	14940	14690
TDS (mg/L)	9580	8310	8190
Temperature (°C)	14.5	13.8	13.8
pH	6.3	6.0	6.0
Sample Observations			
Turbidity	trace	trace	trace
Colour	light grey brown	light grey brown	light reddish brown
Odour	none	none	none
Film	none	none	none
Sediment	trace silt	trace silt	trace silt
COMMENTS: (Note bgs = below ground surface)		50L initially purged 13/11/14 18:05 75L purged 14/11/14 8:30 25L purged 14/11/14 10:30	55L initially purged 13/11/14 17:10

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SGEO WATER TEST EQUIPMENT CALIBRATION RECORDS

CONDUCTIVITY/TDS/pH METER

TPS WP-81

S#: 7208

Site: **MARGATE RWS**

Date: **13/11/2014**

Time: **15:15**

Calibration parameter	Standard	Calibration performed?	Signature
Temperature	15.2 °C	Yes	John Sloan
Conductivity	0 µS/cm	Yes	John Sloan
	2760 µS/cm	Yes	John Sloan
Total Dissolved Solids	0 mg/L	Yes	John Sloan
	2,000 mg/L	Yes	John Sloan
pH	6.88 pH	Yes	John Sloan
	4.00 pH	No	John Sloan

CONDUCTIVITY/TDS/pH METER

TPS WP-81

S#: 7208

Site: **MARGATE RWS**

Date: **14/11/2014**

Time: **7:45**

Calibration parameter	Standard	Calibration performed?	Signature
Temperature	15.5 °C	Yes	John Sloan
Conductivity	0 µS/cm	Yes	John Sloan
	2760 µS/cm	Yes	John Sloan
Total Dissolved Solids	0 mg/L	Yes	John Sloan
	2,000 mg/L	Yes	John Sloan
pH	6.88 pH	Yes	John Sloan
	4.00 pH	No	John Sloan

RTI - DL - RELEASED

Appendix C:

Sampling records.

Test equipment calibration records.

RTI - DL - RELEASE - EPA

**MARGATE STP
GROUNDWATER MONITORING BORE SAMPLING RECORDS**

BORE ID	MAGW1	MAGW2	MAGW3
Bore Installation Record			
Coordinates (GDA94)	55 0522498mE 5236327mN	55 0522474mE 5236436mN	55 0522373mE 5236413mN
Date Installed	12-Nov-14	13-Nov-14	13-Nov-14
Installer	SGEO/KMR	SGEO/KMR	SGEO/KMR
Installation Report	SGEO PN 108571: Margate STP Groundwater Monitoring Bore Installation, November 2014.	SGEO PN 108571: Margate STP Groundwater Monitoring Bore Installation, November 2014.	SGEO PN 108571: Margate STP Groundwater Monitoring Bore Installation, November 2014.
Bore Type	Monitoring bore	Monitoring bore	Monitoring bore
Depth (m) from standpipe top	13.950	16.380	11.600
Approx Standpipe stick up (m)	-0.09	-0.1	-0.16
Standpipe RL (m AHD)	Unknown	Unknown	Unknown
Diameter (mm)	50	50	50
Aquifer Interval (m bgs) approx.	9.5-10.0	9.2-10.5	9.4-11.5
Screen Interval (m bgs)	8.0-14.0	7.5-16.5	7.8-11.8
Gravel/sand pack interval (m bgs)	7.5-14.0	7.0-16.5	7.0-11.8
Seal (bentonite/grout) interval (m bgs)	0.0-7.5	0.0-7.0	0.0-7.0
Aquifer rock/sediment type	Extremely weathered dolerite	Extremely weathered dolerite	Extremely weathered dolerite
Estimated continuous yield (L/hr)	100	12	240
Sampling Record			
Date	27-Nov-14	27-Nov-14	27-Nov-14
Sampler	John Sloane	John Sloane	John Sloane
Sampling method	Multi-stage submersible pump	Multi-stage submersible pump	Multi-stage submersible pump
Time Commenced	11:35	9:35	13:00
SWL (m) - from standpipe top	3.830	3.550	5.140
SWL (m) - below ground surface	3.920	3.650	5.300
RL watertable	Unknown	Unknown	Unknown
Estimated aquifer head (m)	5.6	5.6	4.1
Bore water volume (L)	19.8	25.1	12.7
Minimum purge volume required (L)	59.5	75.4	38.0
Actual purge volume (L)	75.0	80.0	100.0
Estimated continuous yield (L/hr)	100	12	240
Sample ID & time	MAGW1 12:00	MAGW2 14:00	MAGW3 13:30
Final Test			
Time	12:10	14:10	13:40
Conductivity (μ S/cm)	12810	12420	12040
TDS (mg/L)	7450	7210	7000
Temperature ($^{\circ}$ C)	15.6	14.5	15.6
pH	6.1	5.8	5.4
Dissolved oxygen (ppm)	8.9	7.8	2.4
Sample Observations			
Turbidity	none	trace	trace
Colour	clear	light reddish brown	light reddish brown
Odour	none	none	none
Film	none	none	none
Sediment	trace silt	trace silt	trace silt
COMMENTS: (Note bgs = below ground surface)		50L initially purged 13/11/14 18:05 75L purged 14/11/14 8:30 25L purged 14/11/14 10:30	Duplicate sample DUP01 taken

SGEO WATER TEST EQUIPMENT CALIBRATION RECORDS

CONDUCTIVITY/TDS/pH METER

TPS WP-81

S#: 7208

Date:

27/11/2014

Time: 8:05

Calibration parameter	Standard	Calibration performed?	Signature
Temperature	15.4 °C	Yes	John Sloan
Conductivity	0 µS/cm	Yes	John Sloan
	2760 µS/cm	Yes	John Sloan
Total Dissolved Solids	0 mg/L	Yes	John Sloan
	2,000 mg/L	Yes	John Sloan
pH	6.88 pH	Yes	John Sloan
	4.00 pH	No	John Sloan

DISSOLVED OXYGEN METER

WTW Multi 3410

S#: 12480473

Probe: SC-FDO 925

S#: 12470839

Date:

27/11/2014

Time: 8:15

Calibration parameter	Relative Slope	Sensor Indicator	Signature
Dissolved Oxygen	0.99	+++	John Sloan

RTI - DL - RELEASE - EPA

Appendix D

Sample submission records.
Analytical Services Tasmania analysis results.
TasWater analysis results,
QC assessment.

RTI - DL - RELEASE - EPA

TasWater - Sample Submission Form

Project: [SW/RWS/MARGATE] Margate Groundwater Monitoring
 Taken By: frances.smith
 Sample Group:

Sampled Location	Collection Date/Time	AST	SPL	pH
[DPSTE63] Margate Groundwater/Lagoon 1 Operational	27/11/14 10:30	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
[DPSTE64] Margate Groundwater/Lagoon 2 Operational	27/11/14 11:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
[DPSTE60] Margate Groundwater/MARGW1 Groundwater	27/11/14 12:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
[DPSTE61] Margate Groundwater/MARGW2 Groundwater	27/11/14 14:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
[DPSTE62] Margate Groundwater/MARGW3 Groundwater	27/11/14 13:30	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
[DUP01] Duplicate/Unknown Sample Site Unclassified	27/11/14	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

+ CONDUCTIVITY

"
"
"
"
"

Required Tests:

- AST/DPSTE63, AST/DPSTE64, AST/DPSTE60, AST/DPSTE61, AST/DPSTE62, AST/DUP01: (Calcium, mg/L, [Ca_tot]), (Carbonate, mg/L, [Carbonate]), (Chloride, mg/L, [Chloride]), (HCO3, mg/L, [HCO3_]), (Potassium, µg/L, [K]), (Magnesium, mg/L, [Mg_tot]), (Nitrogen, mg/L, [N_tot]), (Sodium, mg/L, [Na_tot]), (Ammonia, mg/L, [NH3_N]), (Nitrite (as N), mg/L, [NO2_N]), (Nitrate N, mg/L, [NO3_N]), (Orthophosphorus as P, mg/L, [OrthoP]), (Phosphorus, mg/L, [P_tot]), (Sulphate, mg/L, [SO4]), (TDS Standards Methods, mg/L, [TDS_S])
- SPL/DPSTE63, SPL/DPSTE64, SPL/DPSTE60, SPL/DPSTE61, SPL/DPSTE62, SPL/DUP01: (Ecoli MF, cfu/100mL, [Ecoli_WW]), (Enterococci, cfu/100mL, [Enterococci]), (Thermotolerant Coliforms, cfu/100mL, [TTColi])

SUBMITTED BY: John Slowe 27/11/14
15:35

RTI - RELEASED - EPA

ANALYTICAL SERVICES TASMANIA

New Town Laboratory

18 St Johns Avenue

New Town, Tasmania, Australia, 7008

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Tasmania

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Laboratory Report

Report No: 68206

Issue No 1

Report Date 19-Dec-2014 16:25

Status: Full Report

Site Description: SW/RWS/MARGATE

Received: 28-Nov-14

Submitted to: New Town Laboratory

Submitted By: John Sloane (SLOANE GEOSCIENCE)

Client Order No: 14/8821

Report To: Frances Smith

Client: Tas Water South

Address: GPO Box 1393 HOBART TAS 7001

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Samples analysed as received.



ANALYTICAL SERVICES TASMANIA

Report No: 68206 **Issue No:** 1 **Report Date:** 19-Dec-2014 16:25

Method	Analyte	Units / Sampled On :	Sample Id.:	277645	277646	277647	277648	277649	277650
			DPSTE63:Lagoon 1	DPSTE64:Lagoon 2	DPSTE60:MARGW 1	DPSTE61:MARGW 2	DPSTE62:MARGW 3	DUP01	
			27/11/14 10:30	27/11/14 11:00	27/11/14 12:00	27/11/14 14:00	27/11/14 13:30	27/11/14	
1002-Water	Conductivity	µS/cm		995	1070	19100	20200	18900	18900
1004-Water	TDS	mg/L		540	518	12700	14100	12500	12600
1101-Water	Alkalinity CO3	mg CaCO3/L		<u><2</u>	<u><2</u>	<u><2</u>	<u><2</u>	<u><2</u>	<u><2</u>
	Alkalinity HCO3	mg CaCO3/L		<u>223</u>	<u>220</u>	<u>101</u>	<u>73</u>	<u>16</u>	<u>17</u>
1103-Water	Chloride	mg/L		168	146	6600	7180	6680	6630
	Sulphate	mg/L		38.8	34.9	395	402	387	381
1205-Water	Ammonia	mg-N/L		49	45	<0.005	0.019	<0.005	<0.005
	Nitrate	mg-N/L		0.005	0.060	0.022	0.004	0.037	0.037
	Nitrite	mg-N/L		<u>0.009</u>	<u>0.13</u>	<u><0.002</u>	<u><0.002</u>	<u><0.002</u>	<u><0.002</u>
	Phosphorus, Dissolved Re	mg-P/L		7.0	8.4	0.28	0.011	0.073	0.073
1206-Water	Nitrogen, Total	mg-N/L		69	53	0.19	0.24	0.24	0.27
	Phosphorus, Total	mg-P/L		10	9.4	0.31	1.1	0.18	0.18
1301-Water	Ca Total	mg/L		14.4	14.3	283	446	247	246
	K Total	mg/L		20.0	18.2	16.2	14.8	14.2	14.1
	Mg Total	mg/L		12.6	11.2	838	1030	893	892
	Na Total	mg/L		116	106	2620	2380	2440	2470

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Results underlined indicate the recommended sample holding time before analysis has been exceeded.

ANALYTICAL SERVICES TASMANIA

Report No: 68206 **Issue No:** 1 **Report Date:** 19-Dec-2014 16:25

Test Method(s) :

Test Date

Inorganic Testing

1002-Water:	Conductivity in Water at 25°C	02-Dec-2014
1004-Water:	Solids, Total Dissolved dried at 180 ± 5 °C	02-Dec-2014
1101-Water:	Alkalinity in Water to pH 4.5	02-Dec-2014
1103-Water:	Anions in Water by Ion Chromatography	08-Dec-2014
1301-Water:	Metals in Water by ICP-AES	08-Dec-2014

Authorised By:



Glen Naphthali
Section Head - Inorganic
(Nutrients)

Organic and Nutrient Testing

1205-Water:	Dissolved Nutrients by FIA	15-Dec-2014
1206-Water:	Total Nutrients by Kjeldahl Digest and FIA	15-Dec-2014

Authorised By:



Glen Naphthali
Section Head - Inorganic
(Nutrients)

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TasWater

Selfs Point Laboratory Test Report

Selfs Point Laboratory, Selfs Point Rd, New Town, TAS 7008

Ph: 6237 8603 Fax 6278 8465

Job Description: SW/RWS/Margate

Samples Received: 27/11/14

Testing commenced: 27/11/14

Job Status: Final Report

Laboratory Reference: 14/8820

Finalised Date: 2/12/14

Attention: Judi Marshall

Phone Number: 0408 175 522

Email: judi.marshall@taswater.com.au

Description	Location Type	Sample Type	Collection Date	Collection Time	Sample Number	Thermotolerant Coliforms	E. coli	Enterococci
Test method (SPL-TM-)						3813	3813	3804
						cfu/100mL	cfu/100mL	cfu/100mL
DPSTE60:MARGW1		Asep Grab	27/11/2014	10:30	2030	20	<10	<10
DPSTE61:MARGW2		Asep Grab	27/11/2014	11:00	2031	<10	<10	<10
DPSTE62:MARGW3		Asep Grab	27/11/2014	12:00	2032	<10	<10	<10
DPSTE63: Margate lagoon 1		Asep Grab	27/11/2014	14:00	2033	430000 / est	430000 / est	28,000



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Description	Location Type	Sample Type	Collection Date	Collection Time	Sample Number	Thermotolerant Coliforms	E. coli	Enterococci
DPSTE64: Margate lagoon 2		Asep Grab	27/11/2014	13:30	2034	380	380	150
DUP01: Unknown Duplicate		Asep Grab	27/11/2014		2035	<10	<10	<10

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Appendix E:

Explanatory notes for water quality assessments.

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EXPLANATORY NOTES FOR GROUNDWATER & SURFACE WATER QUALITY ASSESSMENT TABLES

SALINITY (TDS, EC & ECse) CRITERIA ARE USED TO INITIALLY DETERMINE WHICH ADWG &/or ANZECC GUIDELINE VALUES ARE RELEVANT FOR ASSESSMENT OF A SPECIFIC SAMPLE.

Assessment Tables are derived from:

ADWG 2011: NHMRC/NRMMC Australian Drinking Water Guidelines

ANZECC 2000: Guidelines for Fresh & Marine Water Quality

NEPM 1999: National Environment Protection (Assessment of Site Contamination) Measure.

The following shading has been applied, with guideline limit exceedance shading (blue) overriding ANZECC range assessment (grey) or ANZECC aquatic ecosystem (green) shading.

	Result exceeds ADWG health-based guideline value Result exceeds ANZECC irrigation/livestock drinking guideline value or is above upper value of guideline range
	Result exceeds an ADWG aesthetic guideline value Result is within an ANZECC irrigation/livestock drinking guideline range, requiring specific suitability assessment
	Result exceeds ANZECC aquatic ecosystem DTV or NEPM GIL

Values in parentheses indicate aesthetic (not health based) values only eg. (250)

* - ECse has been calculated assuming a loam soil type (average root zone LF = 0.33)

** - Set to limit the potential for corrosion and fouling of pumping, irrigation and stock watering systems.

STV - Short term trigger value for contaminant in irrigation water (<20 years) use

LTV - Long term trigger value for contaminant in irrigation water (100 years) use

a - requires site-specific assessment

b - set to minimise bioclogging of irrigation equipment

LOR - Laboratory limit of reporting for each individual chemical group constituent

(1) Suitability depends on salt tolerance of crop & calculation of ECse, the average root zone salinity.

ECse depends on soil type & average root zone leaching fraction.

(ANZECC Tables 4.2.3 & 4.2.4)

ECse (dS/m)	Water or soil salinity rating	Plant salt tolerance groupings
<0.95	Very low	Sensitive crops
0.95-1.9	Low	Moderately sensitive crops
1.9-4.5	Medium	Moderately tolerant crops
4.5-7.7	High	Tolerant crops
7.7-12.2	Very High	Very tolerant crops
>12.2	Extreme	Generally too saline

(2) Depending on animal type, within this salinity range may be reluctance to drink or may be some scouring but stock should adapt without loss of production.

(ANZECC Table 4.3.1)

Livestock	TDS (mg/L)		
	No adverse affect	No loss of production	Loss of production & animal health
Beef Cattle	0-4000	4000-5000	5000-10 000
Dairy Cattle	0-2500	2500-4000	4000-7000
Sheep	0-5000	5000-10 000	10 000-13 000
Horses	0-4000	4000-6000	6000-7000
Pigs	0-4000	4000-6000	6000-8000
Poultry	0-2000	2000-3000	3000-4000

(3i) Chloride concentrations (mg/L) causing foliar injury in crops of varying sensitivity

(ANZECC Table 4.2.6)

Chloride concentration (mg/L)	Crop sensitivity
< 175	Sensitive
175-350	Moderately sensitive
350-700	Moderately tolerant
>700	Tolerant

(3ii) Risks of increasing Cd concentrations in crops due to Cl in irrigation waters

(ANZECC Table 4.2.7)

Irrigation water Cl conc. (mg/L)	Risk of increasing crop Cd conc.
0-350	Low
350-750	Medium
>750	High

(4) Sodium concentrations (mg/L) causing foliar injury in crops of varying sensitivity

(ANZECC Table 4.2.8)

Sodium concentration (mg/L)	Crop sensitivity
< 115	Sensitive
115-230	Moderately sensitive
230-460	Moderately tolerant
>460	Tolerant

(5) Depends on irrigation contact, crop type & withholding period for grazing.