Agnes Water STP Irrigation Area Monitoring Program

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1 INTRODUCTION

The Agnes Water Sewage Treatment Plant (STP), managed by TRILITY Pty Ltd is located approximately 5 km north of Deepwater National Park. The STP is a biological and nutrient removal (BNR) plant comprising inlet works, bioreactor, two clarifiers, a chlorine contact tank and four clay-lined storage lagoons, and discharges recycled water/effluent to an onsite irrigation area.

As per the Agnes Water STP Irrigation Management Plan (IMP), monitoring of soil within the effluent irrigation area must be undertaken annually (Vision Environment, 2016a). Monitoring for the IMP was undertaken in September and December 2016 (Vision Environment, 2016b, 2017), and May 2018 (Vision Environment, 2018), in addition to the current survey in June 2019.

During the EIS for the construction of the Agnes Water STP (Coleridge Water Engineers, 1998), a baseline soil survey was undertaken throughout Lot 20 and Lot 21 to determine which area contained suitable soils for the irrigation area to be located. The selected irrigation area was reported to contain silty to clayey sands on the surface, with a permeability rate of between 0.1 to 1.0 m/day. The surface soils overlie an impervious silty clay layer, with bedrock (Agnes Water Volcanics) present below. The clay layer is thought to seal groundwater from surface and near-surface water, leading to minimal infiltration of recycled water beyond the plant root zone, and therefore no adverse impacts on groundwater quality.

Treated effluent release occurs regularly via irrigation within the specified irrigation area, utilising treated effluent from Lagoon 3. The irrigation area is 48 ha, and an automated sprinkler system manages the irrigation to ensure over-irrigation does not occur and recycled water is spread evenly across the irrigation area. The maximum release of recycled water to the irrigation area over any 24-hour period is 900kL.

Soil monitoring of the irrigation area was undertaken by Miriam Vale Shire Council in 2003 and 2004 (MVSC, 2007), with monitoring undertaken by Vision Environment in September and December 2016 (Vision Environment, 2016b, 2017) as well as May 2018 (Vision Environment, 2018) as per the Agnes Water STP IMP (Vision Environment, 2016a).

Overall, soils in the irrigation area have been found to be similar to the reference soils for the majority of parameters, including nitrogen concentrations, cation exchange capacity and most exchangeable cations. Slightly higher soil pH has been recorded in the irrigation area but mean pH has remained within the optimal range for plant growth.

While higher conductivity and total soluble salts have been recorded at irrigation sites during 2016 to 2018, levels were below concentrations considered saline or sodic. However, during the May 2018 survey, sodium absorption ratio (SAR) values in the surface layers of most irrigation sites indicated the presence of sodic soils, which may result in reduced plant growth. Total phosphorus was also found to be higher in irrigation areas, but as the phosphorus adsorption capacity (PAC) was also higher it appeared that the soils had the ability to respond to excess phosphorus concentrations (Vision Environment, 2018).

2 METHODOLOGY

2.1 Soil Collection

Soils from six pre-established locations within the irrigation area, and three pre-established up-gradient reference locations, were collected for analysis. Figure 1 shows the location of the sampling sites, with GPS locations tabulated in the Appendix (Table 10).

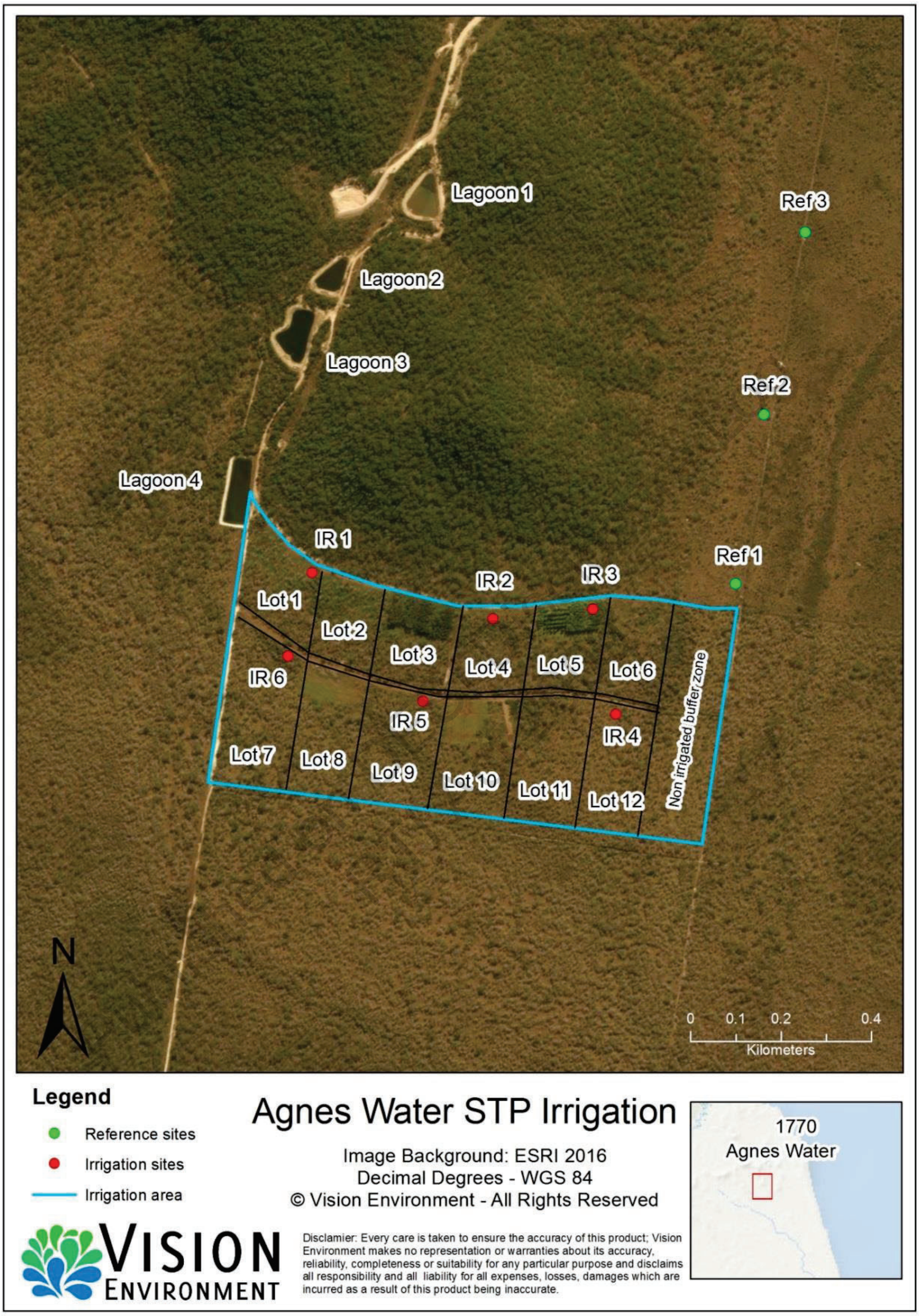

Figure 1 Location of Agnes STP soil monitoring sites

Sampling methodologies from standard protocols derived from worldwide authorities were used including: the Australian and New Zealand Standards for sediment sampling (AS/NZS, 1998); the American Public Health Association Standard Methods for the Examination of Water and Wastewater (APHA, 2005); and the Department of Environment and Science Monitoring and Sampling Manual (DES, 2018).

Sampling was undertaken on 27 June 2019. Soils were collected at three depths for each site (0 – 20 cm, 20 to 40 cm and 40 to 60 cm). A soil auger was used to dig for the sub-surface samples (Figures 2 to 6). Approximately 1L of soil was collected at each sample depth using a trowel and deposited into the labelled laboratory provided sample containers. Samples were kept cool in an esky prior to being transported to the NATA-accredited analytical laboratory (ALS), using strict chain of custody procedures.

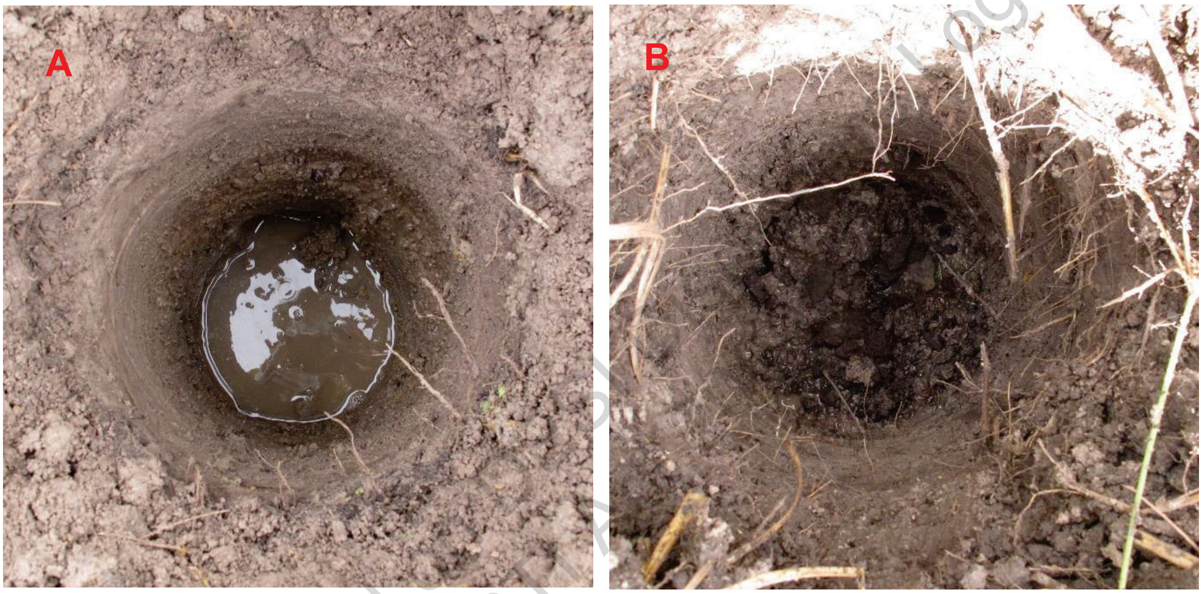

Figure 2 Soil cores at sites A) IR1 and B) IR2.

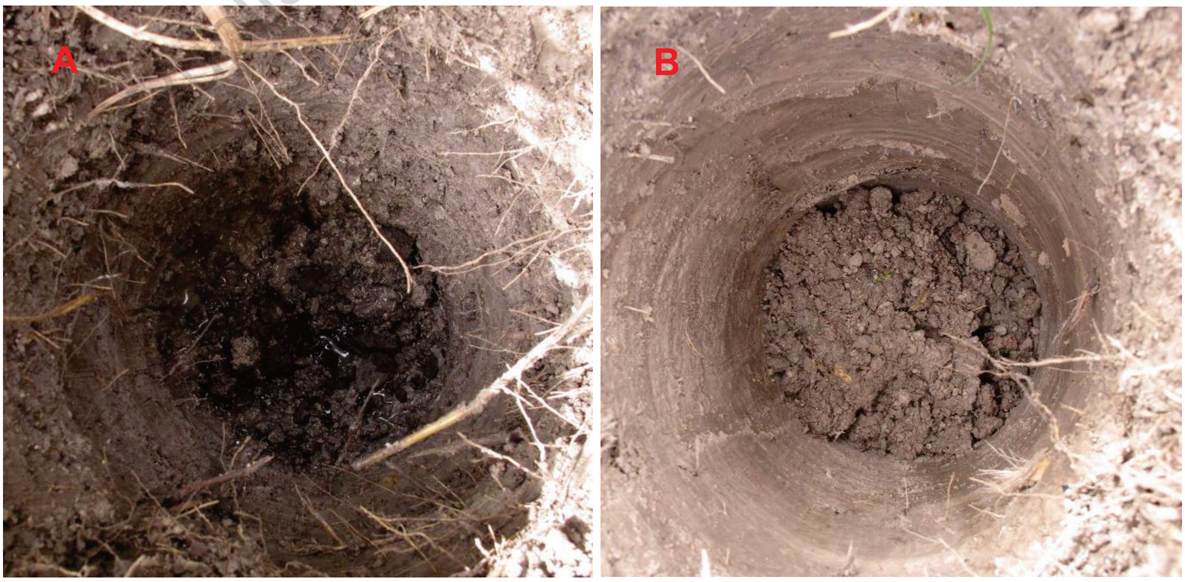

Figure 3 Soil cores at sites A) IR3 and B) IR4.

Figure 4 Soil cores at sites A) IR5 and B) IR6.

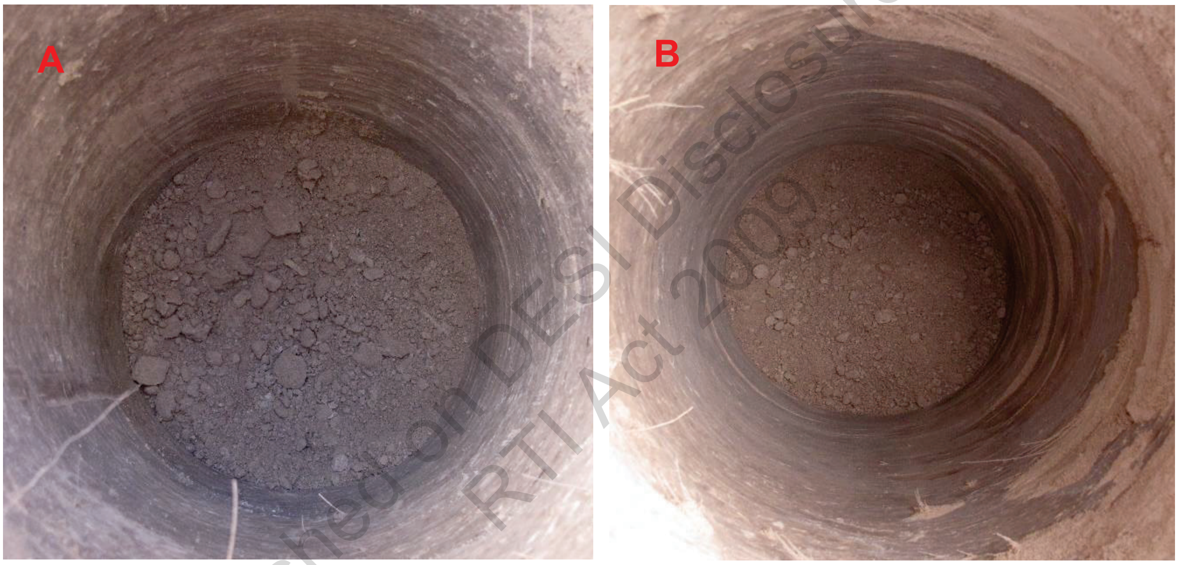

Figure 5 Soil cores at sites A) REF1 and B) REF2.

Figure 6 Soil core at site REF3.

2.2 Soil Analysis

As per EA EPPR00959915 and the GRC IMP, the following laboratory analyses were undertaken:

- pH
- Salinity
- Nutrients (total nitrogen, total phosphorus, organic nitrogen, nitrate and nitrite)
- Phosphorus adsorption capacity
- Cation Exchange Capacity
- Exchangeable Cations
- Sodicity
- Sodium Absorption Ratio

Particle size analysis and Emerson Aggregate Test were also undertaken on the soils during June 2019. These analyses are scheduled to be undertaken triennially, and were last carried out in September 2016 (Vision Environment, 2016b).

2.3 Data Analysis

Soil data was compiled, with data pooled from each type of location: irrigated and reference; and statistical analysis carried out to determine if the soils differed significantly between the two locations, potentially indicating impacts from recycled water. Two-way analyses of variance (ANOVA) were undertaken to determine whether there were any significant difference in soil parameters between locations (irrigation and reference) and/or depths (surface, mid or sub-surface) during the June 2019 survey. Fisher's LSD *Post hoc* multiple comparison tests were used to elucidate any significant differences among zones.

Temporal analysis of the data was also undertaken using Two-way ANOVA and Fisher's LSD *Post hoc* multiple comparison tests, to determine whether there were any statistical differences in soil parameters between surveys (September 2016, December 2016, May 2018 and June 2019) and/or locations (irrigated and reference).

3 RESULTS AND DISCUSSION

3.1 Soil Moisture

Soil moisture was determined at all three soil depths for each site. Table 1 lists the mean moisture at each soil depth for the irrigation and reference locations in June 2019 while Figure 7 exhibits mean soil moisture in September 2016, December 2016 and May 2018 in addition to June 2019. See Table 12 in Appendix for individual site and soil levels during June 2019.

Table 1. Soil moisture (%) at different sample depths in the irrigation area and reference locations in June 2019.
Values are means ± se (n = 3 to 6).

Parameter	Irrigation Area			Reference Area		
	0-200 mm depth	**200-400 mm depth**	**400-600 mm depth**	**0-200 mm depth**	**200-400 mm depth**	**400-600 mm depth**
Moisture (%)	23 ± 3	18 ± 1	19 ± 2	14 ± 1	12 ± 1	12 ± 1

During the June 2019 survey, soil moisture was significantly ($P < 0.05$) lower in the reference area (10 to 15 % moisture) than in the irrigation area (12 to 32 % moisture), most likely due to the regular application of water to the latter area (Table 1). This has been a consistent pattern over the four surveys undertaken since September 2016 (Figure 7). However, there was no significant difference with soil depth, indicating soil moisture was consistent throughout the three soil depths.

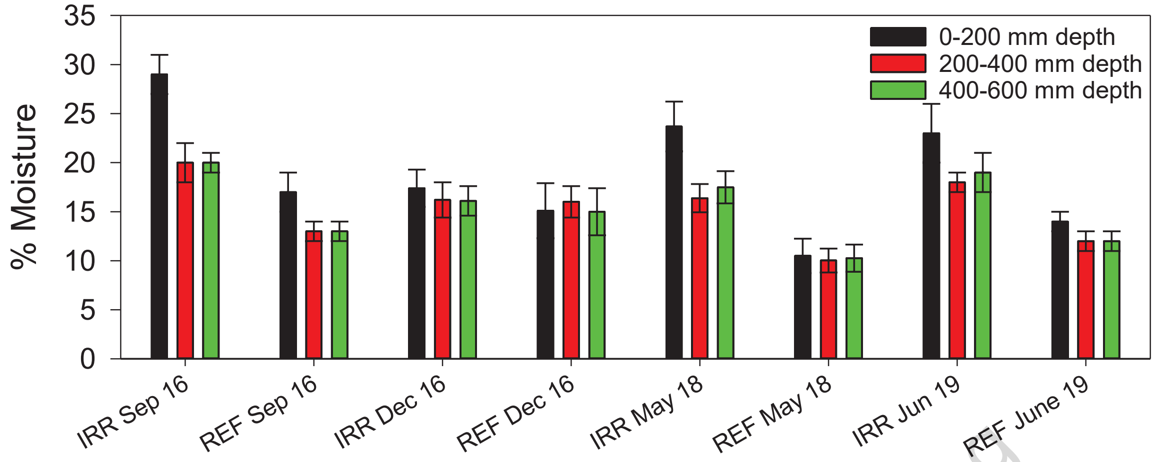

Figure 7 Mean soil moisture (%) at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2019.
Values are means ± se (n = 3 to 6).

A temporal comparison of soil moisture in the irrigation area indicates that soil moisture during the initial survey in September 2016 (20% moisture overall) was significantly higher ($P < 0.05$) than during the latter three surveys in June 2019 (17 %), May 2018 (16%) and December 2016 (16 %). This may be due to the change in irrigation regime undertaken since September 2016 by TRILITY Pty Ltd, where irrigation is generally applied to each lot every three to four days, instead of lower volumes on a daily basis.

Water was recorded in the IR1 and IR5 sample holes during June 2019 (Figures 2 and 4), suggesting the potential waterlogging of the soil. However, documented irrigation disposal records from the Agnes Water STP indicate that irrigation rates are within EA EPPR00959913 conditions of ≤ 900kL/day (TRILITY Pty Ltd, pers. comm.).

3.2 Soil Type and Structure

Soil type and structure was identified by undertaking particle size distribution (PSD) and the Emerson Aggregate Test (EAT). PSD provided an indication of the size of the soil particles within the sample, while EAT classifies the structural stability of the soil.

Table 2 and Figure 5 exhibits the mean particle size distribution at each soil depth for the irrigation and reference locations, while Table 13 in Appendix lists individual site and soil composition during June 2019.

Particle size distribution was consistent between the irrigated and reference locations, as well as across the different sample depth, similar to what was recorded in September 2016 (Vision Environment, 2016b).

Table 2. Mean particle size distribution at different soil depths in the irrigation area and reference locations during June 2019.
Values are means ± se (n = 3 to 6).

Particle size	Irrigation Area (%)			Reference Area (%)		
	0-200 mm depth	200-400 mm depth	400-600 mm depth	0-200 mm depth	200-400 mm depth	400-600 mm depth
Fines (<75 µm)	68 ± 7	62 ± 9	65 ± 9	79 ± 10	78 ± 12	77 ± 12
Sand (75 µm – 2 mm)	31 ± 7	34 ± 8	30 ± 7	20 ± 9	21 ± 11	21 ± 10
Gravel (>2 mm)	1 ± 0	3 ± 2	6 ± 3	2 ± 1	1 ± 1	2 ± 2

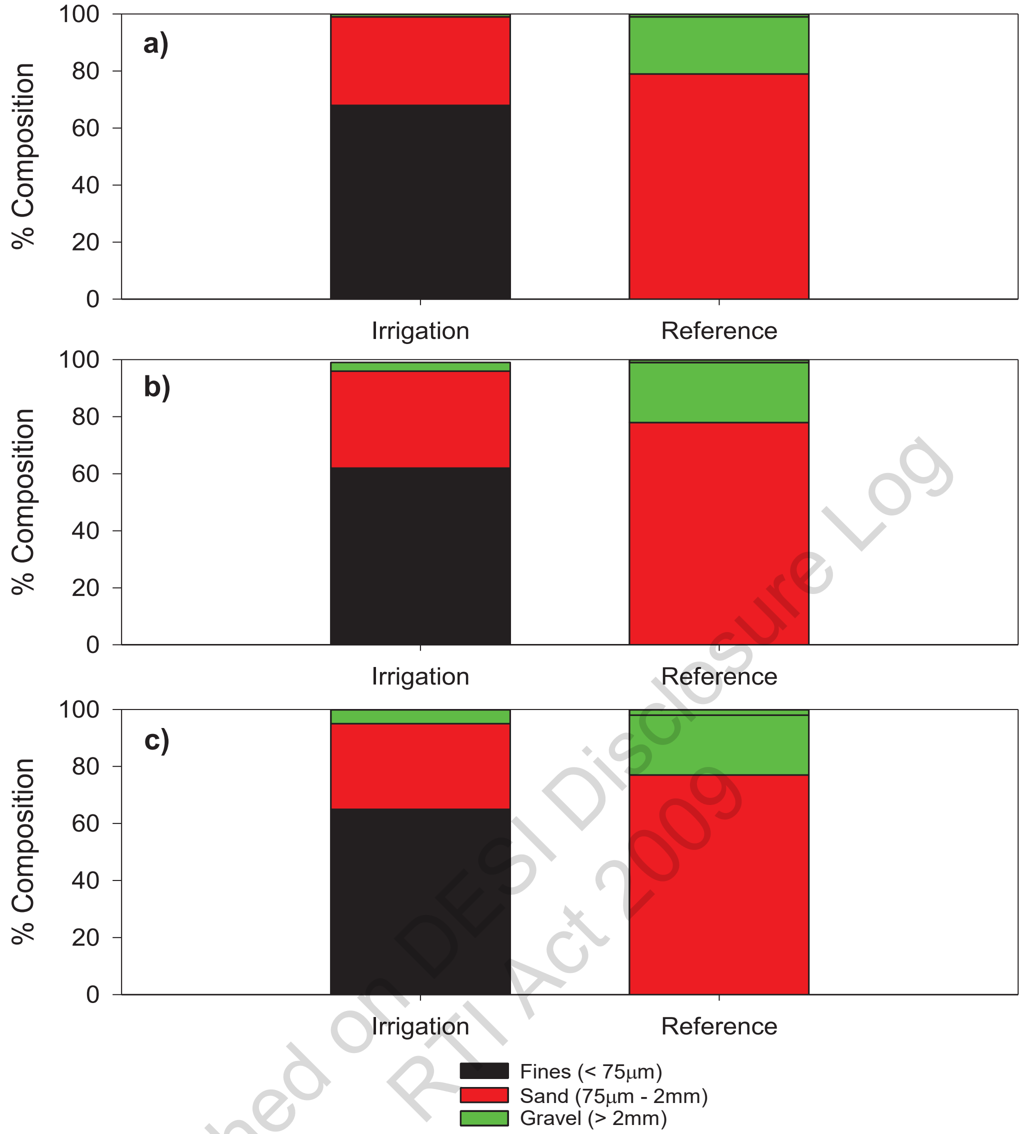

Figure 8. Mean particle size distribution in; a) surface soil (0 – 200mm depth); b) mid soil (200 to 400 mm depth), and; c) sub soil (400 to 600 mm depth) at irrigation and reference locations during June 2019.

The EAT test provides the Munsell soil colour (which can assist in indicating the makeup of a soil), soil texture classification (e.g. loam, clay) and a class number. Table 3 provides the Munsell colour classification of the topsoil and sub-surface soils at each sample site. Most soils were similar, ranging from reddish grey to very dark grey, the natural colour of mineral grains (Owens and Rutledge, 2005). Of note were the surface soils at IR2 which were black suggesting soil with a higher organic content (Owens and Rutledge, 2005). All soils at IR3 were classified as brown indicating higher organic content than the grey hued soils.

The texture classification of the topsoil and sub-surface soils at each sample site are listed in Table 4. Soils were found to be predominantly loam, with sand and/or clay components.

The Emerson Class Number for the topsoil and sub-surface soils from each sample site are provided in Table 5. The class number can range from 1 (highly dispersive soils with the least stable structure) to 8 (low dispersion, stable soils). Soils with an EAT score of 4 to 8 are considered more suitable for recycled water irrigation (AMPC, 2012), while suboptimal plant growth is often observed in soils with an EAT of 2 to 3, which all soils in the current study were found to be. These soils are considered to be moderately dispersive.

Table 3. Munsell colour classification for soils at different sample depths during June 2019.

Location	Sample	Munsell Colour		
		0 - 200 mm depth	200 - 400 mm depth	400 - 600 mm depth
Irrigation Plots	IR1	Reddish Gray	Grayish Brown	Grayish Brown
	IR2	Black	Dark Gray	Dark Gray
	IR3	Brown	Brown	Brown
	IR4	Dark Gray	Dark Gray	Brown
	IR5	Dark Gray	Dark Gray	Dark Gray
	IR6	Very Dark Gray	Dark Gray	Gray
Reference	R1	Gray	Gray	Gray
	R2	Gray	Brown	Gray
	R3	Gray	Light Brownish Gray	Gray

Table 4. Texture classification for soils at different sample depths during June 2019.

Location	Sample	Soil Texture		
		0 – 200 mm depth	200 – 400 mm depth	400 – 600 mm depth
Irrigation Plots	IR1	Sandy Loam	Sandy Loam	Sand Clay Loam
	IR2	Clay Loam	Sand Clay Loam	Sandy Loam
	IR3	Sandy Loam	Sandy Loam	Sandy Loam
	IR4	Clay Loam	Clay Loam	Clay Loam
	IR5	Clay Loam	Clay Loam	Clay Loam
	IR6	Clay Loam	Clay Loam	Clay Loam
Reference	R1	Clay Loam	Clay Loam	Clay Loam
	R2	Clay Loam	Clay Loam	Clay Loam
	R3	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam

Table 5. Emerson Class Number for soils at different sample depths during June 2019.

Location	Sample	Emerson Class Number		
		0 – 200 mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	2	2	2
	IR2	3	2	2
	IR3	3	3	2
	IR4	2	2	2
	IR5	2	2	2
	IR6	2	2	2
Reference	R1	2	2	2
	R2	2	2	2
	R3	2	2	2

3.3 Soil pH

The pH is an indication of the acidity or alkalinity of the soil, which has the ability to increase or decrease nutrient availability (APHA, 2005). Most phases of wastewater treatment are pH dependent. As such, the pH of the recycled water may vary, resulting in different effects on irrigated soil. Daily records of Lagoon 3 water during June 2019 indicates pH ranged between 7.8 and 8.9 (TRILITY Pty Ltd, pers. comm).

Table 6 lists the mean pH at each soil depth for the irrigation and reference areas in June 2019, while Figure 9 exhibits mean soil pH during each of the four surveys since September 2016. See Table 12 in Appendix for individual site and soil levels during June 2019.

Table 6. Mean pH at different soil depths in the irrigation area and reference locations in June 2019. *Values are means ± se (n = 3 to 6).*

Parameter	Irrigation Area			Reference Area		
	0 – 200 mm depth	**200 – 400 mm depth**	**400 – 600 mm depth**	**0 – 200 mm depth**	**200 – 400 mm depth**	**400 – 600 mm depth**
pH	6.9 ± 0.2	6.8 ± 0.2	6.4 ± 0.3	5.5 ± 0.2	6.3 ± 0.3	6.4 ± 0.5

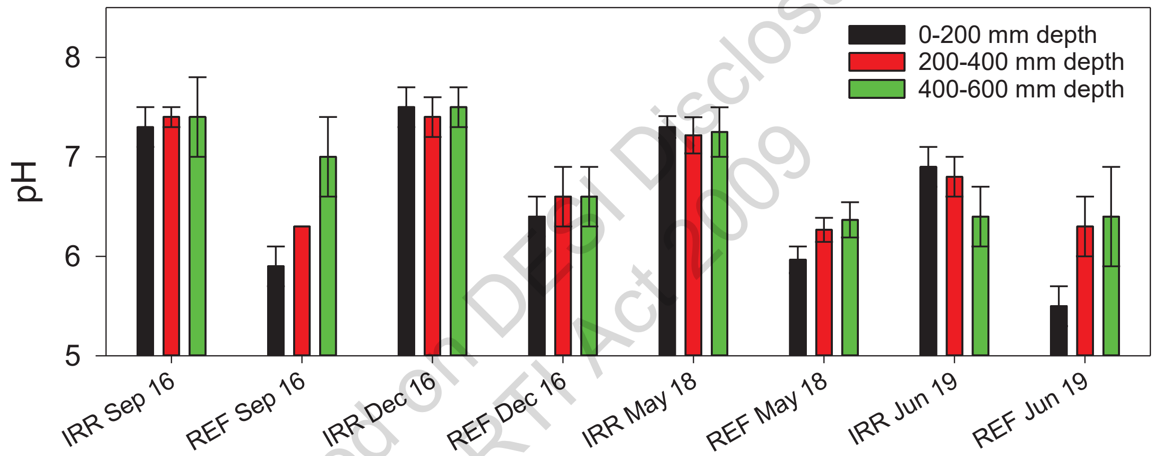

Figure 9 Mean soil pH at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2019.
Values are means ± se (n = 3 to 6).

During the June 2019 survey, significantly ($P < 0.05$) higher pH was evident at the irrigated sites (mean = 6.7) in comparison with the reference sites (mean = 6.1), potentially indicating effects from the more alkaline recycled water. This has been a consistent pattern over the four surveys. However, soil pH overall during the June 2019 survey was significantly lower (mean of 6.5) than the previous three surveys (6.9 to 7.2). A decrease was evident in both the irrigation and reference sites indicating that irrigation water was not the source of the decreased pH.

It has been found that in warm, humid climates soil pH decreases over time in a process called soil acidification due to leaching from rainfall (NRCS, 1998). This may be what is occurring in these areas. Subsequent monitoring will determine whether pH continues to decrease.

Soil pH between 6.0 to 7.5 is considered optimal as it maximises nutrient availability for plants, and hence the potential for plant growth (AMPC, 2012). Mean pH across both irrigation and reference locations were within this range during the four surveys to date, indicating minor, if any, adverse effects of the recycled water irrigation.

3.4 Soil Nutrients

Mean nutrient concentrations at each soil depth for the irrigation and reference locations are shown in Table 7 and Figures 10 and 11, while Tables 14 to 16 in the Appendix list individual site soil nutrient levels during June 2019.

Table 7. Mean nutrient concentrations at different soil depths in the irrigation area and reference locations in June 2019.
Values are means ± se (n = 3 to 6). TKN = Total Kjeldahl Nitrogen. PAC = Phosphorus Adsorption Capacity.

Nutrient (mg/kg)	Irrigation Area			Reference Area		
	0 – 200 mm depth	200 – 400 mm depth	400 – 600 mm depth	0 – 200 mm depth	200 – 400 mm depth	400 – 600 mm depth
Total Nitrogen	655 ± 194	332 ± 59	247 ± 40	497 ± 87	350 ± 64	180 ± 60
TKN	655 ± 194	330 ± 58	247 ± 40	497 ± 87	350 ± 64	180 ± 60
Ammonia	<20	<20	<20	<20	<20	<20
Nitrate	1.7 ± 0.8	1.5 ± 1.3	1.0 ± 0.5	0.2 ± 0.1	0.7 ± 0.3	0.9 ± 0.4
Nitrite	<0.1	<0.1	<0.1	<0.1	0.2 ± 0.2	0.3 ± 0.2
Phosphorus	72 ± 25	43 ± 13	26 ± 3	20 ± 4	19 ± 3	16 ± 2
PAC	283 ± 61	348 ± 49	364 ± 143	571 ± 114	492 ± 113	403 ± 58

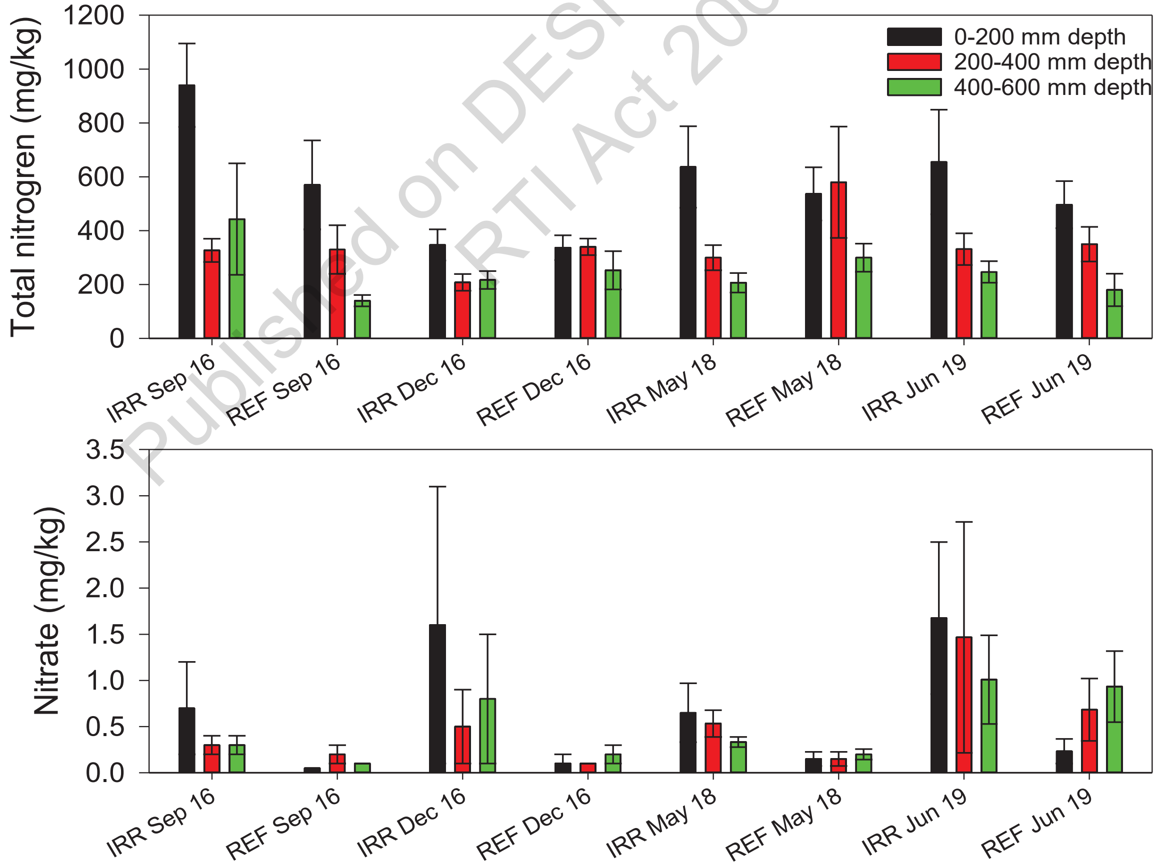

Figure 10 Mean total nitrogen and nitrate concentrations at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2019.
Values are means ± se (n = 3 to 6). Nitrite and ammonia not plotted as < LOR.

Total nitrogen and a variety of nitrogen forms were examined, including the organic form of nitrogen (Total Kjeldahl Nitrogen or TKN), and the inorganic (and therefore readily bioavailable) forms for plant uptake (ammonia, nitrate and nitrite). Total nitrogen and TKN were found at similar concentrations in each sample, indicating that nitrogen was primarily in organic form, and therefore not readily bioavailable (Table 7).

During June 2019, total nitrogen was found to be similar between the irrigation (100 to 1580 mg/kg) and reference (110 to 670 mg/kg) areas. However, nitrogen was found to be significantly ($P < 0.05$) higher in the surface layer (mean = 602 mg/kg), than in the mid (338 mg/kg) and bottom layers (224 mg/kg), most likely due to decomposing plant material at the surface.

Of note was the high total nitrogen concentrations at IR2 surface (1580 mg/kg), which were almost triple the next highest surface concentrations (650 mg/kg) recorded at IR4 surface. The Munsell colour classification of IR2 surface soils (Table 3) indicated the presence of high organic matter, which is likely to be a repository for nutrients. No significant temporal variation in soil nitrogen (or TKN) was evident across the four surveys (Figure 10).

The bioavailable nitrogen forms of ammonia and nitrite were at or below laboratory detection limits at each site and depth (Table 7). Nitrate concentrations did not differ significantly between irrigated and reference sites, nor at different soil depths. No significant temporal variation in soil nitrate has been evident across the four surveys undertaken since September 2016 (Figure 10).

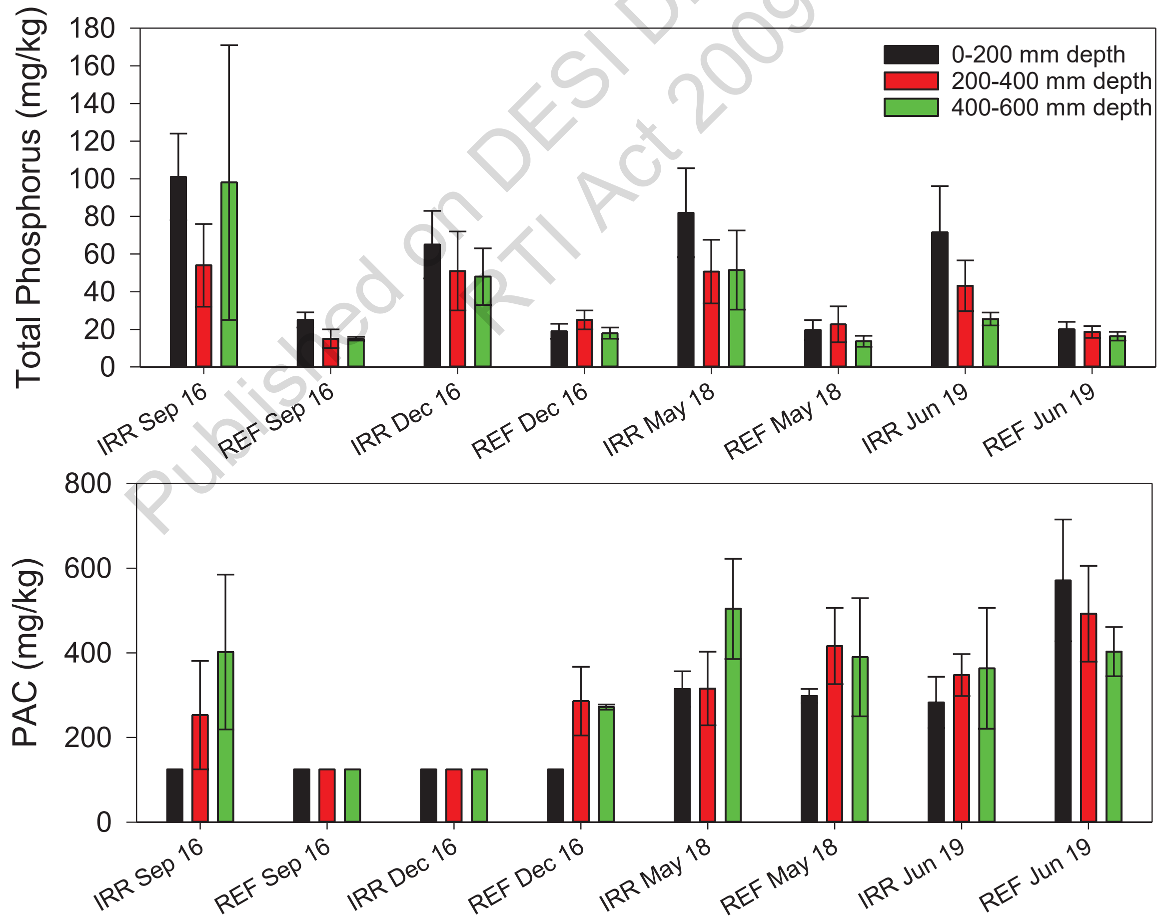

Figure 11 Mean total phosphorus concentrations and phosphate absorption capacity (PAC) at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2019. *Values are means ± se (n = 3 to 6).*

Total phosphorus, as well as the phosphate absorption capacity (PAC) of the soil was also quantified (Table 7). PAC provides an indication of the ability of the soil to absorb and retain phosphorus, making it unavailable for plant uptake. In the case of recycled water irrigation, a higher PAC is beneficial, with phosphorus from the recycled water removed and bound to soil particles. Therefore, any phosphorus in excess of plant uptake would be unable to move through to the groundwater.

In contrast to the previous three surveys, during June 2019 total phosphorus did not vary significantly between the irrigation (13 to 184 mg/kg) and reference sites (12 to 28 mg/kg). Nor was there any variation in total phosphorus concentrations between soil depths (Table 7). Similar to total nitrogen, high total phosphorus concentrations were evident at IR2 surface (184 mg/kg), almost double the next highest surface concentrations (98 mg/kg) recorded at IR1 surface. No significant temporal variation in soil total phosphorus was evident across the four surveys (Figure 11).

While no significant differences in phosphate adsorption capacity (PAC) were evident between the irrigated and reference sites during June 2019 (Table 7), the PAC during the most recent two surveys (June 2019 and May 2018) was significantly ($P < 0.05$) higher than concentrations recorded during the two 2016 surveys (Figure 11), indicating increased ability of the soil to respond to any excesses in phosphorus. An increase in soil organic matter is thought to increase the PAC (Yang *et al.*, 2019).

3.5 Soil Cations

The cation exchange capacity (CEC) was also quantified in the soil samples. The CEC is the quantity of exchangeable cations the soil can retain on its absorption complex at a given pH, with soils exhibiting a higher CEC able to retain nutrients more easily than low CEC soils (AMPC, 2012).

Exchangeable cations included calcium, magnesium, potassium and sodium ions. The mean CEC and individual exchangeable cation concentrations at each soil depth for the irrigation and reference locations are shown in Table 8 and Figure 12, while Tables 17 and 18 in Appendix list individual site and soil depths during June 2019.

Table 8. Mean cation exchange capacity and exchangeable cations and anions at different soil depths in the irrigation area and reference locations in June 2019.
Values are means ± se (n = 3 to 6).

Parameter (meq/100g)	Irrigation Area			Reference Area		
	0 – 200 mm depth	200 – 400 mm depth	400 – 600 mm depth	0 – 200 mm depth	200 – 400 mm depth	400 – 600 mm depth
Exchange Capacity	5.9 ± 1.3	3.2 ± 0.4	4.3 ± 1.2	2.8 ± 0.7	3.4 ± 1.1	4.1 ± 1.4
Ex. calcium	2.9 ± 1.0	1.0 ± 0.2	0.7 ± 0.2	0.3 ± 0.0	0.3 ± 0.0	0.2 ± 0.0
Ex. magnesium	1.3 ± 0.3	0.8 ± 0.1	1.9 ± 0.9	1.6 ± 0.4	1.9 ± 0.7	2.2 ± 0.8
Ex. potassium	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0
Ex. sodium	1.5 ± 0.3	1.1 ± 0.2	1.5 ± 0.3	0.7 ± 0.5	1.0 ± 0.5	1.4 ± 0.7

No significant difference in cation exchange capacity was evident between the irrigated and reference sites, indicating no apparent effect from irrigation with recycled water (Table 8). Additionally, there was no evidence of temporal variation in the cation exchange capacity across the four surveys (Figure 12).

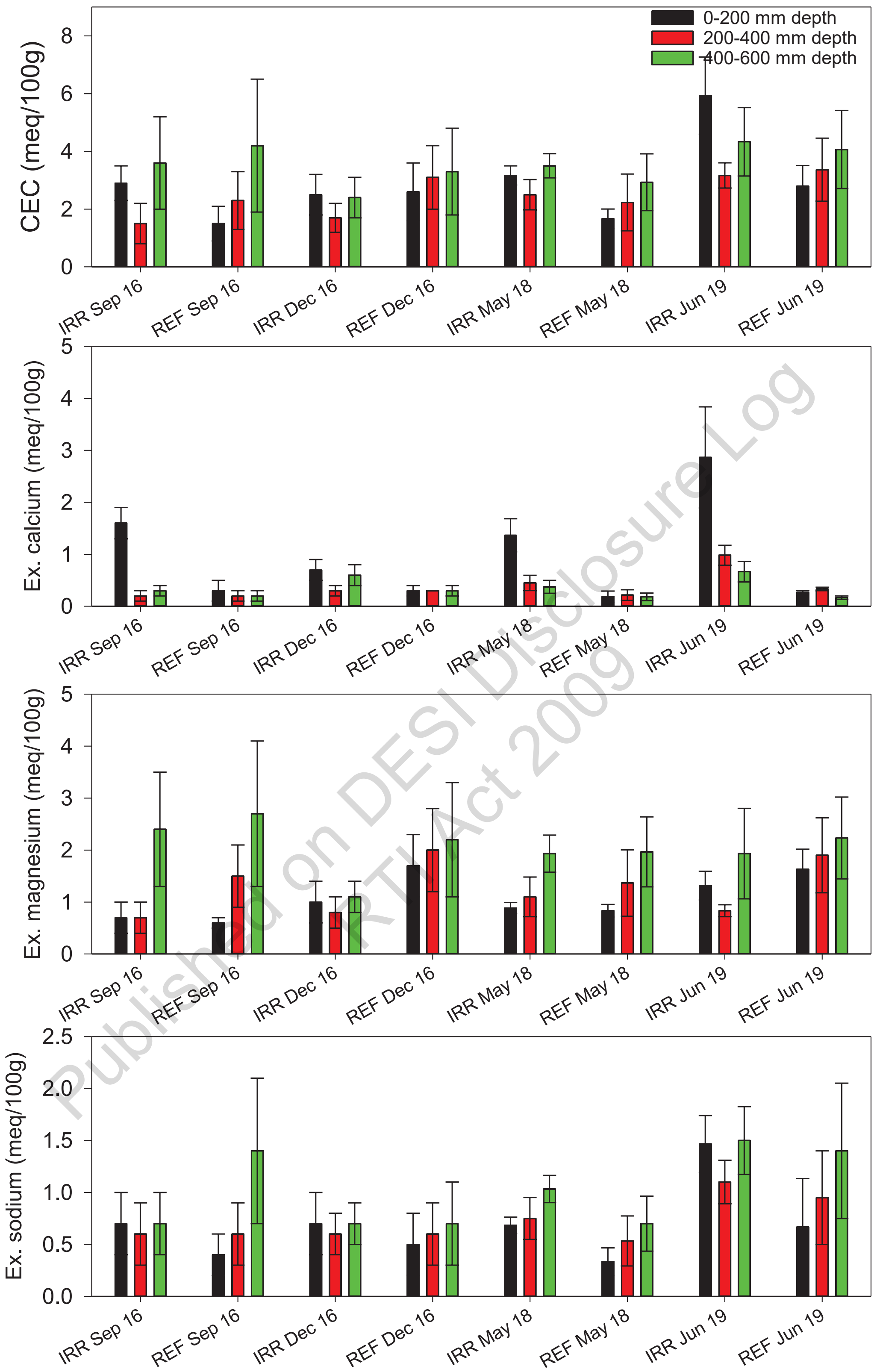

Figure 12 Mean Soil Cation Exchange Capacity (CEC) and exchangeable calcium, magnesium and sodium at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2019.
Values are means ± se (n = 3 to 6). Exchangeable potassium not plotted as mean values over surveys were generally ≤ LOR.

However, concentrations of exchangeable calcium and potassium were significantly ($P < 0.05$) higher in the irrigation area than in the reference area (Table 8). This has been a consistent pattern over time, evident during both the September 2016 and May 2018 surveys (Figure 12).

Exchangeable magnesium and sodium concentrations did not differ between the irrigation and reference areas (Table 8). However, exchangeable sodium during the June 2019 survey (mean of 1.2 meq/100g) was significantly higher than during previous surveys (0.66 to 0.72 meq/100g, Figure 12).

3.6 Soil Salinity/Sodicity

Soil salinity is indicated by high levels of salts in soils, while soil sodicity specifically indicates high sodium salt levels. Soil salinity or sodicity can be measured in a number of ways:

- Electrical conductivity, which is a measure of the soil solution to conduct electricity. Increased salts result in a higher conductivity, with an EC of > 4,000 µS/cm classified as saline soil;
- Total soluble salts (TSS), which refers to the total amount of dissolved salts in the soil;
- Exchangeable sodium percentage (ESP); the amount of sodium absorbed on soil particles as a percentage of the CEC; and
- Sodium Absorption Ratio (SAR), which is the ratio of sodium ions to magnesium and calcium ions in the soil. A SAR greater than 13 can indicate a sodic soil.

When soil salinity or sodicity increases, adverse effects on plant growth become evident (EPA, 2005). Plants affected by salinity or sodicity have a reduced growth rate, with increased salt concentrations potentially mobilising metals (particularly cadmium) into the soil and leading to metal contamination of the plant (NRMMC, 2006). Saline and sodic soils tend to have poor structure, making them less permeable, leading to runoff of irrigation (AMPC, 2012, EPA, 2005, NRMMC, 2006). When soil becomes saline or sodic, plants have difficulty extending their roots and may suffer from waterlogging and anoxia.

The mean conductivity, TSS, ESP and SAR for each soil depth at irrigation and reference locations are shown in Table 9 and Figure 13, while Tables 19 and 20 in the Appendix exhibit individual site and soil depths during June 2019.

Table 9. Mean conductivity, total soluble salts (TSS), exchangeable sodium percentage (ESP) and sodium absorption ratio (SAR) at different soil depths in the irrigation area and reference locations in June 2019.
Values are means ± se (n = 3 to 6).

Parameter	Irrigation Area			Reference Area		
	0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Conductivity (µS/cm)	124 ± 24	124 ± 20	133 ± 26	150 ± 100	126 ± 71	175 ± 88
Total Soluble Salts (mg/kg)	402 ± 79	401 ± 65	431 ± 84	488 ± 324	408 ± 230	570 ± 284
Exchangeable sodium percentage (ESP %)	28 ± 5	35 ± 3	37 ± 4	19 ± 9	24 ± 8	30 ± 9
Sodium absorption ratio (SAR)	15 ± 3	15 ± 2	17 ± 2	12 ± 6	9 ± 4	15 ± 6

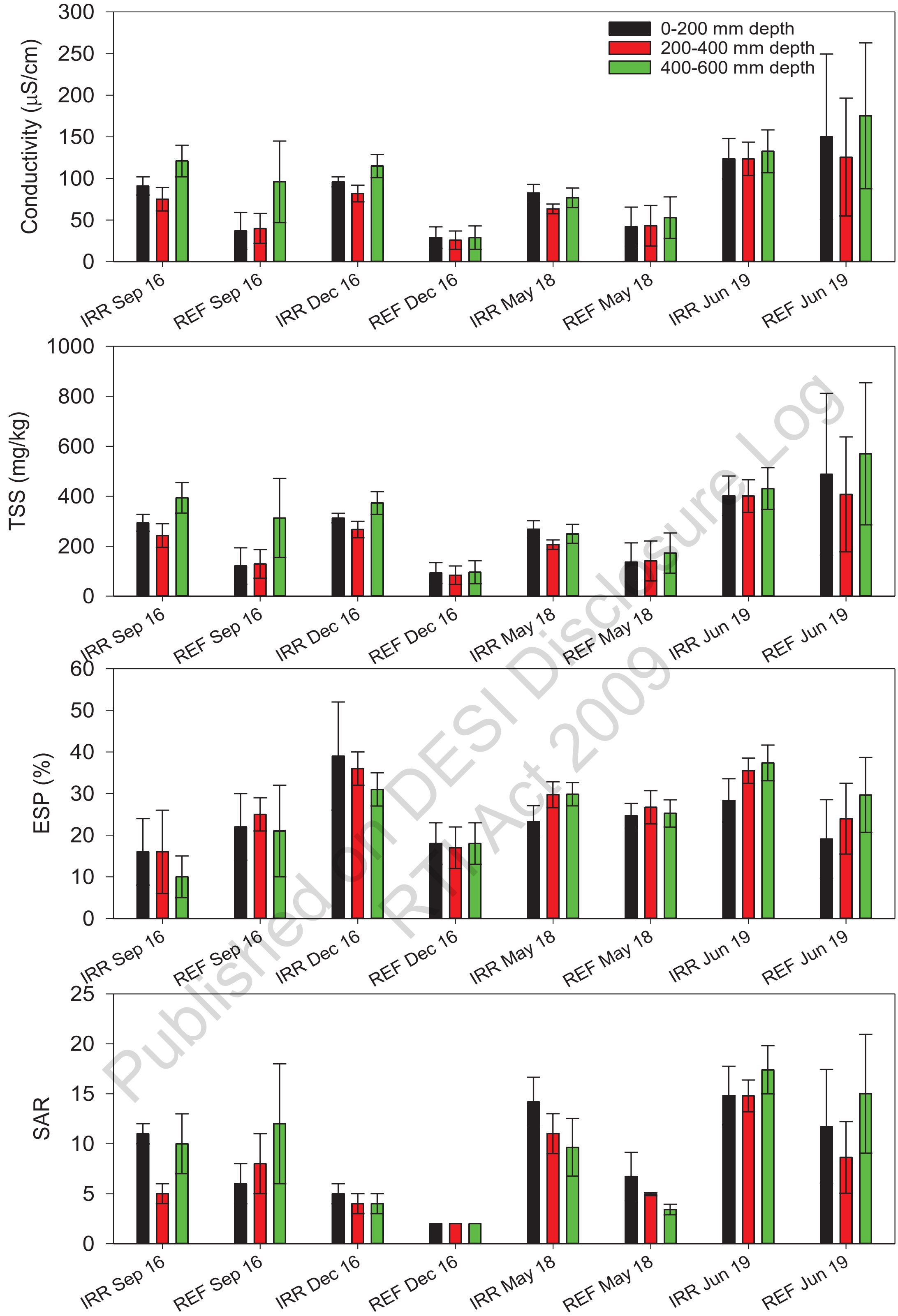

Figure 13 Mean conductivity, total soluble salts (TSS), exchangeable sodium percentage (ESP) and sodium absorption ratio (SAR) at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2019.
Values are means ± se (n = 3 to 6).

During June 2019, concentrations of conductivity, TSS, ESP and SAR were similar across the irrigated and reference sites (Table 9). This contrasts with the three previous surveys where conductivity, TSS and SAR were found to be significantly higher in the irrigated areas (Figure 13).

Temporal variation was also evident across the four surveys with a significant increase in conductivity, TSS, ESP and SAR during 2019, in comparison with the previous three surveys (Figure 13). As this was evident across both the irrigation and reference sites, it indicates that the irrigation water was not the cause of the increase.

The increase in these parameters may be due to the lower than typical rainfall experienced during July 2018 to June 2019 (732 mm) as recorded by the Bureau of Meteorology weather station (039314) at 1770. The average annual rainfall for the area is 1163 mm, as calculated from 1986 to 2019 (BOM, 2019). Decreased rainfall leads to decreased leaching of salts from the soils, resulting in higher soil salt concentrations.

Despite the higher values in 2019, conductivity values of all soil samples were well below 4,000 µS/cm, indicating none of these could be classified as saline. However, a mean SAR value of > 13 was recorded at all depths of the irrigation soils, and the lowest depth of the reference soils suggesting that these soils may potentially be sodic (contain high sodium levels).

4 SUMMARY AND RECOMMENDATIONS

Overall, soils tested in the irrigation area in June 2019 were similar to those in reference locations for many parameters, including concentrations soil particle size distribution, structure, nutrient concentrations, cation exchange capacity, some exchangeable cations and soil conductivity, total soluble salts (TSS), exchangeable percent sodium (ESP) and sodium absorption ratio (SAR).

Several parameters have been shown to consistently vary between the irrigated and reference areas over the past four surveys. These include soil moisture, most likely due to the regular application of irrigation to these sites; pH, although as mean values remain within the optimal range for plant growth, adverse impacts are unlikely; and exchangeable calcium and potassium.

Temporal variation was evident for several parameters during 2019. Overall, pH was lower across both the irrigation and reference locations, possibly indicating natural soil acidification processes occurring. Continued monitoring will determine whether this process is occurring. The phosphorus adsorption capacity (PAC) was higher during June 2019 than during the previous three surveys, which may be associated with an increase in soil organic matter. However, increased PAC lessens the potential availability of phosphorus to groundwaters and is not detrimental to the effluent irrigation program.

Increased conductivity, TSS, ESP and SAR were recorded in 2019 in comparison with the prior three surveys. This may be associated with the lower than average rainfall during the past year which has decreased the leaching of salts and ions from the soil. While the soils are not yet classified as saline, increased soil sodicity is indicated across both irrigated and reference locations, which may result in reduced plant growth rate.

As per the Agnes Water STP IMP (Vision Environment, 2016a), the following actions are recommended:

- Continue with annual monitoring in 2020, particularly for soil salinity measurements, pH and exchangeable cations;

- Continue to undertake temporal comparisons of soil parameters when additional data has been obtained in order to elucidate any temporal trends; and
- Undertake monitoring of soil type and structure (particle size distribution and Emerson Aggregate Test) in 2022. These parameters are required to be monitored triennially.

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6 APPENDIX

Table 10. GPS locations of monitoring sites captured in WGS84 and decimal degrees.

Location	Site	GPS Location
Irrigation Plots	IR1	S24.2781 E151.902
	IR2	S24.279 E151.902
	IR3	S24.2788 E151.902
	IR4	S24.2809 E151.902
	IR5	S24.2806 E151.902
	IR6	S24.2797 E151.902
Reference	R1	S24.2783 E151.902
	R2	S24.2749 E151.902
	R3	S24.2713 E151.902

Table 11. Summary of ALS Quality Control Data.

Report number	EB1917085
Laboratory Method Blank Concentration	Acceptable
RPD Laboratory duplicate	Acceptable, with the exception of higher (32%) than acceptable (0 – 20%) RPD for total phosphorus in one duplicate analysis
Recovery from laboratory control sample (LCS)	Acceptable
Recovery from matrix spike (MS) sample	Acceptable, with the exception of lower (65%) than acceptable (70 - 130%) recovery for total phosphorus in one MS sample

Table 12. Soil moisture and pH in soils at different sample depths.

Location	Site	Soil Moisture (%)			pH		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	16	19	28	7.1	6.7	5.0
	IR2	32	21	22	7.0	7.0	6.9
	IR3	25	17	17	7.1	7.3	7.2
	IR4	27	17	15	7.3	6.8	6.4
	IR5	23	20	19	7.3	6.6	6.6
	IR6	14	13	12	5.8	6.1	6.0
Reference	R1	15	12	12	5.2	6.2	6.3
	R2	12	10	12	5.6	6.9	7.3
	R3	14	13	10	5.7	5.7	5.6

Table 13. Particle size distribution in soil at different sample depths.

Location	Site	% Fines (< 75 µm)			% Sand (75 µm – 2mm)			% Gravel (> 2mm)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	51	35	69	47	53	22	2	12	9
	IR2	73	57	41	26	39	40	1	4	19
	IR3	44	41	37	56	58	60	1	1	3
	IR4	84	83	83	15	16	16	1	1	1
	IR5	84	85	86	15	14	14	1	1	<1
	IR6	74	73	72	26	26	28	<1	1	<1
Reference	R1	90	90	91	10	10	9	<1	<1	<1
	R2	88	90	88	12	10	12	<1	<1	<1
	R3	58	53	53	38	44	41	4	3	6

Table 14. Concentration of Total Kjeldahl Nitrogen and total nitrogen in soil at different sample depths.

Location	Site	Total Kjeldahl Nitrogen (mg/kg)			Total Nitrogen (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	270	210	210	270	210	210
	IR2	1580	470	250	1580	470	250
	IR3	340	130	100	340	130	100
	IR4	650	320	210	650	320	210
	IR5	500	360	370	500	360	370
	IR6	590	490	340	590	500	340
Reference	R1	670	470	300	670	470	300
	R2	430	330	130	430	330	130
	R3	390	250	110	390	250	110

Table 15. Concentration of ammonia, nitrite and nitrate in soils at different sample depths.

Location	Site	Ammonia (mg/kg)			Nitrate (mg/kg)			Nitrite (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	<20	<20	<20	0.4	<0.1	<0.1	<0.1	<0.1	<0.1
	IR2	<20	<20	<20	4.7	0.7	0.3	<0.1	<0.1	<0.1
	IR3	<20	<20	<20	0.1	<0.1	0.2	<0.1	<0.1	<0.1
	IR4	<20	<20	<20	<0.1	0.1	1.2	<0.1	0.2	<0.5
	IR5	<20	<20	<20	1.1	0.2	1.1	<0.1	<0.1	<0.5
	IR6	<20	<20	<20	3.7	7.7	3.2	<0.1	<0.1	<0.1
Reference	R1	<20	<20	<20	0.1	0.8	1.1	<0.1	<0.5	<0.5
	R2	<20	<20	<20	0.5	1.2	1.5	<0.5	0.6	0.7
	R3	<20	<20	<20	0.1	<0.1	0.2	<0.1	<0.1	<0.1

Table 16. Concentration of total phosphorus and phosphorus sorption capacity in soil at different sample depths.

Location	Site	Total Phosphorus (mg/kg)			Phosphorus Sorption Capacity (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	98	78	30	265	442	1020
	IR2	184	91	38	463	426	<250
	IR3	38	13	29	<250	305	<250
	IR4	36	18	15	<250	<250	<250
	IR5	41	26	19	272	431	455
	IR6	32	33	22	448	357	331
Reference	R1	28	24	20	385	279	351
	R2	16	19	12	474	534	339
	R3	16	13	17	854	664	519

Table 17. Cation exchange capacity and exchangeable calcium and magnesium in soil at different sample depths.

Location	Site	Cation Exchange Capacity (meq/100g)			Exchangeable Calcium (meq/100g)			Exchangeable Magnesium (meq/100g)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	3.8	3.2	9.9	1.2	0.9	0.6	0.7	0.9	6.2
	IR2	11.3	3.7	3.1	7.3	1.7	1.3	2.1	0.9	0.8
	IR3	2.3	1.9	2	0.9	0.8	0.5	0.4	0.3	0.6
	IR4	6.6	4.8	4.8	2.2	1.4	1.2	1.4	1.1	1.2
	IR5	7.6	3.3	3.8	3.7	0.6	0.1	2	1	1.8
	IR6	4	2.1	2.4	1.9	0.5	0.3	1.3	0.8	1
Reference	R1	1.9	4.2	5.8	0.3	0.4	0.2	1.3	2.3	3.3
	R2	4.2	4.7	5	0.2	0.3	0.2	2.4	2.9	2.7
	R3	2.3	1.2	1.4	0.3	0.3	0.1	1.2	0.5	0.7

Table 18. Exchangeable potassium and sodium in soil at different sample depths.

Location	Site	Exchangeable Potassium (meq/100g)			Exchangeable Sodium (meq/100g)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	0.3	0.2	0.3	1.6	1	2.6
	IR2	0.4	0.2	0.2	1.4	0.8	0.7
	IR3	0.1	0.1	0.1	0.9	0.7	0.7
	IR4	0.3	0.2	0.2	2.6	2	2.2
	IR5	0.2	0.2	0.2	1.6	1.4	1.7
	IR6	0.1	<0.1	<0.1	0.7	0.7	1.1
Reference	R1	<0.1	<0.1	<0.1	0.2	1.4	2.1
	R2	<0.1	<0.1	<0.1	1.6	1.4	2
	R3	<0.1	<0.1	<0.1	0.2	<0.1	0.1

Table 19. Conductivity and total soluble salts in soil at different sample depths.

Location	Site	Conductivity (µS/cm)			Total Soluble Salts (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	159	148	226	517	481	734
	IR2	93	64	58	302	207	188
	IR3	116	104	96	378	338	313
	IR4	222	205	183	721	665	594
	IR5	102	94	92	332	306	300
	IR6	50	126	141	162	410	457
Reference	R1	341	250	289	1110	812	940
	R2	103	122	234	333	396	759
	R3	6	5	3	20	15	11

Table 20. Sodium Absorption Ratio and exchangeable sodium (%) in soil at different sample depths.

Location	Site	Sodium Absorption Ratio			Exchangeable Sodium (%)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	26	15	24	42	34	27
	IR2	10	12	12	13	23	23
	IR3	14	13	14	38	35	36
	IR4	20	22	26	39	43	46
	IR5	13	17	13	22	44	45
	IR6	6	11	16	17	35	47
Reference	R1	8	12	19	8	35	37
	R2	23	13	23	38	30	40
	R3	4	2	3	11	7	12

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APRIL 2020 QUARTERLY REPORT

June 2020
J163599-03

Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

C114943: JH

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Definitions and Acronyms

Acronym	Definition
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZS 5667:11	Water Quality Sampling Part 11: Guidance on sampling of groundwaters (1998)
CoC	Chain of Custody
EHP	Department of Environment and Heritage Protection
ERA	Environmentally Relevant Activity
Greencap	Greencap Pty Ltd
IWTP	Integrated Water Treatment Plant
m AHD	metres Australian Height Datum
mg/L	milligrams per litre
ML	Mega Litre
NATA	National Association of Testing Authorities
NEPM	*National Environmental Protection (Assessment of Site Contamination) Measure 1999,* as amended May 2013
QA/QC	Quality Assurance / Quality Control
RPD	Relative Percent Difference
SWL	Standing Water Level
TOC	Top of Casing
Trility	Trility Pty Ltd
µS/cm	microsiemens per centimetre
µg/L	mircograms per litre
WwTP	Wastewater Treatment Plant

April 2020 QUARTERLY REPORT

Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

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1 INTRODUCTION

1.1 Background

In 2015, Greencap Pty Ltd (Greencap) was commissioned by Trility Pty Ltd (Trility) to provide advice regarding the site groundwater conditions and monitoring of groundwater at the Gladstone Regional Council owned and Trility operated Integrated Water Treatment Plant (IWTP) and Wastewater Treatment Plant (WwTP) facilities located in Agnes Water, Queensland (**Table 1-1**).

Table 1-1 Location and ERAs of Facilities

Facility	Environmental Relevant Activity	Location
Integrated Water Treatment Plant (IWTP)	ERA64-(1a) Water Treatment > 0.5 ML but < 5ML water day	Springs Road AGNES WATERS - (Lot 52 Plan SP155903 and Lot 41 Plan SP 206868 (**Figure 2-1)**
Wastewater Treatment Plant (WwTP)*	ERA63 (1d) Sewage Treatment >4000 to 10,000EP	Streeter Drive AGNES WATERS (Lot 20 Plan FD991 and Lot 21 Plan SP168519) (**Figure 2-2**)

* It is acknowledged that the treated effluent from the WwTP is irrigated to land as identified in the lot and plan provided above.

These two facilities are administered in accordance with the Department of Environment and Science (DES) Environmental Authority EPPR00959913 (hereafter referred to as the Environmental Authority) issued to Gladstone Regional Council on 1 September 2015.

In accordance with condition WT7-AW of the Environmental Authority, Greencap was engaged to prepare a Preliminary Groundwater Assessment Report for the IWTP in August 2015 and the WwTP in February 2016. The reports presented an overview of the local geological and hydrogeological conditions, and a number of recommendations identified during the assessment were implemented in September 2016. These included Greencap's recommendations:

IWTP

- Prepare and document a groundwater monitoring program, and provide this to EHP for approval, as required by the Environmental Authority EPPR00959913 (the Environmental Authority);
- Install three additional groundwater monitoring wells at the site, in accordance with the Groundwater Monitoring Program; and
- Ongoing groundwater monitoring, in accordance with the Groundwater Monitoring Program.

WwTP

- Undertake collar surveys of the existing groundwater monitoring bores so that groundwater level elevations can be determined with reference to the Australian Height Datum (AHD);
- Install two inferred up hydraulic gradient bores to enable monitoring of background groundwater conditions;
- Prepare a groundwater management system in accordance with the Environmental Authority conditions that meet the requirements of the Environmental Authority in relation to monitoring groundwater for potential contamination; and

- Undertake the required assessment and reporting of groundwater monitoring results.

Trility reviewed these reports and agreed to Greencap's recommendations. These recommendations were implemented, commencing May 2016 and quarterly groundwater monitoring commenced at the IWTP and WwTP in September 2016. Greencap have been compiling groundwater monitoring data collected by Trility into quarterly and annual reports since this work commenced.

1.2 Objectives and Scope of Work

The overarching objective of the groundwater monitoring for IWTP and WwTP is to comply with requirements of the Environmental Authority issued by EHP in relation to the monitoring of groundwater for the Gladstone Regional Council owned and Trility operated IWTP and WwTP facilities.

The objective of this quarterly report is to present and summarise the results from the groundwater sampling events undertaken by Trility at the WwTP and IWTP in accordance with Conditions WT8-AW, WT9-AW, WT10-AW and WT11-AW of the Environmental Authority.

The scope of work implemented during the April 2020 monitoring round included groundwater level sampling from existing groundwater bores at both sites. Groundwater gauging was undertaken on a monthly basis to determine groundwater level, and groundwater sampling occurred in parallel with the April 2020 gauging event.

2 SITE DESCRIPTION

2.1 Integrated Water Treatment Plant

2.1.1 Geology

The IWTP is located at Springs Road, Agnes Water on (Lot 6 on SP150900, Lot 40 Plan SP206868, Lot 52 Plan 155903 and Lot 41 Plan SP206868) and is positioned on the coastal dune system between the Reedy Creek coastal swamp and the Coral Sea (**Figure 2-1**).

The basement rocks in the area are the Lower to Middle Triassic age Agnes Water Volcanics. The shoreline to the east of the IWTP is characterised by rocky outcrops and form coastal headlands to the north and south of the IWTP. These volcanics are widespread to the inland of the site. Overlying the volcanics are Tertiary age Elliot Formation sandstones and alluvial sediments. The Elliot Formation is mapped as outcropping in the elevated areas to the west of the Agnes Water.

The Quaternary Age Coastal Dune deposits are a linear sand deposit located immediately adjacent the Coral Sea. These dune deposits reach heights of 50 m AHD in the vicinity of the IWTP. The Reedy Creek swamp area to the west of the IWTP is mapped as consisting of Quaternary age alluvium.

2.1.2 Operations

The IWTP operations can be summarised as follows:

- The IWTP extracts raw water from the adjoining Pacific Ocean via an intake system sited at Chinaman's Beach, and bore water from the Springs Road bores (**Figure 3-1**);
- Water received at the IWTP is processed via filtration and reverse osmosis systems;
- Water is then chemically dosed to adjust the water properties before distribution to the Gladstone City Council operated potable water network.

The IWTP incorporates the storage and usage of chemicals required to be used during the water treatment process. These chemicals are stored under cover in designated chemical storage locations and managed in accordance with the IWTP Environmental Management Plan provisions.

2.1.3 Potential for Leaks

The potential for impacts on groundwater from IWTP activities are generally restricted to:

- Release of chemicals and materials during transfer to and around the treatment facility;
- Loss of integrity of bunding and/or containment systems in chemical storage areas;
- Leakages from transfer systems in the plant operational area;
- Sewage pipe leakages; and
- Brine disposal pipe leakages.

Any releases of chemicals, raw materials and/or process by products have the potential to impact on the existing shallow sand dune aquifer above the coffee rock layer and potentially move west, the inferred groundwater flow direction.

2.2 Wastewater Treatment Plant and Irrigation Area

2.2.1 Geology

The WwTP is located at Streeter Drive, Agnes Water (Lot 21 on SP168519 and Lot 20 on FD991), and is positioned some 4.5 km inland to the west of the Coral Sea, south-east of a local topographic feature known as Round Hill, within the Deepwater Creek catchment area (**Figure 2-2**).

The WwTP is situated within the Lower to Middle Triassic age Agnes Water Volcanics. These rocks commonly outcrop in the elevated landforms surrounding and to the north of the WwTP. In addition, these rocks form coastal headlands to the east of the WwTP.

These volcanics are a mixture of igneous rock types, thought to have been deposited in a terrestrial environment. Overlying the volcanics in the WwTP area are Quaternary age alluvium and colluvium.

2.2.2 Operations

The operations of the wastewater treatment plant on site can be summarised as follows:

- Sewage from Agnes Water township is pumped to the site via a number of designated pumping stations, at a volume of no more than 10,000 equivalent persons (EPs);
- Sewage undergoes tertiary treatment (to class B standard) on site through aerobic digestion;
- Following tertiary treatment, treated effluent is retained in a series of specially constructed lagoons; and
- Treated effluent is discharged via irrigation to the designated irrigation area.

2.2.3 Potential for Leaks

The potential for impacts on groundwater from WwTP activities is generally restricted to:

- Release of chemicals and materials during transfer to and around the treatment facility;
- Loss of integrity from bunding and/or containment systems in chemical storage areas;
- Leakages from transfer systems in the plant operational area;
- Sewage pipe leakages;
- Leaks from the liner of the treated effluent pond; and
- Deep drainage from inappropriate irrigation practices in the irrigation area.

Any leaks of chemicals and/or contaminants arising from the operation have the potential to impact the aquifer in the Agnes Water Volcanics and shallow alluvial material at the WwTP site.

As groundwater flow is inferred as flowing in a southerly direction, impacts from the release of chemicals and/or contaminants on residents drawing water from this aquifer at Agnes Water is unlikely.

Within the irrigation area, both the shallow local alluvial aquifer and the deeper Agnes Water Volcanics may be present. In both areas, groundwater flow direction inferred to be generally in a southern direction, based on groundwater level gauging data and local topography, and hence have the potential to be impacted upon by any chemical and/or contaminant releases.

Lot Boundary

Site Location of Integrated Water Treatment Plant

Figure 2-1	**Trility Pty Ltd**
Date: *15/01/2020*	**Author:** Persona **Map Scale:** 1:8,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56

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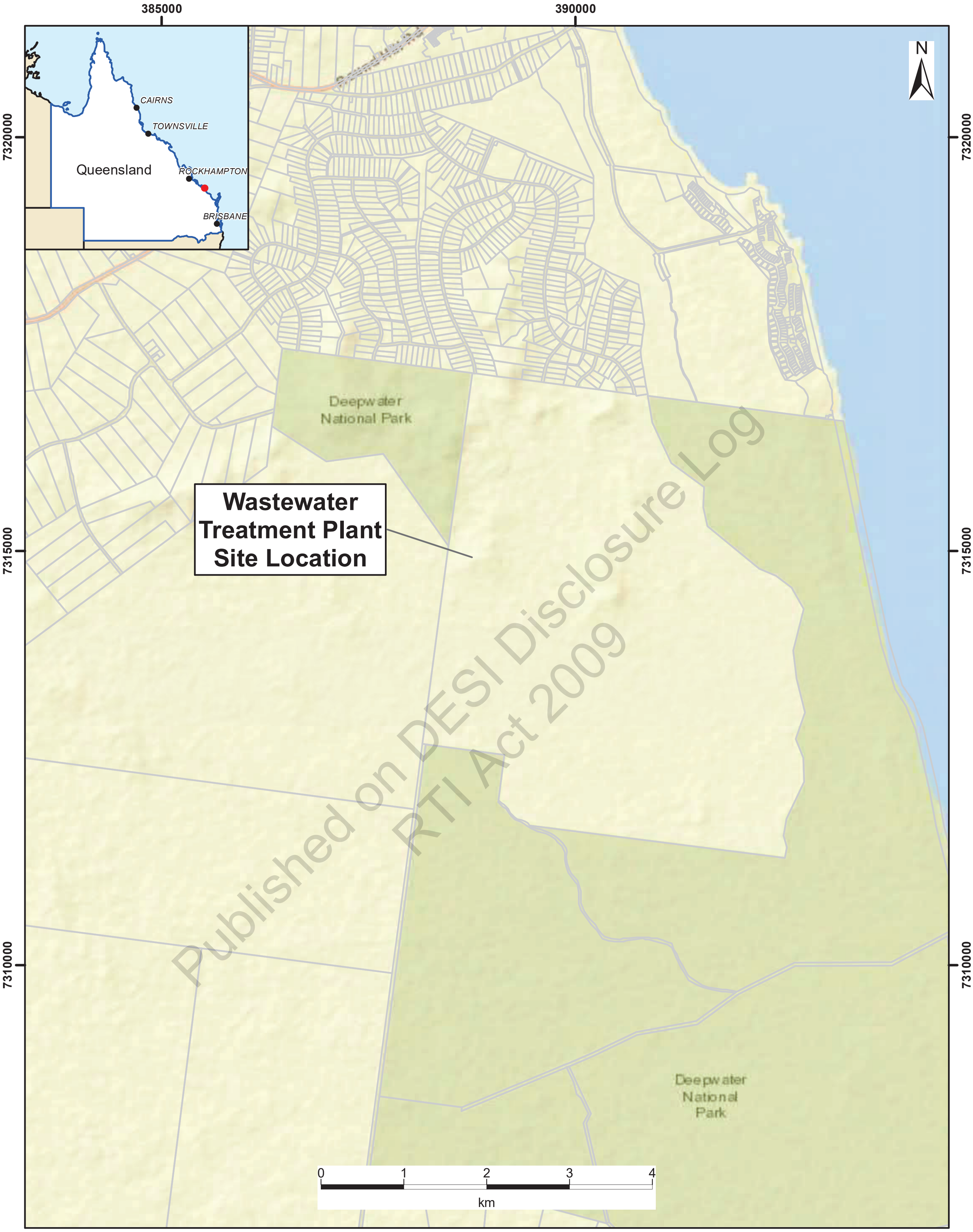
Imagery © Esri 2019
R:_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\J163599-01_Sept_2019_QR\mxd\FIG_2_1_IWTP_site_location_191014.mxd



Lot Boundary

Site Location of Wastewater Treatment Plant

Figure 2-2	Trility Pty Ltd
Date: 15/01/2020	**Author** Persona **Map Scale:** 1:60,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56

GREENCAP

R:_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\J143710-01_Sept_2017_QR\mxd\FIG_2_2_WwTP_site_location_171221.mxd

3 GROUNDWATER BORE MONITORING NETWORK

3.1 Integrated Water Treatment Plant

Greencap attended the IWTP on 23 May 2016 to supervise the installation of three groundwater monitoring bores in accordance with condition WT22-AWDP. A surveyor was engaged to provide the coordinates for each monitoring bore and to determine the relative elevation levels.

Following development of the bores, groundwater level gauging was also conducted by Greencap and documented on 25 May 2016 to identify the level of water within bores. **Table 3-1** below summarises the details of the IWTP groundwater monitoring bores. The locations of the IWTP groundwater bores are shown in **Figure 3-1.**

Table 3-1 Integrated Water Treatment Plant Groundwater Monitoring Bores

Well Name	Easting	Northing	Depth of Well (m)	Relative Level (m)	Depth to Water (m)[1]	Relative Height Data (m AHD)
DESAL1	390050.613	7320897.615	6.5	19.117	2.287	16.830
DESAL2	390045.732	7320949.351	6.0	19.555	2.483	17.072
DESAL3	390005.808	7320906.402	5.0	18.739	3.014	15.725

[1] As measured on 25 May 2016.

3.2 Wastewater Treatment Plant and Irrigation Area

Groundwater monitoring bores were installed at the WwTP prior to 2008 (MP97/01 to MP97/05, MP00/07 and MP00/08) and the management of the facility by Trility. Monitoring of water quality from the supply pipe from the existing bores commenced in September 2008 and has been ongoing on a regular basis.

On 25 May 2016 Greencap inspected all the existing bores and identified that they appeared to be in good working condition and suitable for monitoring purposes. At this time Greencap supervised the installation of two additional groundwater monitoring bores at the WwTP, identified as STP1 and STP2, for the purposes of obtaining information on the background groundwater quality in the area. A surveyor was engaged to provide the coordinates for all the existing and newly installed monitoring bores at the WwTP and to determine the levels relative to AHD.

Groundwater level gauging was also conducted by Greencap and documented on 25 May 2016 to identify the level of water within bores. **Table 3-2** below summaries the details of the WwTP groundwater monitoring bores. The locations of the WwTP groundwater bores are shown in **Figure 3-2.**

Table 3-2 Wastewater Treatment Plant Groundwater Monitoring Bores

Well Name	Easting	Northing	Depth of Well (m)	Relative Level	Depth to Water (m)[1]	Relative Height Data (m AHD)
STP1	388929.148	7315839.541	15.36	31.081	0.607	30.474
STP2	389440.292	7314580.914	13.14	10.880	2.915	7.965
MP97/01	388501.285	7315186.657	1.10	19.938	0.959	18.979
MP97/02	388820.691	7313990.578	1.70	9.422	1.154	8.268
MP97/03	389158.188	7313938.606	1.69	8.479	1.342	7.137
MP97/04	389280.803	7313491.850	1.57	7.130	1.108	6.022
MP97/05	388379.765	7312693.071	1.02	6.074	0.784	5.290
MP00/07	388376.341	7314916.325	1.80	15.835	DRY	NA
MP00/08	388215.935	7314808.284	1.785	14.120	1.706	12.414

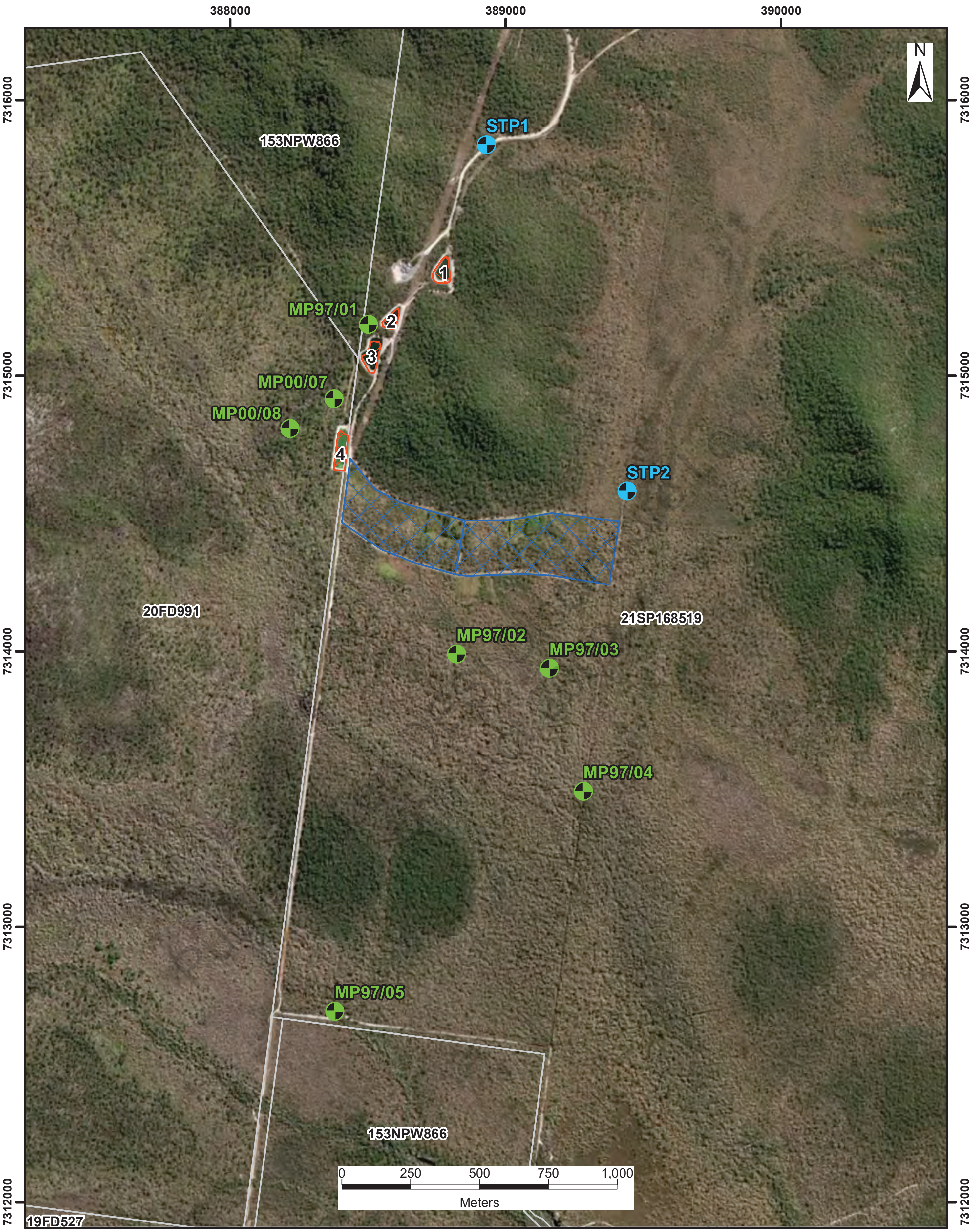
[1] As measured on 25 May 2016.

Lot Boundary
Groundwater Bore (Greencap May 2016)
Indicative Location of Treated Water Flush Point
Indicative Location of Brine Pipe
Indicative Location of Seawater Pipe

Location of IWTP Groundwater Bores

Figure 3-1	Trility Pty Ltd	
Date: 9/07/2018	**Author:** Persona **Map Scale:** 1:1,200	GREENCAP
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56	

R:_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\J143710-01-01-01_Mar_2018_QR\mxd\FIG_3_1_IWTP_GW_bore_loc_180709.mxd



Lot Boundary
Lagoon
Recycled Water Irrigation Area

Groundwater Bore

Greencap (May 2016)
Previously Existing

Location of WwTP Groundwater Bores

Figure 3-2

Trility Pty Ltd

Date: *6/08/2018*

Author: Persona

Map Scale: 1:18,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 56

GREENCAP

R:_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\Annual 2018\mxd\FIG_3_2_WwTP_GW_bore_loc_180806.mxd

4 MONITORING PARAMETERS AND TRIGGER VALUES

The Environmental Authority for the WwTP sets out the list of parameters required to be monitored as part of the regular groundwater monitoring program, and the associated trigger values. These are summarised in **Table 4-1**.

Table 4-1 Monitoring Parameters and Trigger Values

Quality Characteristic	Units	Trigger Values
Dissolved Oxygen	mg/L	20% change from background[1]
Total Nitrogen	mg/L as Nitrogen	
Nitrate	mg/L as Nitrogen	
Ammonia	mg/L as Nitrogen	
Total Phosphorous	mg/L	
Chloride	mg/L	
Conductivity	uS/cm	
Sulphate	mg/L	No change from background[2]
Boron	mg/L	
pH	pH unit	
Faecal Coliforms	Colony forming units/100ml	
Enterococcus Organisms	Colony forming units/100ml	
Total Metals: (Al, Fe, Mn, As, Cd, Cr, Co, Cu, Pb, Hg, Ni, Se, Ag, Sn, Zn).	mg/L or ug/L	Within ANZECC Guidelines
Dissolved Metals: (Al, Fe, Mn, As, Cd, Cr, Co, Cu, Pb, Hg, Ni, Se, Ag, Sn, Zn).	mg/L or ug/L	

[1] Trigger values are defined as an upper limit (20% increase from background) with the exception of dissolved oxygen, which is defined as a lower limit (20% decrease from background).
[2] Trigger values are defined as an upper limit – an exceedance is any increase from the background value, with the exception of pH which is defined as any change up or down from the background value.

Due to the absence of a background level defined by Environmental Authority and/or suitable baseline groundwater data for the area, the background value for the purposes of the trigger values are currently considered to be the results from the first sampling event conducted for each of the bores included in the Groundwater Monitoring Program.

Trigger values for total and dissolved metals are detailed in the Agnes Water Groundwater Management System and are in accordance with *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council [ANZECC] and the Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ], 2000a) (ANZECC Guidelines).

The Environmental Authority for the IWTP does not specify any particular requirements for groundwater monitoring parameters and trigger values. On this basis, the groundwater monitoring parameters and trigger values set out in **Table 4-1** above will also apply to the IWTP.

5 SAMPLING METHODOLOGY

Groundwater sampling was undertaken by Trility in accordance with industry standards including AS/NZS 5667.11:1998 *Water Quality Sampling – Guidance on sampling of groundwater* (AS/NZS 5667.11).

Sampling was undertaken using low-flow sampling techniques to obtain samples representative of groundwater within the aquifer. This technique has been recognised by *National Environmental Protection (Assessment of Site Contamination) Measure 1999,* as amended May 2013 (NEPM [2013]).

Prior to the sampling, the standing water levels (SWL) were measured from the top of each bore casing (TOC).

As indicated by Trility, groundwater bores were purged using a peristaltic pump and sampled via dedicated low-density polyethylene tubing at each location. During purging, groundwater level measurements were recorded to confirm that drawdown within the bores stabilised.

Groundwater quality measurements including pH, temperature, electrical conductivity (EC), salinity, dissolved oxygen (DO), and oxidation reduction potential (ORP), were recorded continually during the purging process using a YSI Professional Plus multi-parameter water quality meter fitted with a flow-through cell. The samples were collected when the field parameters stabilised. The groundwater field sampling records provided by Trility are given in **Appendix A.**

It is understood that decontamination of non-dedicated sampling equipment between each sampled bore was undertaken using a phosphate-free detergent and rinsed with laboratory grade deionised water between sampling locations, in accordance with AS/NZS 5667:11.

Samples used for dissolved analytes were filtered in the field using a 0.45 µm filter and placed in the appropriately preserved sample bottles provided by the testing laboratory as required for individual analyses.

Samples were stored in a chilled portable cooler immediately after collection and were delivered under similar conditions to the analytical laboratories with accompanying chain of custody (COC) documentation.

The laboratory used for the program was Australian Laboratory Services Pty Ltd (ALS), a laboratory accredited by the National Association of Testing Authorities (NATA) with analysis of the samples being conducted under NATA approved methodologies as required under condition G15-AW (b) of the Environmental Authority.

6 RESULTS

Groundwater samples for the January to April 2020 quarter were collected on the 15th and 21st of April 2020. Results for this period are presented below. A summary of the analytical results is provided in **Appendix B** and is discussed in the sections below. Laboratory certificates and chain of custody (COC) documentation provided by Trility are given in **Appendix C**.

6.1 Rainfall

The rainfall recorded at the WwTP was 669.65 mm and 666.7 mm at the IWTP for the period 1 January to 30 April 2020 (**Table 6-1**). This was higher than the rainfall recorded for the same period in 2019 which had 370.8 mm and 469.6 mm of rainfall at the WwTP and IWTP respectively. It was similar to rainfall records for the same period in 2018. 2018 and 2020 have both recorded high February rainfall (>350 mm).

Table 6-1 Rainfall Data, January – April 2020

Month	WwTP	IWTP
January 2020	67.8	54.05
February 2020	422.65	451.95
March 2020	88	83.7
April 2020	91.2	77
Total	669.65	666.7

6.2 Field Observations

Groundwater level gauging was conducted at the WwTP and IWTP bores in January, February and April 2020 (**Table 6-2**). Physical aspects of groundwater quality including colour, and odour noted during sampling are summarised in **Table 6-3**.

The inferred groundwater flow direction for each month for IWTP and WwTP are presented in **Figure 6-1** to **Figure 6-6**.

Field data sheets for the MP bores within the WwTP were not provided. Information provided by Trility indicates that these bores did not recover after initial purging and therefore had insufficient groundwater volumes for sample collection.

Table 6-2 Groundwater Gauging Data, January – April 2020

Monitoring Location	Relative Height Data (m AHD)	Depth to Groundwater from Top of Casing (m bTOC)[1]			Groundwater Elevation (m AHD)[2]		
		January 2020	February 2020	April 2020	January 2020	February 2020	April 2020
WwTP							
STP1	31.081	2.403	2.245	2.248	28.678	28.836	28.833
STP2	10.880	4.628	4.370	4.142	6.252	6.510	6.738
MP97/01	19.938	DRY	FLOODED	0.838	DRY	FLOODED	19.100
MP97/02	9.422	DRY	FLOODED	1.270	DRY	FLOODED	8.152
MP97/03	8.479	DRY	0.270	1.350	DRY	8.209	7.129
MP97/04	7.130	DRY	FLOODED	1.110	DRY	FLOODED	6.020
MP97/05	6.074	DRY	0.325	0.760	DRY	5.749	5.314
MP00/07	15.835	DRY	0.480	DRY	DRY	15.355	DRY
MP00/08	14.120	DRY	0.650	1.440	DRY	13.470	12.680
IWTP							
DESAL1	19.117	2.943	2.104	2.243	16.174	17.013	16.874
DESAL2	19.555	3.244	2.445	2.523	16.311	17.110	17.032
DESAL3	18.739	3.652	2.779	2.960	15.087	15.960	15.779

[1] m bTOC = metres below top of casing
[2] m AHD = metres Australian Height Datum

Table 6-3 Groundwater Field Description, January - April 2020

Monitoring Location	Colours	Odour	Turbidity
WwTP			
STP1	Clear	No Odour	ND[1]
STP2	Clear	No Odour	ND[1]
MP97/01	ND[1]	ND[1]	ND[1]
MP97/02	ND[1]	ND[1]	ND[1]
MP97/03	ND[1]	ND[1]	ND[1]
MP97/04	ND[1]	ND[1]	ND[1]
MP97/05	ND[1]	ND[1]	ND[1]
MP00/07	DRY	DRY	DRY
MP00/08	ND[1]	ND[1]	ND[1]
IWTP			
DESAL1	Light Tannin Stained	No Odour	ND[1]
DESAL2	Tannin Stained	No Odour	ND[1]
DESAL3	Tannin Stained	High Odour	ND[1]

[1]ND = no data

Lot Boundary

Groundwater Bore

Greencap (May 2016)

Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

IWTP Inferred Groundwater Flow Direction, January 2020		
Figure 6-1	**Trility Pty Ltd**	
Date: *4/06/2020*	**Author:** ersona	GREENCAP
	Map Scale: 1:800	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56	

C:\Users ersona Greencap\Gis Data1 - Agnes Water\J163599-03_Apr_2020_QR\mxd\FIG_6_1_IWTP_GW_Level_01_2020_200604.mxd

Lot Boundary

Groundwater Bore

Greencap (May 2016)

Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

IWTP Inferred Groundwater Flow Direction, February 2020		
Figure 6-2	**Trility Pty Ltd**	
Date: *4/06/2020*	**Author:** Persona **Map Scale:** 1:800	GREENCAP
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56	

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C:\Users\ersona\Greencap\Gis Data1 - Agnes Water\J163599-03_Apr_2020_QR\mxd\FIG_6_2_IWTP_GW_Level_02_2020_200604.mxd

Lot Boundary

Groundwater Bore

Greencap (May 2016)

Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

IWTP Inferred Groundwater Flow Direction, April 2020	
Figure 6-3	**Trility Pty Ltd**
Date: 4/06/2020	Author: ersona Map Scale: 1:800
Revision: R1	Coordinate System: GDA 1994 MGA Zone 56

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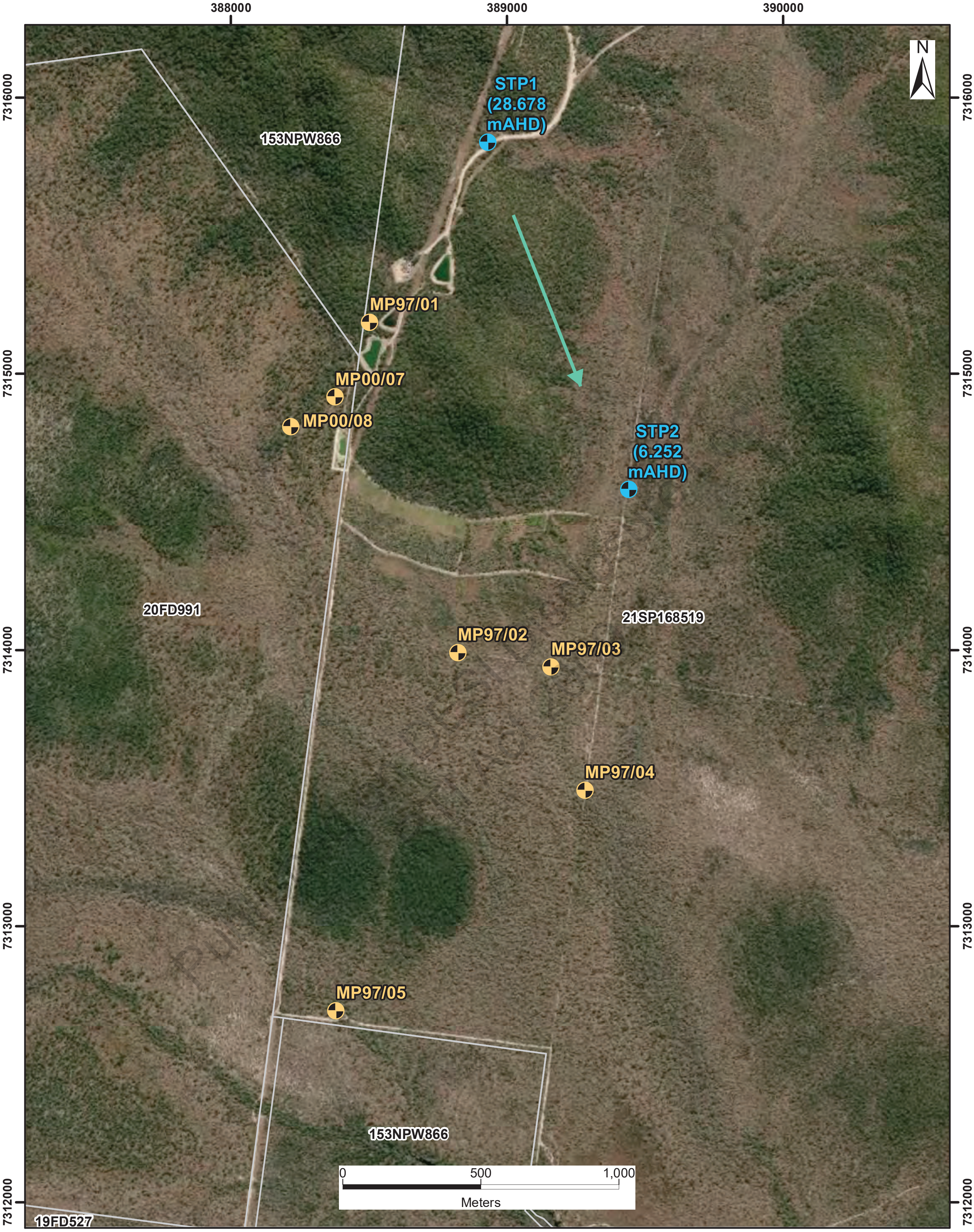
C:\Users\ersona Greencap\Gis Data1 - Agnes Water\J163599-03_Apr_2020_QR\mxd\FIG_6_3_IWTP_GW_Level_04_2020_200604.mxd



Lot Boundary

Inferred Groundwater Flow Direction

Groundwater Bore

Sampled

Dry

WwTP Inferred Groundwater Flow Direction, January 2020

Figure 6-4	**Trility Pty Ltd**
Date: 4/06/2020	Author: ersona Map Scale: 1:18,000
Revision: R1	Coordinate System: GDA 1994 MGA Zone 56

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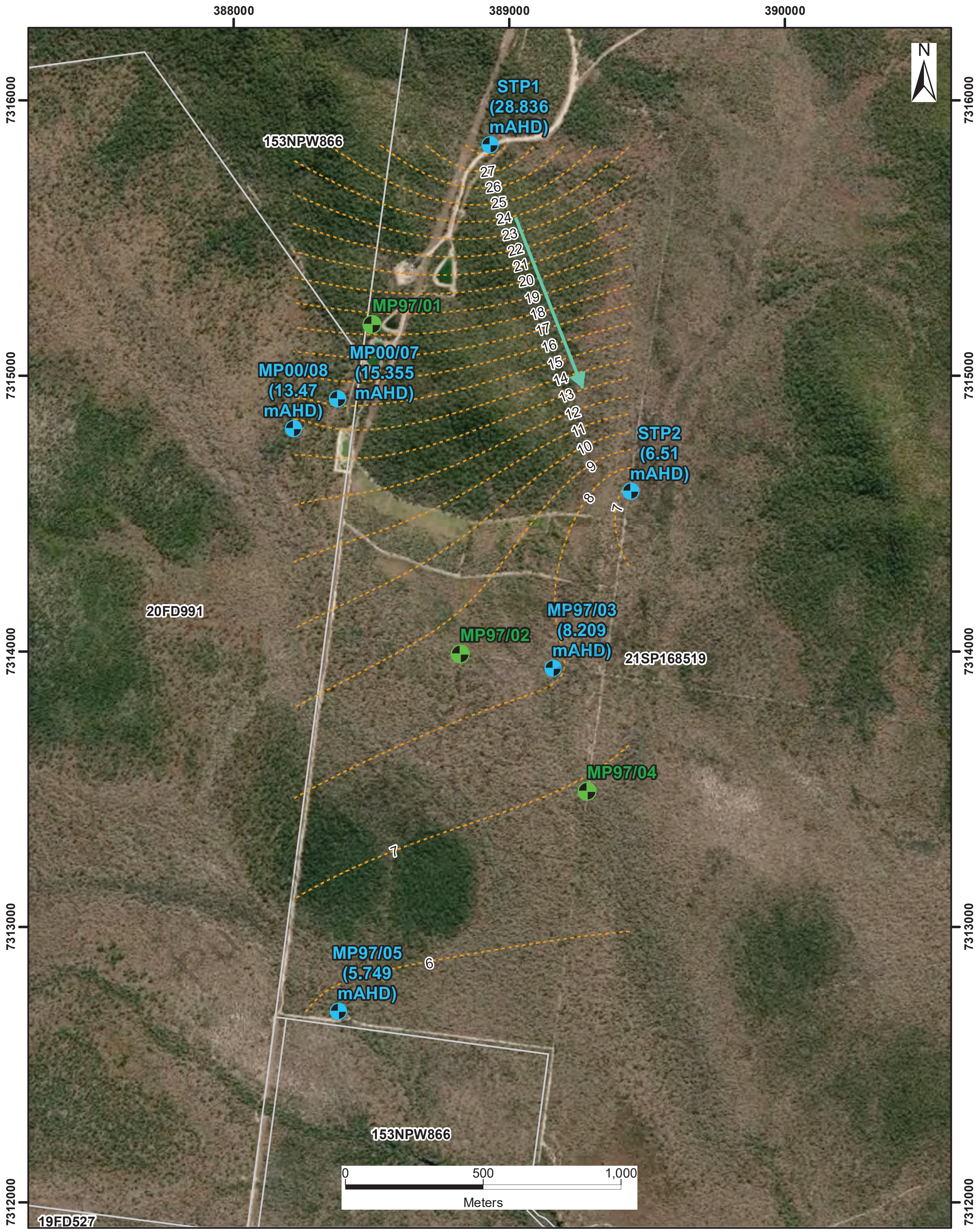
C:\Users\ersona Greencap\Gis Data1 - Agnes Water\J163599-03_Apr_2020_QR\mxd\FIG_6_4_WwTP_GW_Level_01_2020_200604.mxd



Lot Boundary

Groundwater Bore

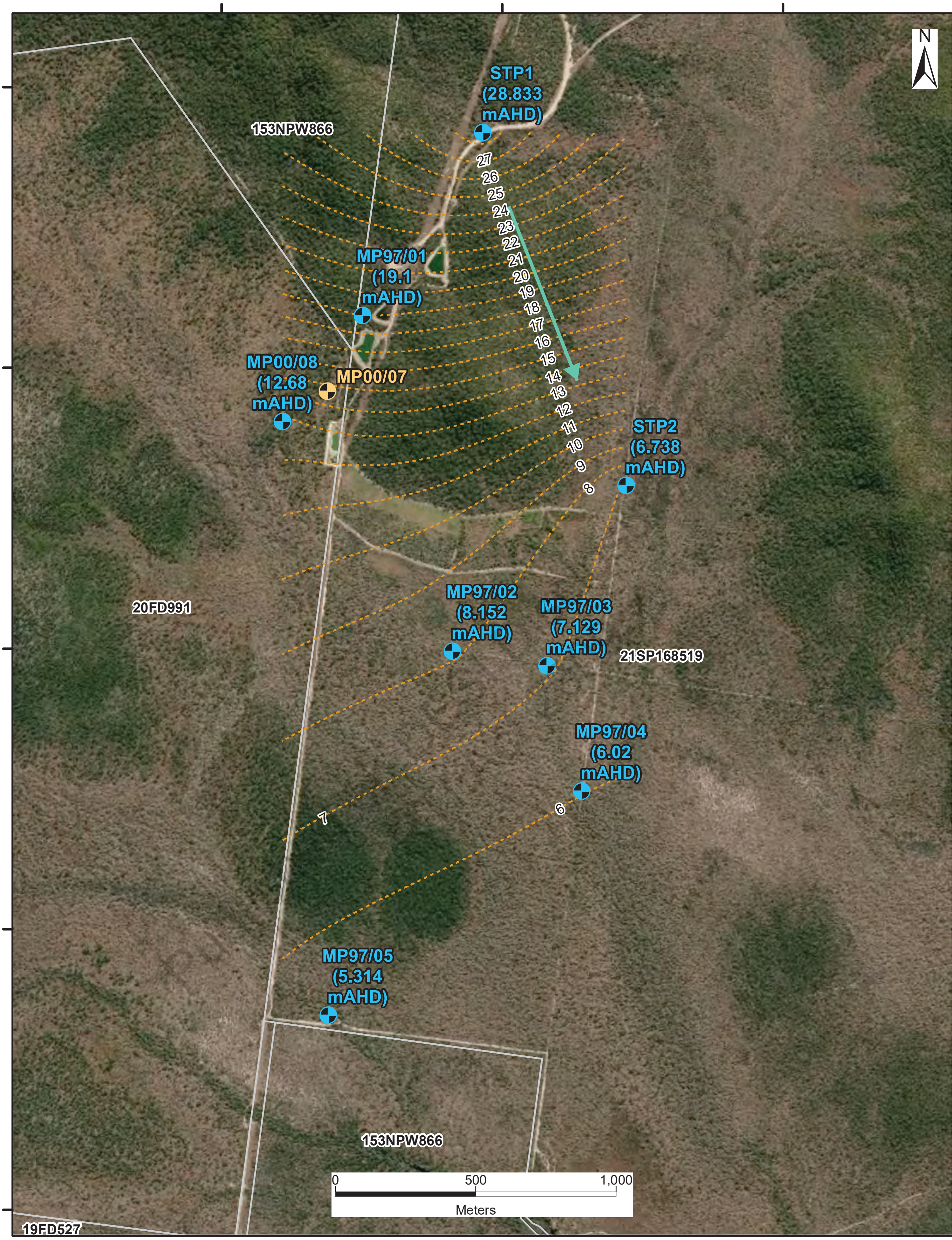
Sampled

Flooded

Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

WwTP Inferred Groundwater Flow Direction, February 2020		
Figure 6-5	**Trility Pty Ltd**	
Date: *4/06/2020*	**Author:** ersona **Map Scale:** 1:18,000	GREENCAP
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56	



Lot Boundary

Groundwater Bore

Sampled

Dry

Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

WwTP Inferred Groundwater Flow Direction, April 2020

Figure 6-6	**Trility Pty Ltd**
Date: 4/06/2020	**Author:** ersona **Map Scale:** 1:18,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56

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C:\Users ersona Greencap\Gis Data1 - Agnes Water\J163599-03_Apr_2020_QR\mxd\FIG_6_6_WwTP_GW_Level_04_2020_200604.mxd

6.3 Field Measurements

Physio-chemical water quality parameters were monitored in groundwater bores during purging and prior to sampling. Parameters measured were pH, electrical conductivity (EC), dissolved oxygen (DO), temperature and oxidation reduction potential (ORP). Samples were only collected from STP1, STP2, DESAL1, DESAL2, and DESAL3. Other bores were found to have an insufficient water volume for sample collection. The parameters are summarised in **Table 6-4**. Shaded cells indicate exceedances of the adopted criteria.

Table 6-4 Field Measured Water Quality Parameters, April 2020

Monitoring locations	DO [1] (mg/L)	EC (µS/cm)	pH [2] (pH Units)	ORP [3] (mV)	Temperature [3] (°C)
WwTP					
STP1	0.72	3,729	6.71	-16.7	24.1
STP2	1.13	11,732	6.53	85.5	24
IWTP					
DESAL1	0.32	298.7	3.99	172.4	26.3
DESAL2	0.31	313.6	3.92	180.6	24.8
DESAL3	0.44	219	4.82	-177.7	27.6

[1] The criteria for dissolved oxygen exceedance is a 20% change down from the background value, instead of up

[2] The criteria for pH exceedance is any change up or down from the background-derived trigger value

[3] No associated trigger value

These results indicate that the groundwater within the bores is acidic which is consistent with previous quarterly results. The dissolved oxygen is low, which is expected in groundwater aquifers. The salinity of the IWTP groundwater is indicative of fresh water, whilst the salinity of the WwTP is highly variable and tending towards saline.

6.4 Laboratory Results

Laboratory results for the background bores at the WwTP and the Desal bores within the IWTP were compared against the adopted trigger values (**Table 4-1**). A Summary is provided below. All bores down-gradient of the WwTP were found to have an insufficient water volume following purging and were therefore not sampled during this quarter.

The groundwater quality exceeded adopted trigger values at the background WwTP bores for:

- Ammonia (all sampled bores);
- Total Nitrogen (all sampled bores);
- Total Phosphorus (all sampled bores);
- Sulphate as S (all sampled bores);
- Boron (STP2 only); and
- Dissolved Cobalt (STP2 only).

The groundwater quality exceeded adopted trigger values within the IWTP bores for:

- Ammonia (all bores);
- Chloride (all bores);
- Nitrate (DESAL1 and DESAL2);
- Total Nitrogen (DESAL1 and DESAL2);
- Total Phosphorus (DESAL2);

- Sulphate (DESAL1 and DESAL2);
- Total Chromium (DESAL2 and DESAL3);
- Dissolved Chromium (DESAL3 only); and
- Total Copper (DESAL2 only).

These exceedances are summarised in **Table 6-5**, and **Appendix B** presents a summary of all reported results and exceedances.

Table 6-5 Groundwater Trigger Value Exceedances, April 2020

Parameter	Trigger Value	Bores Exceeding Trigger Value	Exceedance Value	% Lower than Background	% Higher than Background
WwTP					
Ammonia	20% change from background	STP1, STP2	0.18 – 0.25 mg/L	-	1,700 – 2,400%
Total Nitrogen	20% change from background	STP1, STP2	0.3 mg/L	-	200%
Total Phosphorus	20% change from background	STP1, STP2	0.02 – 0.04 mg/L	-	33 -100%
Sulphate as S	No change from background	STP1 ^, STP2 ᵛ	95 – 369 mg/L	1.1%	4.4%
Boron	No change from background	STP2	<50 µg/L	29%	-
Dissolved Cobalt	1.4 µg/L	STP2	2.0 µg/L	-	-
IWTP					
Ammonia	20% change from background	DESAL1, DESAL2, DESAL3	0.1 – 0.38 mg/L	-	900 – 3,700%
Chloride	20% change from background	DESAL1, DESAL2, DESAL3	54 – 81 mg/L	-	125 – 208%
Nitrate	20% change from background	DESAL1 ^, DESAL2 ᵛ	0.03 – 0.76 mg/L	80%	21%
Total Nitrogen	20% change from background	DESAL1^, DESAL2^	1.3 – 2.0 mg/L	-	30 - 82%
Total Phosphorus	20% change from background	DESAL2^	0.1 mg/L		43%
Sulphate	No change from background	DESAL1^, DESAL2^	2.0 - <5.0 mg/L	-	100 – 400%
Total Chromium	1.0 µg/L	DESAL 2, DESAL3	3.0 µg/L	-	-
Dissolved Chromium	1.0 µg/L	DESAL3	3.0 µg/L	-	-
Total Copper	1.4 µg/L	DESAL2	2.0 µg/L	-	-

7 QUALITY ASSURANCE AND QUALITY CONTROL

7.1 Field QA/QC Data

Only intra-laboratory duplicates were collected during groundwater sampling. Calculated relative percent differences (RPD) between primary and duplicate samples were within the adopted acceptance criteria of 30-50% (Australian Standard AS4482.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds*) relative percent difference (RPD), for samples where results were greater than 10 times the laboratory's limit of reporting.

It should be noted however that in accordance with environmental standards field QA/QC samples should include:

- Field rinsate sample (assesses effectiveness of sampling equipment decontamination procedures);
- Field blank sample (assesses potential for sample contamination during sampling);
- Trip blank sample (assesses for contamination during transportation); and
- Inter-laboratory sample (triplicate – assesses reproducibility of results through a second NATA-accredited laboratory).

Inclusion of these QA samples will assist in identifying potential sources of errors (if any) that may influence the quality of samples during the sampling, sample transportation and equipment decontamination.

Issues have arisen where laboratory results for dissolved metals have returned higher concentrations than the associated total metal. As indicated by the analytical laboratory used this is likely to be a result of the use of different methods for total and filtered chemicals, and measurement uncertainty at such low concentrations.

7.2 Laboratory QA/QC Data

A summary of laboratory quality assurance and quality control (QA/QC) data is presented in **Table 7-1**.

Table 7-1 Laboratory QA/QC data

Report #	Analysis Within Holding Time	Lab. Duplicate RPD %	Lab Matrix Spike Recovery	Lab. Control Sample	Lab Method Blank
EB2010399 (IWTP)	P	P	P	P	P
EB2010933 (WwTP)	P	P	X	P	P

P= Pass X = Fail - = not required * = refer to report text

Quality Assurance Criteria	Quality Control Criteria
Holding Times	**Accuracy**
Volatile Organic Carbons 14 days soil and water Semi Volatile Organic Carbons 7 days water, 14 days soil Metals 6 months, Mercury 28 days	Matrix spike, control sample: 70-130%, depending on analyte. Surrogate recovery: 50-150%, depending on analyte.
	Precision
	Method Blank: Not detected Duplicate: No limit (<10xLOR), 0-50% (10-20xLOR), 0-20% (>20xLOR)

As shown in **Table 7-1** there were matrix spike issues within the WwTP analyses quality control batch. The laboratory advised that the matrix spikes could not be determined for chloride, on an unrelated sample from another client, due to the background levels being greater than four times the spike level.

This issue was not considered to affect the validity of the data.

8 DISCUSSION

The following sections discuss the results of the April 2020 groundwater sampling event, with reference to previous events.

It is important to note that the exceedances for most parameters, with the exception of metals, reported in quarterly reports and in **Section 6** of this report were based on comparison with the results of the initial groundwater monitoring undertaken in September 2016. The result from this single round have been used to develop a set of trigger levels as discussed in **Section 4**.

Aside from trigger values developed based on the initial groundwater monitoring event, concentrations of metals were also compared against water quality criteria specified by ANZECC Guidelines. Although some exceedances were noted against this criteria, the reported concentrations of metals are likely to be naturally elevated, as there is no consistency in up-gradient vs down-gradient concentrations recorded to indicate impacts from site activities. Also, variations in metal concentrations are evident in some bores in which concentrations periodically decrease to be below the ANZECC criteria. Such variations may be seasonal and need to be further assessed.

The section below summarises the groundwater results and discusses potential causes for the changes in reported concentrations of chemicals of concern and other water quality parameters.

A summary of sampling results is presented in **Appendix B**.

8.1 IWTP

The groundwater hydraulic gradient was consistent with previous monitoring periods, with inferred groundwater flow west-southwest from DESAL1 and DESAL2 towards DESAL3.

Groundwater results for DESAL Bores within the IWTP (DESAL1, DESAL2, and DESAL3) in April 2020 were similar compared with previous results. Some observations were made and discussed below:

- Groundwater salinity (expressed as EC) at IWTP bores returned similar values compared to the previous quarterly results. The EC indicates that the water is fresh and low in salinity;
- Dissolved oxygen levels measured during sampling in all three bores (DESAL1 to DESAL3) were low, and have decreased substantially compared to concentrations from the previous quarter. Low dissolved oxygen is typical for groundwater environments due to the lack of groundwater exposure to atmospheric air;
- The overall pH values in all three bores was again acidic with the most acidic pH values recorded in DESAL2, up-hydraulic gradient of the IWTP. This may be representative of the local groundwater conditions due to the overall general consistency in the pH values over the duration of monitoring, and the most-acidic bore being up-hydraulic gradient of the IWTP;
- Trigger value exceedances were noted for chloride at all three IWTP bores, as well as nitrate, total nitrogen and sulphate at DESAL1, and DESAL2, total phosphorus at DESAL2 and ammonia at DESAL3. It should be noted that the background values (the first sample recorded at each site in September 2016) for ammonia were below the limit of reporting and <0.01 mg/L. The background values established in 2016 may not be representative of the current background conditions, therefore, increases in concentrations classified as an exceedance of background trigger values may not necessarily be a result of onsite activities, particular as DESAL1 and DESAL2 are up-gradient of the IWTP;
- Chromium (total and dissolved) showed exceedances against ANZECC criteria at DESAL3, which is consistent with previous results. Total chromium and total copper also reported exceedance against ANZECC criteria at DESAL2, which is consistent with results from the same period in 2019.
- Microbiological parameters (*E. Coli* and Enterococci) were below the limit of reporting in all three IWTP bores; and

- As discussed above some exceedances noted for the DESAL 3for pH, EC, DO and some chemicals were attributed to the trigger criteria adopted, which is based on the first monitoring round in September 2016, and may not accurately reflect the background conditions of the aquifer and does not allow for seasonal variation in groundwater quality. It is therefore difficult to conclusively determine if these exceedances are a result of natural variation or the result of an impact from site activities. Dissolved chromium was the only parameter that exceeded the adopted criteria in the inferred down-gradient bore, DESAL3 that did not also exceed the criteria in the two IWTP background bores DESAL1 and DESAL2, and therefore may be evidence of an impact from site activities. The calculation and adoption of IWTP site specific groundwater trigger values would allow a more robust and accurate assessment of the dataset that should also take into account potential seasonal variability.

8.2 WwTP

As all bores located down the inferred hydraulic gradient (97/01, 97/02, 97/03, 97/04, 97/05, 00/07 and 00/08) from the WwTP were not sampled during the April 2020 monitoring event, only results from the background bores STP1 and STP2 are discussed below.

- The exceedances noted in the WwTP bores for pH were attributed to the criteria adopted from the Environmental Authority conditions for the WwTP, which states that any change from the background value constitutes an exceedance. The difference in pH at STP1 and STP2 compared to the background values was approximately <1%, this is not a significant difference;
- Exceedances were noted for sulphate at STP1 and STP2 (<5% change from background), however this was comparable to previous results, and again is not a significant difference;
- Nutrient exceedances in April 2020 were reported for ammonia, total nitrogen and total phosphorus at both STP1 and STP2. Low concentrations of nutrients were detected in the baseline sampling event in September 2016, and therefore slightly elevated but still low concentrations are considered an exceedance of the adopted trigger values;
- STP2 exceeded the 'background' concentration for Boron. STP2 has recorded a decrease in boron (<50 µg/L) compared to the background value (70 µg/L);
- Dissolved cobalt exceeded the ANZECC criteria at STP2. This is consistent with previous results from 2018 and 2017.
- *E. Coli* and Enterococci results were below the limit of reporting in both bores.

As these two bores are upgradient of the irrigation area they are likely to represent natural conditions. There is no data from the downgradient bores to determine if there is any impact from site activities. This will need to be assessed further when data from these downgradient bores becomes available.

9 SUMMARY & CONCLUSIONS

Sampling was undertaken at both IWTP and WwTP bores in April 2020. The groundwater hydraulic gradient and direction at both sites were consistent with historical observations.

IWTP

For the IWTP, all three bores (DESAL1, DESAL2, and DESAL3) were sampled. Exceedances against adopted trigger values were noted for:

- pH (all bores);
- Electrical conductivity (all bores);
- Dissolved oxygen (DESAL1 and DESAL3);
- Ammonia (DESAL3 only);
- Chloride (all bores);
- Nitrate (DESAL1 and DESAL2);
- Total Nitrogen (DESAL1 and DESAL2);
- Total Phosphorus (DESAL2);
- Sulphate (DESAL1 and DESAL2);
- Total Chromium (DESAL2 and DESAL3 only);
- Dissolved Chromium (DESAL3 only); and
- Total Copper (DESAL2 only)

Exceedances of field parameter trigger values occurred in the up-gradient and down-gradient bores at the IWTP, indicating that the exceedances are likely to be related to changes in background groundwater quality rather than as a result of site activities. Exceedances in nutrients at the IWTP further support this, with exceedances occurring in all three bores, or only the up-gradient bores. Calculation of site-specific trigger values will provide a better analysis of potential groundwater quality impacts from the IWTP. Groundwater results for DESAL1, DESAL2 and DESAL3 were generally consistent with results from recent previous quarterly monitoring rounds.

WwTP

For the WwTP, two background bores were sampled for all analytes (STP1 and STP2). All downgradient bores (97/01, 97/02, 97/03, 97/04, 97/05, 00/07 and 00/08) were not sampled. Exceedances against adopted trigger values were noted for:

- pH (all sampled bores);
- Dissolved Oxygen (all sampled bores);
- Ammonia (all sampled bores);
- Total Nitrogen (all sampled bores);
- Total Phosphorus (all sampled bores);
- Sulphate as S (all sampled bores);
- Boron (STP2 only); and
- Dissolved Cobalt (STP2 only).

Any exceedances reported for these background bores are likely to represent variations in the background groundwater quality unrelated to the treatment plant activities, as they are up-hydraulic gradient of treatment plant activities. As mentioned at the beginning of this section, it is recommended that downgradient bores be installed to a greater depth to enable monitoring of potential impacts from site activities.

In general, the following recommendations were made:

- Field QA/QC samples should be expanded to include inter-laboratory duplicates and blanks to assist in identifying potential sources of errors that may influence the quality of samples; and
- Site specific trigger values should be developed for the IWTP. This process is currently underway.
- Deeper wells should be installed at MP97/01, MP97/02, MP97/03, MP97/04, MP97/05, MP00/07 and MP00/08, as they are all less than 2m deep and have been dry during the majority of sampling events. This would increase the likelihood of obtaining samples from these wells to allow monitoring of potential impacts from site activities associated with the operation of the WwTP

Level 1 / 381 MacArthur Avenue
Hamilton QLD 4007
Australia

APRIL 2020
QUARTERLY REPORT
Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

Appendix A: Groundwater Field Sampling Records

TRILITY

DESAL **Groundwater Monitoring Standing Water Level Measurement**

NB Measurement to be taken in mm from top of bore casing

Date	Time	Operator	Desal 1	Desal 2	Desal 3
7-9-2016	1300	[redacted]	2210	2440	2985
27.9.2016	10:00	[redacted]	2275	2500	2992
18.10.2016	11.45	[redacted]	2324	2575	2845
15.11.2016	2.50pm	[redacted]	2440	2672	3142
14.12.2016.	0910am	[redacted]	2405	2650	2995
19.1.2017	0745	[redacted]	2461	2698	3072
27.2.2017	0230	[redacted]	2627	2860	3402
8.3.2017	0930	[redacted]	2650	2889	3642
18/4/2017	3.30pm	[redacted]	2051	2278	2953
19/5/2017	11:30am	[redacted]	2135	2372	2860
21-6-2017	9.30	[redacted]	2170	2470	2980
20-7-2017	15.40	[redacted]	2240	2510	2998
23-8-2017	8.10 A.M	[redacted]	2317	2627	3017
27-9-2017	9.10 Am	[redacted]	2425	2718	3120
26/10/2017	3pm	[redacted]	1825	2120	2554
20/11/2017	12pm	[redacted]	2020	2344	2892
14-12-17	8.30	[redacted]	1882	2085	2862
21.1.18	1:10pm	[redacted]	2065	2280	2950
27.2.18	8.30 A.M	[redacted]	1522	1728	2745
22.3.18	9.00 A.M	[redacted]	1602	1830	2846
27-4-18	3.30pm	[redacted]	1834	2023	2875
23-5-18	8.15	4p4(6) Personal informa [redacted]	1912	2123	2896
4-6-18	9.00 a.m	[redacted]	1930	2150	2912
6-7-18	9.10 a.m	[redacted]	2030	2023	2083
03-8-18	11.10 a.m	[redacted]	2210	2441	3001
19-9-18	9.00 am	[redacted]	2296	2498	3058
8-10-18	8.42 Am	[redacted]	2350	2570	3022
29-11-18	13.06pm	[redacted]	2370	2660	3175
18-12-18	9.00 A.M	[redacted]	2265	2692	3016
31-1-19	16:00 pm	[redacted]	2475	2810	3390
28-2-19	10:40 Am	[redacted]	2587	2980	3535
25-3-19	9.00 Am	[redacted]	2530	2882	3375
16-4-19	8.10 A.M	[redacted]	2547	2889	3401
27-5-19	12.30 p.m	[redacted]	2234	2552	3012
24-6-19	9.00 Am	[redacted]	2380	2681	3100
31-7-2019	7.20 A.M	[redacted]	2478	2786	3181
16.8.19	8.30 am	[redacted]	2582	2832	3227
16.9.19	8.45 Am	[redacted]	2627	2949	3306
21.10.19	11:20 Am	[redacted]	2547	2851	3090
27.11.19	14.15 P.M.	[redacted]	2760	3065	3082
16-12-19	9.00 Am	[redacted]	2784	3140	2692
29.1.20	15:00 pm	[redacted]	2943	3244	3652
26.2.20	12:30 pm	[redacted]	2104	2445	2779
15-4-20	0830	[redacted]	2243	2523	2960

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility
Project:	Groundwater bore installation and sampling
Location:	Agnes Water, Qld
Job No:	
Sampled by:	h4p4(6) Personal informati
Date:	15-4-2020

DESAL 1

WELL DETAILS		SAMPLING EQUIPMENT	
Well depth:	6.5 (m)	Sampling device: Peristaltic (low flow)	GEO# ✓
Well diameter:	50 mm	Water meter:	YSI# ✓ PRO +
Casing type:	PVC	Turbidity Meter:	TM#
Initial water level:	2.243 (m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
11.27	2	2	2.252	26.0	0.12	338.8		3.88	233.1	
11.31	2	4	2.252	26.2	0.11	324.5		3.90	219.3	
11.35	2	6	2.252	26.2	0.15	311.6		3.95	208.4	
11.39	2	8	2.252	26.3	0.22	303.6		3.97	199.4	
11.43	2	10	2.252	26.3	0.27	302.0		3.98	193.1	
11.47	2	12	2.252	26.3	0.29	301.0		3.98	186.7	
11.51	2	14	2.252	26.3	0.30	300.2		3.99	182.1	
11.55	2	16	2.252	26.3	0.31	299.6		3.99	178.9	
11.59	2	18	2.252	26.3	0.32	297.1		4.00	174.9	
12.03	2	20	2.252	26.3	0.32	298.7		3.99	172.4	
			SAMPLES TAKEN							
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, SLIGHT SOUTHERLY BREEZE

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

COLOUR BUT NOT TURBID.

Samples Taken	Number	Duplicte: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.0 L /m

Field Technician #1 **Field Technician #2**

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	sch4p4(6) Personal information
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	15-4-2020

	WELL DETAILS			SAMPLING EQUIPMENT		
DESAL 2	Well depth:	6.0	(m)	Sampling device: Peristaltic (low flow)	GEO#	✓
	Well diameter:	50mm		Water meter:	YSI#	✓ PRO+
	Casing type:	PVC		Turbidity Meter:	TM#	
	Initial water level:	2.523	(m)	Interphase probe:	IP#	

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
10.10	2	2	2.530	24.7	0.24	292.2		4.16	135.0	
10.14	2	4	2.530	24.7	0.16	286.0		4.03	163.3	
10.18	2	6	2.532	24.8	0.16	304.0		3.99	186.2	
10.22	2	8	2.532	24.8	0.19	311.0		3.91	190.0	
10.26	2	10	2.532	24.8	0.22	314.2		3.89	191.8	
10.30	2	12	2.532	24.8	0.26	314.0		3.87	189.6	
10.34	2	14	2.532	24.8	0.28	313.3		3.90	186.8	
10.38	2	16	2.532	24.8	0.29	311.7		3.91	186.2	
10.42	2	18	2.532	24.8	0.31	313.6		3.94	185.3	
10.46	2	20	2.532	24.8	0.31	313.6		3.92	180.6	
			SAMPLES	TAKEN						
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, SLIGHT SOUTHERLY BREEZE

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

TURBID

Samples Taken	Number	Duplicte: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm		
Diameter of hole drilled:		mm		
(1) Volume of casing only	0.000000	m3 (kL)	0.00	L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00	L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00	L per metre
(4) Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.0	L /m

Field Technician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	

	WELL DETAILS		SAMPLING EQUIPMENT	
DESAL 3	Well depth:	5.0 (m)	Sampling device: Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm	Water meter:	YSI# ✓ PRO+
	Casing type:	PVC	Turbidity Meter:	TM#
	Initial water level:	2.960 (m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
0830	2	2	3.264	27.6	0.12	198.7		4.86	-109.8	
0834	2	4	3.323	27.7	0.22	199.1		4.83	-139.7	
0838	2	6	3.328	27.6	0.36	200.6		4.81	-155.7	
0842	2	8	3.342	27.7	0.39	204.6		4.83	-159.7	
0846	2	10	3.350	27.7	0.41	205.4		4.82	-167.2	
0850	2	12	3.360	27.7	0.42	207.9		4.82	-171.9	
0854	2	14	3.370	27.6	0.42	209.1		4.82	-173.2	
0858	2	16	3.376	27.6	0.42	211.1		4.82	-175.8	
0902	2	18	3.382	27.6	0.42	211.1		4.83	-177.8	
0906	2	20	3.386	27.7	0.43	212.3		4.82	-177.9	
0910	2	22	3.392	27.6	0.43	218.5		4.82	-177.7	
0914	2	24	3.396	27.6	0.44	219.0		4.82	-177.7	
			SAMPLES TAKEN							
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, SLIGHT SOUTHERLY BREEZE

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

DIRTY, TANNIN COLOURED, ODOUROUS

Samples Taken	Number	Duplicte: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm		
Diameter of hole drilled:		mm		
(1) Volume of casing only	0.000000	m3 (kL)	0.00	L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00	L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00	L per metre
(4) Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.0	L /m

Field Technician #1

Field Technician #2

TRILITY

STP Groundwater Monitoring Standing Water Level Measurement

NB Measurement to be taken in mm from top of bore casing

Date	Time	Operator	STP 1	STP 2	97-01	97-2	97-3	97-4	97-5	0.007	0.008
8-10-18	8.00	[redacted] 4(6) Personal infor	1.462	3710	Dry	Dry	Dry	Dry	Dry	Dry	Dry
29.11.18	8.00		1.578	3862	"	"	"	"	"	"	"
20.12.18	8.35		1.743	3938	Dry	Dry	Dry	Dry	Dry	Dry	Dry
30.1.19	7.10		1.795	4050	"	"	"	"	"	"	"
2-3-19	7.30		1.913	4170	"	"	"	"	"	"	"
26-3-19	8.30		1.915	4201	—	—	—	—	—	—	—
16-4-19	10.15 a.m		1.927	4.226	—	—	—	—	—	—	—
27-5-19	2.20 p.m		1.804	3.942	0.748	1.302	1.355	1.113	.732	Dry	Dry
25-6-19	8.30 am		1.860	3938	1.305	Dry	Dry	Dry	Dry	Dry	Dry
31-7-19	10.58		1.838	3992	Dry	Dry	Dry	Dry	Dry	Dry	Dry
16-8-19	10-07		1.972	4086	Dry	Dry	Dry	Dry	Dry	Dry	Dry
17-9-19	8-30		2.068	4195	Dry	Dry	Dry	Dry	Dry	Dry	Dry
29.10.19	08:50		2.202	4320	1.030	1.320	1.355	1.110	0.765	DRY	DRY
25.11.19	9.00		2.263	4381	1.280	DRY	DRY	DRY	DRY	DRY	DRY
17-12-19	9.30		2.305	4492	Dry	—	—	—	—	—	—
30-12-20	2.03		2.403	4628	Dry	Dry	Dry	Dry	Dry	Dry	Dry
26-02-20	1420		2.245	4370	FLOODED	FLOODED	0.27	FLOODED	0.325	0.48	0.65
21-04-20	0925		2.248	4142	0.838	1.270	1.350	1.110	0.760	DRY	1.440

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	sch4p4(6) Personal information
Project:	Groundwater bore Installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	21-4-2020

STP 1

WELL DETAILS			SAMPLING EQUIPMENT	
Well depth:	15.36	(m)	Sampling device. Peristaltic (low flow)	GEO# ✓
Well diameter:	50mm		Water meter	YSI# ✓ PRO+
Casing type:	PVC		Turbidity Meter	TM#
Initial water level:	2.248	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
0936	2	2	2.375	24.2	0.39	3801		6.66	2.2	
0940	2	4	2.395	24.2	0.54	3764		6.64	2.8	
0944	2	6	2.428	24.2	0.65	3738		6.70	-6.7	
0948	2	8	2.448	24.1	0.66	3727		6.70	-9.9	
0952	2	10	2.468	24.1	0.68	3680		6.70	-13.2	
0956	2	12	2.484	24.2	0.70	3716		6.71	-15.4	
1000	2	14	2.495	24.1	0.71	3720		6.72	-19.1	
1004	2	16	2.505	24.1	0.72	3716		6.72	-17.4	
1008	2	18	2.512	24.1	0.72	3729		6.71	-16.7	
				SAMPLES TAKEN						
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, NO WIND, SUNNY

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

CLEAR, NO ODOUR

Samples Taken	Number	Duplicte: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-			
Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.00 L per metre

Field Technician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	sch4p4(6) Personal information
Project:	Groundwater bore Installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	21-4-2020

	WELL DETAILS			SAMPLING EQUIPMENT	
STP 2	Well depth:	13.14	(m)	Sampling device. Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm		Water meter	YSI# ✓ PRO +
	Casing type:	PVC		Turbidity Meter	TM#
	Initial water level:	4.142	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
1051	2	2	4.512	24.1	0.62	11903		6.55	92.5	
1055	2	4	4.560	24.0	1.02	11786		6.54	89.7	
1059	2	6	4.565	24.0	1.07	11749		6.54	85.6	
1105	2	8	4.565	24.0	1.09	11656		6.53	86.3	
1109	2	10	4.565	24.0	1.10	11778		6.53	86.3	
1114	2	12	4.565	24.0	1.12	11640		6.53	85.9	
1118	2	14	4.565	24.0	1.13	11732		6.53	85.5	
			SAMPLES TAKEN							
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, NO WIND, SUNNY

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

CLEAR, NO ODOUR

Samples Taken	Number	Duplicte: QA_	Triplicate: QA_	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved Inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-			
Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.00 L per metre

Field Technician #1

Field Technician #2

Level 1 / 381 MacArthur Avenue
Hamilton QLD 4007
Australia

APRIL 2020
QUARTERLY REPORT
Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

Appendix B: Results Summary Table

Appendix B: Results Summary Table April 2020

			Field					Inorganics							
Bore ID	**Sampling Date**	**Lab Report Number**	**Dissolved Oxygen (DO) [1]**	**Electrical Conductivity (EC)**	**pH [2]**	**Oxidation Reduction Potential (ORP)**	**Temperature**	**Ammonia as N**	**Chloride**	**Kjeldahl Nitrogen Total**	**Nitrate (as N)**	**Nitrite (as N)**	**Nitrogen (Total)**	**Oxides of Nitrogen**	**Total Phosphorus as P**
		Units	mg/L	µS/cm	pH_Units	mV	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Trigger Criteria			20% change from background	20% change from background	Any change from background			20% change from background	20% change from background		20% change from background		20% change from background		20% change from background
DESAL1	15/04/2020	EB2010399	0.32	298.7	3.99	172.4	26.3	0.13	74	1.2	0.76	<0.01	2.0	0.76	0.07
DESAL2	15/04/2020	EB2010399	0.31	313.6	3.92	180.6	24.8	0.1	81	1.3	0.03	<0.01	1.3	0.03	0.1
DESAL3	15/04/2020	EB2010399	0.44	219	4.82	-177.7	27.6	0.5	60	1.6	<0.01	<0.01	1.6	<0.01	0.21
STP1	21/04/2020	EB2010933	0.72	3,729	6.71	-16.7	24.1	0.25	1,020	0.3	<0.01	<0.01	0.3	<0.01	0.02
STP2	21/04/2020	EB2010933	1.13	11,732	6.53	85.5	24	0.18	3,850	0.3	<0.01	<0.01	0.3	<0.01	0.04

[1] Dissolved oxygen criteria is a 20% change down from the background value instead of up.

[2] Criteria for pH is any change up or down from the background-derived trigger value

Appendix B: Results Summary Table April 2020

			Inorganics	Metals									
Bore ID	Sampling Date	Lab Report Number	Sulphate as S	Aluminium	Aluminium (Filtered)	Arsenic	Arsenic (Filtered)	Boron	Cadmium	Cadmium (Filtered)	Chromium (III+VI)	Chromium (III+VI) (Filtered)
		Units	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Trigger Criteria			Any change from background	55 if pH >6.5	55 if pH >6.5	13	13	Any change from background	0.2	0.2	1	1
DESAL1	15/04/2020	EB2010399	<5.0	600	510	<1.0	<1.0	<50	<0.1	<0.1	<1.0	<1.0
DESAL2	15/04/2020	EB2010399	2.0	1350	560	<1.0	<1.0	<50	<0.1	<0.1	3.0	<1.0
DESAL3	15/04/2020	EB2010399	<1.0	920	730	1.0	1.0	<50	<0.1	<0.1	3.0	2.0
STP1	21/04/2020	EB2010933	95	<10	<10	1.0	1.0	<50	<0.1	<0.1	<1.0	<1.0
STP2	21/04/2020	EB2010933	369	<10	<10	1.0	2.0	<50	<0.1	<0.1	<1.0	<1.0

Appendix B: Results Summary Table April 2020

			Metals												
Bore ID	Sampling Date	Lab Report Number	Cobalt	Cobalt (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Manganese (Filtered)	Mercury	Mercury (Filtered)	Nickel
		Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Trigger Criteria			1.4	1.4	1.4	1.4			3.4	3.4	1900	1900	0.06	0.06	11
DESAL1	15/04/2020	EB2010399	<1.0	<1.0	<1.0	<1.0	180	160	<1.0	<1.0	8.0	8.0	<0.1	<0.1	<1.0
DESAL2	15/04/2020	EB2010399	<1.0	<1.0	2.0	<1.0	670	570	1.0	<1.0	30.0	28.0	<0.1	<0.1	2.0
DESAL3	15/04/2020	EB2010399	<1.0	<1.0	<1.0	<1.0	3,990	3,710	<1.0	<1.0	28	29	<0.1	<0.1	3.0
STP1	21/04/2020	EB2010933	<1.0	<1.0	<1.0	<1.0	1,820	1,600	<1.0	<1.0	1,390	1,260	<0.1	<0.1	<1.0
STP2	21/04/2020	EB2010933	1.0	2.0	<1.0	<1.0	<50	<50	<1.0	<1.0	113	111	<0.1	<0.1	3.0

Appendix B: Results Summary Table April 2020

			Metals									Microbiological	
Bore ID	Sampling Date	Lab Report Number	Nickel (Filtered)	Silver	Silver (Filtered)	Selenium	Selenium (Filtered)	Tin	Tin (Filtered)	Zinc	Zinc (Filtered)	E. Coli	Enterococci
		Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	cfu/100 ml	cfu/100 ml
Trigger Criteria			11	0.05	0.05	5	5			8	8	Any change from background	Any change from background
DESAL1	15/04/2020	EB2010399	<1.0	<0.01	<0.01	<10	<10	<1.0	<1.0	6.0	<5.0	<1	<1
DESAL2	15/04/2020	EB2010399	1.0	0.04	<0.01	<10	<10	<1.0	<1.0	<5.0	7.0	<1	<1
DESAL3	15/04/2020	EB2010399	3.0	0.02	<0.01	<10	<10	<1.0	<1.0	6.0	8.0	<1	<1
STP1	21/04/2020	EB2010933	<1.0	<0.01	<0.01	<10	<10	<1.0	<1.0	<5.0	6.0	<1	<1
STP2	21/04/2020	EB2010933	3.0	0.02	0.01	<10	<10	<1.0	<1.0	<5.0	5.0	<1	<1

GREENCAP
Going Further in Managing Risk

Level 1 / 381 MacArthur Avenue
Hamilton QLD 4007
Australia

APRIL 2020
QUARTERLY REPORT
Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

Appendix C: Laboratory Results. COC and QA/QC Documentation

2314

CHAIN OF CUSTODY

ALS Laboratory: *please tick →*

- ☐ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
- ☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
- ☐BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
- ☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
- ☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 4978 7944 E: ALSEnviro.gladstone@alsglobal.com
- ☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
- ☐NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
- ☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
- ☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
- ☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
- ☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
- ☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: TRILITY

OFFICE: AGNES WATER

PROJECT: GROUNDWATER MONITORING **PROJECT NO.:**

ORDER NUMBER: **PURCHASE ORDER NO.:** 4500059581

PROJECT MANAGER: (6) Personal info **CONTACT PH:** DL: +61 7 49757975 | M: (6) Personal inf

SAMPLER: David McConnell **SAMPLER MOBILE:** Personal i

COC Emailed to ALS? (YES / NO) — YES circled **EDD FORMAT (or default):**

Email Reports to : Personal i awatergroup@trility.com.au

Email Invoice to (will default to PM if no other addresses are listed): accountspayable@trility.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)

☐ Standard TAT (List due date):

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: BN/222/16

COUNTRY OF ORIGIN:

COC SEQUENCE NUMBER (Circle)

COC: 1 2 3 4 5 6 7

OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt:	°C		
Other comment:			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
sch4p4(6) Personal information	6) Personal inf		
DATE/TIME: 15/04/2020 1400	DATE/TIME: [redacted] 16/4/2020 9:00	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).							Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	TABLE 1	pH Field	Temp Field	D.O. Field	Cond Field μS/cm	ORP Field		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc. Please add field results to COA
1	DESAL 1	15/04/2020 1205	W		5	X	3.99	26.3	0.32	298.7	172.4		
2	DESAL 2	15/04/2020 1050	W		5	X	3.92	24.8	0.31	313.6	180.6		
3	DESAL 3	15/04/2020 0920	W		5	X	4.82	27.6	0.44	219.0	-171.7		
4	DESAL 1 (Duplicate)	15/04/2020 1210	W		5	X	3.99	26.3	0.32	298.7	172.4		
				TOTAL	20								

Environmental Division
Brisbane
Work Order Reference
EB2010399

Telephone : + 61-7-3243 7222

MICRO LAB

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

22-205 File A

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2010399**	Page	: 1 of 4
Client	: **TRILITY Pty Ltd**	Laboratory	: Environmental Division Brisbane
Contact	: MR p4(6) Personal inform	Contact	: Customer Services EB
Address	: LOT 40 SPRINGS ROAD AGNES WATER QLD 4677	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 08 84086500	Telephone	: +61-7-3243 7222
Project	: Groundwater Monitoring	Date Samples Received	: 16-Apr-2020 09:00
Order number	: 4500059581	Date Analysis Commenced	: 16-Apr-2020
C-O-C number	: ----	Issue Date	: 23-Apr-2020 15:18
Sampler	: 4p4(6) Personal informa		
Site	: ----		
Quote number	: BN/222/16		
No. of samples received	: 4		
No. of samples analysed	: 4		

NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

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

(6) Personal infor	Senior Inorganic Chemist	Brisbane Administration, Stafford, QLD
	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
	Microbiologist	Brisbane Microbiological, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK067G (Total Phosphorus as P): Sample EB2010399_001 (DESAL 1) was diluted due to matrix interference. LOR adjusted accordingly.
- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for samples DESAL 2 (EB2010399-002) and DESAL 3 (EB2010399-003). However, the difference is within experimental variation of the methods.
- ED041G (Sulfate as SO4): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- MW023 is ALS's internal code and is equivalent to AS4276.9.
- MW006 is ALS's internal code and is equivalent to AS4276.7.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				DESAL 1	DESAL 2	DESAL 3	DESAL 1 (Duplicate)	----
				15-Apr-2020 12:05	15-Apr-2020 10:50	15-Apr-2020 09:20	15-Apr-2020 12:10	----
				EB2010399-001	EB2010399-002	EB2010399-003	EB2010399-004	--------
				Result	Result	Result	Result	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<5	**2**	<1	<5	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**72**	**81**	**60**	**74**	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.48**	**0.56**	**0.73**	**0.51**	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.001**	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.002**	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.001**	**0.003**	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.007**	**0.008**	<0.005	----
Manganese	7439-96-5	0.001	mg/L	**0.008**	**0.028**	**0.029**	**0.008**	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	**0.14**	**0.57**	**3.71**	**0.16**	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.59**	**1.35**	**0.92**	**0.60**	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.001**	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.003**	**0.003**	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.002**	**0.003**	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	**0.001**	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	**0.006**	<0.005	**0.006**	**0.006**	----
Manganese	7439-96-5	0.001	mg/L	**0.008**	**0.030**	**0.028**	**0.008**	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	**0.18**	**0.67**	**3.99**	**0.18**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

				DESAL 1	DESAL 2	DESAL 3	DESAL 1 (Duplicate)	----
				15-Apr-2020 12:05	15-Apr-2020 10:50	15-Apr-2020 09:20	15-Apr-2020 12:10	----
				EB2010399-001	EB2010399-002	EB2010399-003	EB2010399-004	--------
				Result	Result	Result	Result	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS								
Silver	7440-22-4	0.01	µg/L	<0.01	<0.01	<0.01	<0.01	----
EG094T: Total metals in Fresh water by ORC-ICPMS								
Silver	7440-22-4	0.01	µg/L	<0.01	0.04	0.02	<0.01	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.10	0.10	0.50	0.13	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.76	0.03	<0.01	0.73	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.76	0.03	<0.01	0.73	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.2	1.3	1.6	1.2	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	2.0	1.3	1.6	1.9	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	0.10	0.21	0.07	----
EN67: Field Tests								
ø Electrical Conductivity (Non Compensated)	----	1	µS/cm	298.7	313.6	219.0	298.7	----
ø Dissolved Oxygen	----	0.1	mg/L	0.32	0.31	0.44	0.32	----
ø pH	----	0.01	pH Unit	3.99	3.92	4.82	3.99	----
ø Temperature	----	0.1	°C	26.3	24.8	27.6	26.3	----
ø Reactive Phosphorus as P	14265-44-2	0.01	mg/L	172.4	180.6	-177.7	172.4	----
MW006: Faecal Coliforms & E.coli by MF								
Faecal Coliforms	----	1	CFU/100mL	<1	<1	<1	<1	----
MW023: Enterococci by Membrane Filtration								
Enterococci	----	1	CFU/100mL	<1	<1	<1	<1	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB2010399**	Page	: 1 of 7
Client	: **TRILITY Pty Ltd**	Laboratory	: Environmental Division Brisbane
Contact	: MR p4(6) Personal inform	Contact	: Customer Services EB
Address	: LOT 40 SPRINGS ROAD AGNES WATER QLD 4677	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 08 84086500	Telephone	: +61-7-3243 7222
Project	: Groundwater Monitoring	Date Samples Received	: 16-Apr-2020
Order number	: 4500059581	Date Analysis Commenced	: 16-Apr-2020
C-O-C number	: ----	Issue Date	: 23-Apr-2020
Sampler	: p4(6) Personal inform		
Site	: ----		
Quote number	: BN/222/16		
No. of samples received	: 4		
No. of samples analysed	: 4		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

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

) Personal in	Senior Inorganic Chemist	Brisbane Administration, Stafford, QLD
	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
	Microbiologist	Brisbane Microbiological, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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

Key :
- Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
- 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
- RPD = Relative Percentage Difference
- # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2973523)									
EB2010268-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	658000 µg/L	656	0.270	0% - 20%
EB2010399-001	DESAL 1	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<5	<5	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 2973525)									
EB2010399-001	DESAL 1	ED045G: Chloride	16887-00-6	1	mg/L	72	73	0.00	0% - 20%
EB2010545-009	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	2420	2440	0.643	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2972357)									
EB2008355-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.006	0.005	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	1.03	1.01	2.16	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.018	0.019	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.10	0.10	0.00	No Limit
EB2010262-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2972357) - continued									
EB2010262-001	Anonymous	EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.115	0.114	0.00	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2972363)									
EB2010188-005	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.005	0.005	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-T: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.01	<0.01	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.10	<0.10	0.00	No Limit
EB2010262-002	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.050	0.050	0.00	0% - 20%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	31.5	31.5	0.0606	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	3.70	3.71	0.478	0% - 20%
EG035F: Dissolved Mercury by FIMS (QC Lot: 2972358)									
EB2010378-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2008355-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2972368)									
EB2008355-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2010085-004	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS (QC Lot: 2972289)									
EB2010399-001	DESAL 1	EG094-AgF: Silver	7440-22-4	0.01	µg/L	<0.01	<0.01	0.00	No Limit
EG094T: Total metals in Fresh water by ORC-ICPMS (QC Lot: 2972282)									
EB2010399-001	DESAL 1	EG094-AgT: Silver	7440-22-4	0.01	µg/L	<0.01	<0.01	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2977961)									
EB2010399-001	DESAL 1	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.10	0.09	0.00	No Limit
EB2010482-005	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.05	0.06	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2973522)									
EB2010268-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<10 µg/L	<0.01	0.00	No Limit
EB2010399-001	DESAL 1	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2977962)									
EB2010399-001	DESAL 1	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.76	0.72	4.65	0% - 20%
EB2010482-005	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.02	0.02	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2976603)									
EB2010376-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.7	2.3	15.9	No Limit
EB2010394-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	31.1	30.5	2.03	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2976602)									
EB2010376-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	1.35	1.31	2.78	0% - 20%
EB2010394-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	3.51	3.26	7.45	0% - 20%

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2973523)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	107	85.0	118
				<1	100 mg/L	104	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 2973525)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.6	90.0	115
				<1	1000 mg/L	102	90.0	115
EG020F: Dissolved Metals by ICP-MS (QCLot: 2972357)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	100	79.0	118
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	103	88.0	116
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	100	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	97.2	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	102	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	100	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	97.6	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	97.0	89.0	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	98.5	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	102	83.0	112
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	99.3	86.0	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	99.3	87.0	113
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	102	82.0	114
EG020T: Total Metals by ICP-MS (QCLot: 2972363)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	95.9	80.0	114
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	88.0	112
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	97.3	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	99.2	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	95.2	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	95.7	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	98.9	88.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	98.0	88.0	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.9	79.0	111
EG020A-T: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	108	86.0	116
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	98.1	84.0	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	91.7	82.0	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	96.0	82.0	118

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EG035F: Dissolved Mercury by FIMS (QCLot: 2972358)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	103	84.0	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2972368)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	118	84.0	118
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS (QCLot: 2972289)								
EG094-AgF: Silver	7440-22-4	0.01	µg/L	<0.01	0.2 µg/L	90.0	70.0	130
EG094T: Total metals in Fresh water by ORC-ICPMS (QCLot: 2972282)								
EG094-AgT: Silver	7440-22-4	0.01	µg/L	<0.01	0.2 µg/L	106	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2977961)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	102	83.5	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2973522)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	90.0	90.0	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2977962)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	99.0	85.7	111
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2976603)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	88.5	70.1	108
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2976602)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	92.4	79.2	105

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2973523)							
EB2010268-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1000 mg/L	92.5	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 2973525)							
EB2010399-002	DESAL 2	ED045G: Chloride	16887-00-6	400 mg/L	107	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2972357)							
EB2008355-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	101	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	100	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	97.3	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	92.3	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	94.6	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	94.1	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	95.4	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2972357) - continued							
EB2008355-002	Anonymous	EG020A-F: Nickel	7440-02-0	1 mg/L	93.1	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	98.8	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 2972363)							
EB2010188-006	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	96.7	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	98.6	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	105	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	108	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	105	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	107	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	106	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	99.4	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	95.7	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2972358)							
EB2008355-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	88.1	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2972368)							
EB2008355-002	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	82.1	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2977961)							
EB2010399-002	DESAL 2	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	87.6	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2973522)							
EB2010268-002	Anonymous	EK057G: Nitrite as N	14797-65-0	4 mg/L	96.1	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2977962)							
EB2010399-002	DESAL 2	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	89.6	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2976603)							
EB2010393-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	86.8	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2976602)							
EB2010393-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	97.3	70.0	130

Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2010399**	Page	: 1 of 7
Client	: **TRILITY Pty Ltd**	Laboratory	: Environmental Division Brisbane
Contact	: MR p4(6) Personal inform	Telephone	: +61-7-3243 7222
Project	: Groundwater Monitoring	Date Samples Received	: 16-Apr-2020
Site	: ----	Issue Date	: 23-Apr-2020
Sampler	: p4(6) Personal inform	No. of samples received	: 4
Order number	: 4500059581	No. of samples analysed	: 4

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method		*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)			*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
DESAL 1, DESAL 3,	DESAL 2, DESAL 1 (Duplicate)	**15-Apr-2020**	**----**	----	----	**17-Apr-2020**	13-May-2020	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G)								
DESAL 1, DESAL 3,	DESAL 2, DESAL 1 (Duplicate)	**15-Apr-2020**	**----**	----	----	**17-Apr-2020**	13-May-2020	✓
EG020F: Dissolved Metals by ICP-MS								
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG020A-F)								
DESAL 2,	DESAL 3	**15-Apr-2020**	**----**	----	----	**20-Apr-2020**	12-Oct-2020	✓
Clear Plastic Bottle - Natural (EG020A-F)								
DESAL 1,	DESAL 1 (Duplicate)	**15-Apr-2020**	**----**	----	----	**20-Apr-2020**	12-Oct-2020	✓
EG020T: Total Metals by ICP-MS								
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG020A-T)								
DESAL 1, DESAL 3,	DESAL 2, DESAL 1 (Duplicate)	**15-Apr-2020**	**21-Apr-2020**	12-Oct-2020	✓	**21-Apr-2020**	12-Oct-2020	✓
EG035F: Dissolved Mercury by FIMS								
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG035F)								
DESAL 2,	DESAL 3	**15-Apr-2020**	**----**	----	----	**20-Apr-2020**	13-May-2020	✓
Clear Plastic Bottle - Natural (EG035F)								
DESAL 1,	DESAL 1 (Duplicate)	**15-Apr-2020**	**----**	----	----	**20-Apr-2020**	13-May-2020	✓
EG035T: Total Recoverable Mercury by FIMS								
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG035T)								
DESAL 1, DESAL 3,	DESAL 2, DESAL 1 (Duplicate)	**15-Apr-2020**	**----**	----	----	**21-Apr-2020**	13-May-2020	✓
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS								
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG094-AgF)								
DESAL 2,	DESAL 3	**15-Apr-2020**	**----**	----	----	**20-Apr-2020**	12-Oct-2020	✓
Clear Plastic Bottle - Natural (EG094-AgF)								
DESAL 1,	DESAL 1 (Duplicate)	**15-Apr-2020**	**----**	----	----	**20-Apr-2020**	12-Oct-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG094T: Total metals in Fresh water by ORC-ICPMS								
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG094-AgT)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	**20-Apr-2020**	12-Oct-2020	✓	**20-Apr-2020**	12-Oct-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	----	----	----	**21-Apr-2020**	13-May-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	----	----	----	**17-Apr-2020**	17-Apr-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	----	----	----	**21-Apr-2020**	13-May-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	**21-Apr-2020**	13-May-2020	✓	**21-Apr-2020**	13-May-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	**21-Apr-2020**	13-May-2020	✓	**21-Apr-2020**	13-May-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							
MW006: Faecal Coliforms & E.coli by MF								
Sterile Plastic Bottle - Sodium Thiosulfate (MW006)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	----	----	----	**16-Apr-2020**	16-Apr-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							
MW023: Enterococci by Membrane Filtration								
Sterile Plastic Bottle - Sodium Thiosulfate (MW023)								
DESAL 1,	DESAL 2,	**15-Apr-2020**	----	----	----	**16-Apr-2020**	16-Apr-2020	✓
DESAL 3,	DESAL 1 (Duplicate)							

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocyanate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020 Samples are 0.45µm filtered prior to analysis. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM (2013) Schedule B(3)
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Field Tests (performed by external sampler)	* EN67-B02	WATER	Field determinations as per methods described in APHA or supplied by client. The analysis is performed in the field by non-ALS samplers. ALS NATA accreditation does not apply for this service.
Thermotolerant Coliforms & E.coli by Membrane Filtration	MW006	WATER	AS 4276.7 2007
Enumeration of Enterococci by Membrane Filtration	MW023	WATER	AS4276.9: - 2007

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals - ORC	EN25-ORC	WATER	In house: Referenced to USEPA SW846-3005. This is an Ultrapure Nitric acid digestion procedure used to prepare surface and ground water samples for analysis by ORC- ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 4978 7944 E: ALSEnviro.gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: TRILITY
OFFICE: AGNES WATER
PROJECT: GROUNDWATER MONITORING PROJECT NO.:
ORDER NUMBER: PURCHASE ORDER NO.: 4500059581
PROJECT MANAGER: (6) Personal infor CONTACT PH: DL: +61 7 49757975 | M: (6) Personal in
SAMPLER: (6) Personal in SAMPLER MOBILE: (6) Personal in
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):
Email Reports to: Personal i@trility.com.au; awatergroup@trility.com.au
Email Invoice to (will default to PM if no other addresses are listed): accountspayable@trility.com.au

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)
☐ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.: BN/222/16
COUNTRY OF ORIGIN:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

RELINQUISHED BY: (6) Personal informat
DATE/TIME: [redacted] 21-4-20 1400

RECEIVED BY: (6) Personal infor
DATE/TIME: 28/09/2016 22/4/2020 8:10

RELINQUISHED BY:
DATE/TIME:

RECEIVED BY:
DATE/TIME:

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Consignment Note: MYTF134526

ALS USE ONLY | SAMPLE DETAILS MATRIX: Solid(S) Water(W) | CONTAINER INFORMATION | ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required). | Additional Information

LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	TABLE 1	pH Field	DO Field	Temp field	EC Field µS/cm	ORP Field	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc. Please add field results to COA
1	STP1	21/04/2020 1015	W		5	X	6.71	0.72	24.1	3729	-16.7	
2	STP2	21/04/2020 1120	W		5	X	6.53	1.13	24.0	11732	85.5	
	97-01		W									
	97-2		W									
	97-3		W									
	97-4		W									
	97-5		W									
	007		W									
	008		W									
3	STP1 Duplicate	21/04/2020 1020	W		5	X	6.71	0.72	24.1	3729	-16.7	
				TOTAL	15							

Environmental Division
Brisbane
Work Order Reference
EB2010933

Telephone : + 61-7-3243 7222

MICRO LAB

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

22-265

ENFM (2004/11) Form Page 1 of 1 Approved Date: 27/08/13

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2010399**	Page	: 1 of 4
Client	: **TRILITY Pty Ltd**	Laboratory	: Environmental Division Brisbane
Contact	: (6) Personal infor	Contact	: Customer Services EB
Address	: LOT 40 SPRINGS ROAD AGNES WATER QLD 4677	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Groundwater Monitoring	Date Samples Received	: 22-Apr-2020 08:10
Order number	: 4500059581	Date Analysis Commenced	: 22-Apr-2020
C-O-C number	: ----	Issue Date	: 28-Apr-2020 10:40
Sampler	: 4p4(6) Personal informa		
Site	: ----		
Quote number	: BN/222/16		
No. of samples received	: 3		
No. of samples analysed	: 3		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

[illegible]

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

[illegible]	[illegible]	[illegible]
(6) Personal infor	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
	Senior Inorganic Chemist	Brisbane Sampling, Stafford, QLD
	Microbiologist	Brisbane Microbiological, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- MW023 is ALS's internal code and is equivalent to AS4276.9.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- Sampling of waters conducted in accordance with AS5667 and in-house EN/67B.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			[illegible]	STP1	STP2	STP1 Duplicate	----	----
			[illegible]	21-Apr-2020 10:15	21-Apr-2020 11:20	21-Apr-2020 10:20	----	----
[illegible]	[illegible]	[illegible]	[illegible]	EB2010399-001	EB2010399-002	EB2010399-009	--------	--------
				Result	Result	Result	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**35**	**973**	**35**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**1020**	**9850**	**1020**	----	----
EG020F: Dissolved 6 etals by ICP-6 S								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.001**	**0.002**	**0.001**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.002**	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.009**	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Mnc	7440-66-6	0.005	mg/L	**0.005**	**0.005**	**0.007**	----	----
6 anganese	7439-96-5	0.001	mg/L	**1.24**	**0.111**	**1.27**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Iron	7439-89-6	0.05	mg/L	**1.5Z**	<0.05	**1.70**	----	----
EG020T: Total 6 etals by ICP-6 S								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.001**	**0.001**	**0.001**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.001**	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.009**	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Mnc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	----	----
6 anganese	7439-96-5	0.001	mg/L	**1.93**	**0.119**	**1.93**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	----	----
Iron	7439-89-6	0.05	mg/L	**1.82**	<0.05	**1.82**	----	----
EG095F: Dissolved 6 ercury by FI6 S								
6 ercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				STP1	STP2	STP1 Duplicate	----	----
				21-Apr-2020 10:15	21-Apr-2020 11:20	21-Apr-2020 10:20	----	----
				EB2010399-001	EB2010399-002	EB2010399-009	--------	--------
				Result	Result	Result	----	----
EG095T: Total Recoverable 6 ercury by FI6 S								
6 ercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG034F: Dissolved 6 etals in Fresh Water by ORC-ICP6 S								
Silver	7440-22-4	0.01	µg/L	<0.01	0.01	<0.01	----	----
EG034T: Total metals in Fresh water by ORC-ICP6 S								
Silver	7440-22-4	0.01	µg/L	<0.01	0.02	<0.01	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.25	0.18	0.07	----	----
EK05ZG: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK053G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK071G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.9	0.9	0.1	----	----
EK072G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	0.9	0.9	0.1	----	----
EK07ZG: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.02	0.04	0.09	----	----
EN7Z: Field Tests								
pH	----	0.01	pH Unit	7.Z1	7.59	7.Z1	----	----
Electrical Conductivity (Non Compensated)	----	0.1	µS/cm	9Z90	11Z00	9Z90	----	----
Dissolved Oxygen	----	0.01	mg/L	0.Z2	1.19	0.Z2	----	----
Temperature	----	0.1	°C	24.1	24.0	24.1	----	----
Redox Potential	----	0.1	mV	<0.1	85.5	<0.1	----	----
6 W007: Faecal Coliforms & E.coli by 6 F								
Faecal Coliforms	----	1	CFU/100mL	<1	<1	<1	----	----
6 W029: Enterococci by 6 embrane Filtration								
Enterococci	----	1	CFU/100mL	<1	<1	<1	----	----

Environmental

QUALITY CONTROL REPORT

Work Order	: **EB2010933**	Page	: 1 of 7
Client	: **TRILITY Pty Ltd**	Laboratory	: Environmental Division Brisbane
Contact	: (6) Personal infor	Contact	: Customer Services EB
Address	: LOT 40 SPRINGS ROAD AGNES WATER QLD 4677	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Groundwater Monitoring	Date Samples Received	: 22-Apr-2020
Order number	: 4500059581	Date Analysis Commenced	: 22-Apr-2020
C-O-C number	: ----	Issue Date	: 28-Apr-2020
Sampler	: p4(6) Personal informa		
Site	: ----		
Quote number	: BN/222/16		
No. of samples received	: 3		
No. of samples analysed	: 3		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
6) Personal info	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
	Senior Inorganic Chemist	Brisbane Sampling, Stafford, QLD
	Microbiologist	Brisbane Microbiological, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
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
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method : Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EB2010587-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	34	34	0.00	0% - 20%
EB2010590-010	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.00	No Limit
EB2010587-002	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	454	452	0.284	0% - 20%
EB2010590-010	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	<1	<1	0.00	No Limit
EB2010930-006	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.002	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.257	0.264	2.43	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.005	0.005	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.012	0.011	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.20	0.20	0.00	No Limit
EB2010430-002	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2010933**	Page	: 1 of 7
Client	: **TRILITY Pty Ltd**	Laboratory	: Environmental Division Brisbane
Contact	: (6) Personal infor	Telephone	: +61-7-3243 7222
Project	: Groundwater Monitoring	Date Samples Received	: 22-Apr-2020
Site	: ----	Issue Date	: 28-Apr-2020
Sampler	: p4(6) Personal inform	No. of samples received	: 3
Order number	: 4500059581	No. of samples analysed	: 3

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED045G: Chloride by Discrete Analyser	EB2010587--003	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*		*Sample Date*	*Extraction / Preparation*			*Analysis*		
			Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) STP1, STP1 Duplicate	STP2,	**21-Apr-2020**	----	----	----	**22-Apr-2020**	19-May-2020	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) STP1, STP1 Duplicate	STP2,	**21-Apr-2020**	----	----	----	**22-Apr-2020**	19-May-2020	✓
EG020F: Dissolved Metals by ICP-MS								
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG020A-F) STP1, STP1 Duplicate	STP2,	**21-Apr-2020**	----	----	----	**23-Apr-2020**	18-Oct-2020	✓
EG020T: Total Metals by ICP-MS								
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG020A-T) STP1, STP1 Duplicate	STP2,	**21-Apr-2020**	**23-Apr-2020**	18-Oct-2020	✓	**23-Apr-2020**	18-Oct-2020	✓
EG035F: Dissolved Mercury by FIMS								
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG035F) STP1, STP1 Duplicate	STP2,	**21-Apr-2020**	----	----	----	**23-Apr-2020**	19-May-2020	✓
EG035T: Total Recoverable Mercury by FIMS								
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG035T) STP1, STP1 Duplicate	STP2,	**21-Apr-2020**	----	----	----	**23-Apr-2020**	19-May-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation* Date extracted	Due for extraction	Evaluation	*Analysis* Date analysed	Due for analysis	Evaluation
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG094-AgF) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	----	----	----	**23-Apr-2020**	18-Oct-2020	✓
EG094T: Total metals in Fresh water by ORC-ICPMS							
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG094-AgT) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	**23-Apr-2020**	18-Oct-2020	✓	**23-Apr-2020**	18-Oct-2020	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	----	----	----	**23-Apr-2020**	19-May-2020	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	----	----	----	**22-Apr-2020**	23-Apr-2020	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	----	----	----	**23-Apr-2020**	19-May-2020	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	**24-Apr-2020**	19-May-2020	✓	**24-Apr-2020**	19-May-2020	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	**24-Apr-2020**	19-May-2020	✓	**24-Apr-2020**	19-May-2020	✓
EN67: Field Tests							
Clear Plastic Bottle - Natural (EN67) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	----	----	----	**24-Apr-2020**	----	----
MW006: Faecal Coliforms & E.coli by MF							
Sterile Plastic Bottle - Sodium Thiosulfate (MW006) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	----	----	----	**22-Apr-2020**	22-Apr-2020	✓
MW023: Enterococci by Membrane Filtration							
Sterile Plastic Bottle - Sodium Thiosulfate (MW023) STP1, STP2, STP1 Duplicate	**21-Apr-2020**	----	----	----	**22-Apr-2020**	22-Apr-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Sulfate (Turbidimetric) as SO_4^{2-} by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO_4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the $BaSO_4$ suspension is measured by a photometer and the SO_4^{-2} concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection ($SnCl_2$)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by $SnCl_2$ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection ($SnCl_2$)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by $SnCl_2$ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Low-Level Dissolved Silver in Fresh Water by ORC-ICPMS	EG094-AgF	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020 Samples are 0.45µm filtered prior to analysis. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM (2013) Schedule B(3)
Low-Level Total Silver in Fresh Water by ORC-ICPMS	EG094-AgT	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020. The ORC-ICPMS technique removes interfering species through a series of chemical reactions prior to ion detection. Ions are passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to measurement by a discrete dynode ion detector. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Field Tests	EN67	WATER	Field determinations as per methods described in APHA. The analysis is performed in the field by ALS samplers. ALS NATA accreditation applies for this service.
Thermotolerant Coliforms & E.coli by Membrane Filtration	MW006	WATER	AS 4276.7 2007
Enumeration of Enterococci by Membrane Filtration	MW023	WATER	AS4276.9: - 2007

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals - ORC	EN25-ORC	WATER	In house: Referenced to USEPA SW846-3005. This is an Ultrapure Nitric acid digestion procedure used to prepare surface and ground water samples for analysis by ORC- ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

JULY 2020

Agnes Water STP Irrigation Area Monitoring Program

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FILE REFERENCE

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1 INTRODUCTION

The Agnes Water Sewage Treatment Plant (STP), managed by TRILITY Pty Ltd is located approximately 5 km north of Deepwater National Park. The STP is a biological and nutrient removal (BNR) plant comprising inlet works, bioreactor, two clarifiers, a chlorine contact tank and four clay-lined storage lagoons, and discharges recycled water/effluent to an onsite irrigation area.

As per the Agnes Water STP Irrigation Management Plan (IMP), monitoring of soil within the effluent irrigation area must be undertaken annually (Vision Environment, 2016a). Monitoring for the IMP was undertaken in September and December 2016 (Vision Environment, 2016b, 2017), May 2018 (Vision Environment, 2018), and June 2019 (Vision Environment, 2019) in addition to the current survey in July 2020. Prior to this, monitoring of the irrigation area was undertaken by Miriam Vale Shire Council in 2003 and 2004 (MVSC, 2007).

During the EIS for the construction of the Agnes Water STP (Coleridge Water Engineers, 1998), a baseline soil survey was undertaken throughout Lot 20 and Lot 21 to determine which area contained suitable soils for the irrigation area to be located. The selected irrigation area was reported to contain silty to clayey sands on the surface, with a permeability rate of between 0.1 to 1.0 m/day. The surface soils overlie an impervious silty clay layer, with bedrock (Agnes Water Volcanics) present below. The clay layer is thought to seal groundwater from surface and near-surface water, leading to minimal infiltration of recycled water beyond the plant root zone, and therefore no adverse impacts on groundwater quality.

Treated effluent release occurs regularly via irrigation within the specified irrigation area, utilising treated effluent from Lagoon 3. The irrigation area is 48 ha, and an automated sprinkler system manages the irrigation to ensure over-irrigation does not occur and recycled water is spread evenly across the irrigation area. The maximum release of recycled water to the irrigation area over any 24-hour period is typically 900kL.

From 2016 to 2019, soils in the irrigation area have been found to be similar to the reference soils for the majority of parameters, including soil particle size distribution, structure, nutrient concentrations, cation exchange capacity, some exchangeable cations and soil conductivity, total soluble salts (TSS), exchangeable percent sodium (ESP) and sodium absorption ratio (SAR).

Several parameters have been shown to consistently vary between the irrigated and reference areas over the past four surveys. These include soil moisture, most likely due to the regular application of irrigation to these sites; pH, although as mean values remain within the optimal range for plant growth, adverse impacts are unlikely; and exchangeable calcium and potassium.

While higher conductivity and total soluble salts have been recorded at irrigation sites during 2016 to 2018, levels were below concentrations considered saline or sodic. Increased conductivity, TSS, ESP and SAR were recorded in the 2019 survey which may be associated with the lower than average rainfall during the year prior which has decreased the leaching of salts and ions from the soil. While the soils are not yet classified as saline, increased soil sodicity is indicated across both irrigated and reference locations, which may result in reduced plant growth rate.

2 METHODOLOGY

2.1 Soil Collection

Soils from six pre-established locations within the irrigation area, and three pre-established up-gradient reference locations, were collected for analysis. Figure 1 shows the location of the sampling sites, with GPS locations tabulated in the Appendix (Table 10).

Figure 1 Location of Agnes STP soil monitoring sites

Sampling methodologies from standard protocols derived from worldwide authorities were used including: the Australian and New Zealand Standards for sediment sampling (AS/NZS, 1998); the American Public Health Association Standard Methods for the Examination of Water and Wastewater (APHA, 2005); and the Department of Environment and Science Monitoring and Sampling Manual (DES, 2018).

Sampling was undertaken on 16 July 2020. Soils were collected at three depths for each site (0 – 20 cm, 20 to 40 cm and 40 to 60 cm). A soil auger was used to dig for the sub-surface samples (Figures 2 to 6). Approximately 1L of soil was collected at each sample depth using a trowel and deposited into the labelled laboratory provided sample containers. Samples were kept cool in an esky prior to being transported to the NATA-accredited analytical laboratory (ALS), using strict chain of custody procedures.

Figure 2 Soil cores at sites A) IR1 and B) IR2.

Figure 3 Soil cores at sites A) IR3 and B) IR4.

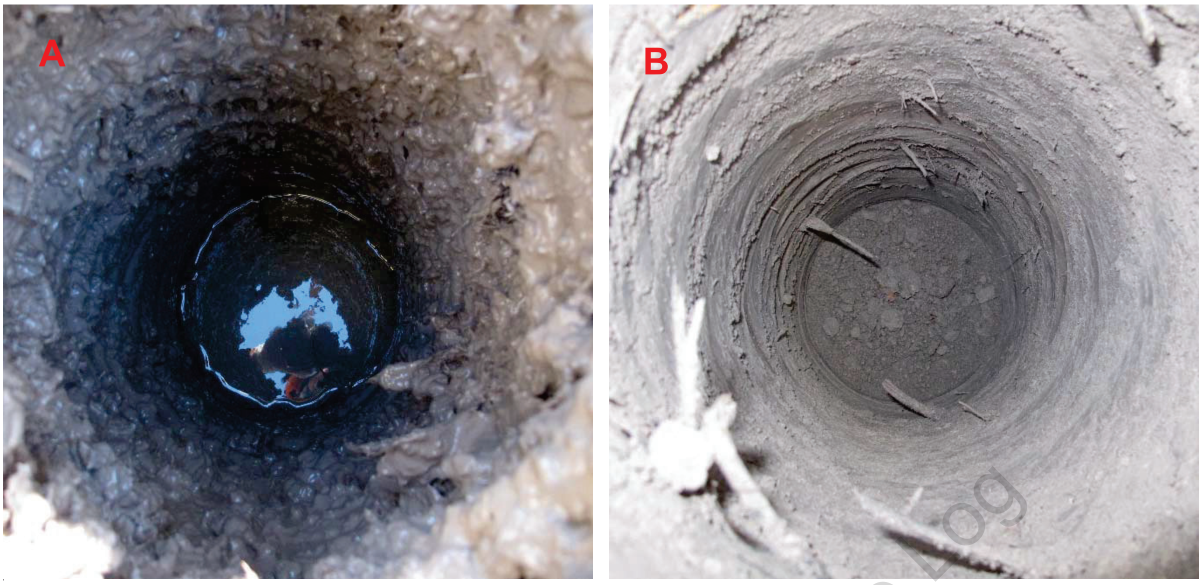

Figure 4 Soil cores at sites A) IR5 and B) IR6.

Figure 5 Soil cores at sites A) REF1 and B) REF2.

Figure 6 Soil core at sites REF3.

2.2 Soil Analysis

As per EA EPPR00959915 and the GRC IMP, the following laboratory analyses were undertaken:

- pH
- Salinity
- Nutrients (total nitrogen, total phosphorus, organic nitrogen, nitrate and nitrite)
- Phosphorus adsorption capacity
- Cation Exchange Capacity
- Exchangeable Cations
- Sodicity
- Sodium Absorption Ratio

Particle size analysis and Emerson Aggregate Test were last undertaken on the soils during June 2019 (Vision Environment, 2019). As these analyses are scheduled to be undertaken triennially, reanalysis is not scheduled until 2022 (Vision Environment, 2016b).

2.3 Data Analysis

Soil data was compiled, with data pooled from each type of location: irrigated and reference; and statistical analysis carried out to determine if the soils differed significantly between the two locations, potentially indicating impacts from recycled water. Two-way analyses of variance (ANOVA) were undertaken to determine whether there were any significant difference in soil parameters between locations (irrigation and reference) and/or depths (surface, mid or sub-surface) during the July 2020 survey. Fisher's LSD *Post hoc* multiple comparison tests were used to elucidate any significant differences among zones.

Temporal analysis of the data was also undertaken using Two-way ANOVA and Fisher's LSD *Post hoc* multiple comparison tests, to determine whether there were any statistical differences in soil parameters between surveys (September 2016, December 2016, May 2018, June 2019 and July 2020) and/or locations (irrigated and reference).

3 RESULTS AND DISCUSSION

3.1 Soil Moisture

Soil moisture was determined at all three soil depths for each site. Table 1 lists the mean moisture at each soil depth for the irrigation and reference locations in July 2020 while Figure 7 exhibits mean soil moisture in July 2020 in addition to the prior three surveys. See Table 8 in Appendix for individual site and soil levels during June 2019.

Table 1. Soil moisture (%) at different sample depths in the irrigation area and reference locations in July 2020.
Values are means ± se (n = 3 to 6).

Parameter	Irrigation Area			Reference Area		
	0-200 mm depth	200-400 mm depth	400-600 mm depth	0-200 mm depth	200-400 mm depth	400-600 mm depth
Moisture (%)	24 ± 4	16 ± 1	15 ± 1	7 ± 1	8 ± 1	8 ± 1

During the July 2020 survey, soil moisture was significantly ($P < 0.05$) lower in the reference area (7 to 8 % moisture) than in the irrigation area (15 to 24 % moisture), most likely due to the regular application of water to the latter area (Table 1). This has been a consistent pattern over the five surveys undertaken since September 2016 (Figure 7). However, there was no significant difference with soil depth, indicating soil moisture was consistent throughout the three soil depths.

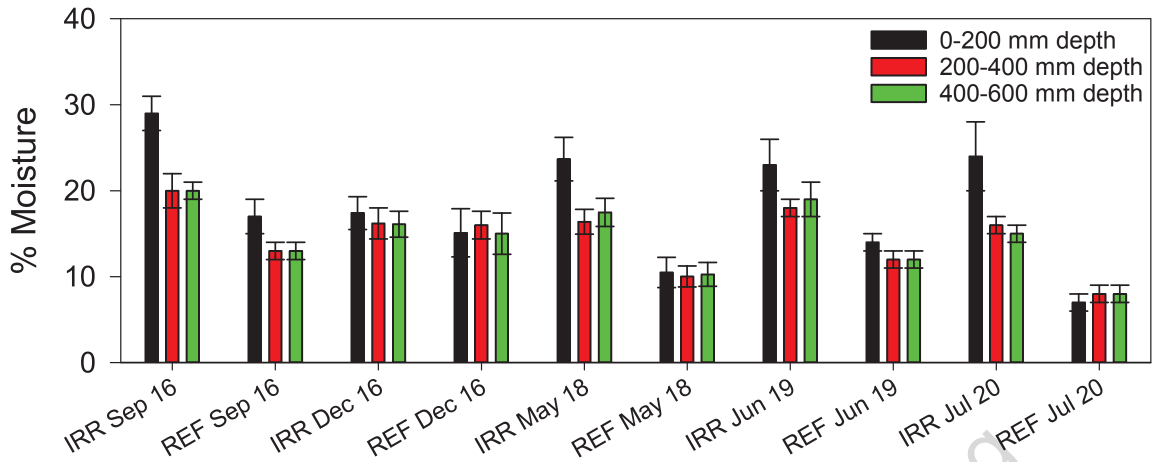

Figure 7 Mean soil moisture (%) at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2020.
Values are means ± se (n = 3 to 6).

A temporal comparison of soil moisture in the irrigation area indicates that soil moisture during the initial survey in September 2016 (20% moisture overall) was significantly higher (P < 0.05) than during the latter four surveys in from December 2016 to July 2020 (15 to 17 %). This may be due to the change in irrigation regime undertaken since September 2016 by TRILITY Pty Ltd, where irrigation is generally applied to each lot every three to four days, instead of lower volumes on a daily basis.

Water was recorded in IR5 sample hole during July 2020 (Figure 4) similar to previous surveys, suggesting the potential waterlogging of the soil. However, documented irrigation disposal records from the Agnes Water STP indicate that irrigation rates are within EA EPPR00959913 conditions of ≤ 900kL/day (TRILITY Pty Ltd, pers. comm.).

3.2 Soil pH

The pH is an indication of the acidity or alkalinity of the soil, which has the ability to increase or decrease nutrient availability (APHA, 2005). Most phases of wastewater treatment are pH dependent. As such, the pH of the recycled water may vary, resulting in different effects on irrigated soil. Daily records of Lagoon 3 water during June to mid-July 2020 indicates pH ranged between 8.2 and 9.1 (TRILITY Pty Ltd, pers. comm).

Table 6 lists the mean pH at each soil depth for the irrigation and reference areas in July 2020, while Figure 9 exhibits mean soil pH during each of the five surveys since September 2016. See Table 8 in Appendix for individual site and soil levels during July 2020.

During the 2020 survey, significantly (P < 0.05) higher pH was evident at the irrigated sites (mean = 7.3) in comparison with the reference sites (mean = 6.1), potentially indicating effects from the more alkaline recycled water. This has been a consistent pattern over the five surveys. The temporal statistical analysis indicated that soil pH in 2020 was similar to pH recorded in the 2016 and 2018 surveys, with significantly lower pH in both irrigation and reference sites during June 2019 survey (Vision Environment, 2019).

Soil pH between 6.0 to 7.5 is considered optimal as it maximises nutrient availability for plants, and hence the potential for plant growth (AMPC, 2012). Mean pH across both irrigation and reference locations were within this range during the five surveys to date, indicating minor, if any, adverse effects of the recycled water irrigation.

Table 2. Mean pH at different soil depths in the irrigation area and reference locations in July 2020.
Values are means ± se (n = 3 to 6).

Parameter	Irrigation Area			Reference Area		
	0-200 mm depth	200-400 mm depth	400-600 mm depth	0-200 mm depth	200-400 mm depth	400-600 mm depth
pH	7.3 ± 0.1	7.3 ± 0.1	7.3 ± 0.2	5.8 ± 0.1	6.1 ± 0.3	6.5 ± 0.6

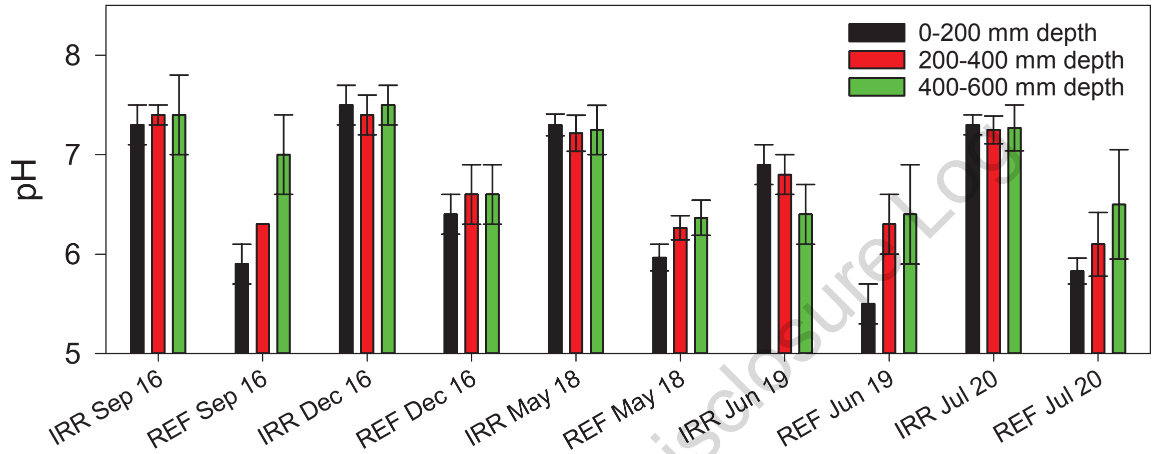

Figure 8 Mean soil pH at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2020.
Values are means ± se (n = 3 to 6).

3.3 Soil Nutrients

Mean nutrient concentrations at each soil depth for the irrigation and reference locations are shown in Table 3 and Figures 9 and 10, while Tables 9 to 11 in the Appendix list individual site soil nutrient levels during July 2020.

Table 3. Mean nutrient concentrations at different soil depths in the irrigation area and reference locations in July 2020.
Values are means ± se (n = 3 to 6). TKN = Total Kjeldahl Nitrogen. PAC = Phosphorus Adsorption Capacity.

Nutrient (mg/kg)	Irrigation Area			Reference Area		
	0-200 mm depth	200-400 mm depth	400-600 mm depth	0-200 mm depth	200-400 mm depth	400-600 mm depth
Total Nitrogen	940 ± 328	260 ± 32	190 ± 21	483 ± 102	440 ± 150	247 ± 152
TKN	940 ± 328	260 ± 32	190 ± 21	483 ± 102	440 ± 150	247 ± 152
Ammonia	<20	<20	<20	<20	<20	<20
Nitrate	0.5 ± 0.3	0.2 ± 0.1	<0.1	<0.1	<0.1	0.1 ± 0.1
Nitrite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phosphorus	129 ± 44	40 ± 13	30 ± 6	21 ± 7	18 ± 6	18 ± 6
PAC	300 ± 100	246 ± 79	251 ± 71	447 ± 99	562 ± 59	516 ± 43

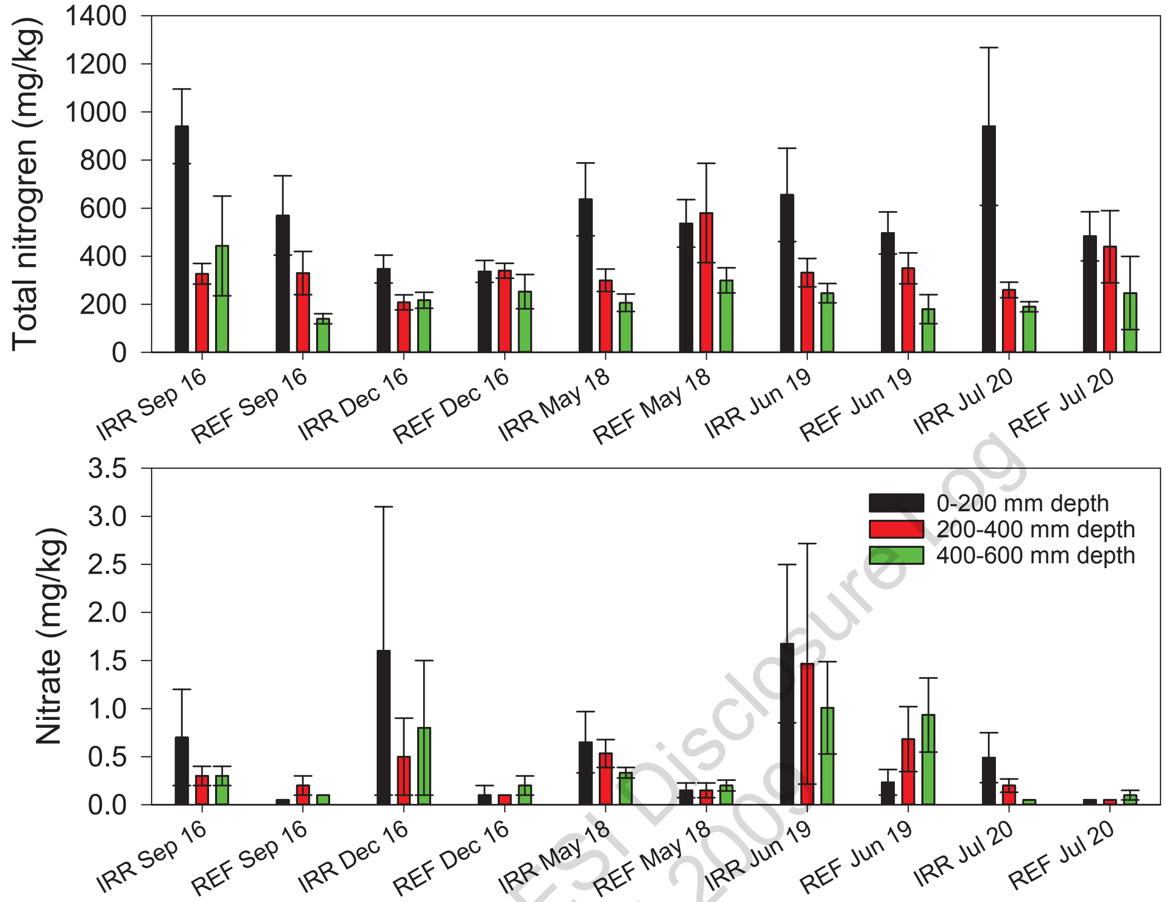

Figure 9 Mean total nitrogen and nitrate concentrations at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2020.
Values are means ± se (n = 3 to 6). Nitrite and ammonia not plotted as < LOR.

Total nitrogen and a variety of nitrogen forms were examined, including the organic form of nitrogen (Total Kjeldahl Nitrogen or TKN), and the inorganic (and therefore readily bioavailable) forms for plant uptake (ammonia, nitrate and nitrite). Total nitrogen and TKN were found at identical concentrations in each sample, indicating that nitrogen was primarily in organic form, and therefore not readily bioavailable (Table 3).

During 2020, total nitrogen did not differ significantly between the irrigation (190 to 940 mg/kg) and reference (247 to 483 mg/kg) areas. Of note was the high total nitrogen concentrations at IR3 surface (2,510 mg/kg), which were approximately triple the next highest surface concentrations recorded at IR2 surface and IR4 surface. No significant temporal variation in soil nitrogen (or TKN) was evident across the five surveys (Figure 9).

The bioavailable nitrogen forms of ammonia and nitrite were below laboratory detection limits at each site and depth (Table 3). Nitrate concentrations did not differ significantly between irrigated and reference sites, nor at different soil depths. No statistically significant temporal variation in soil nitrate has been evident across the five surveys undertaken since September 2016 (Figure 9).

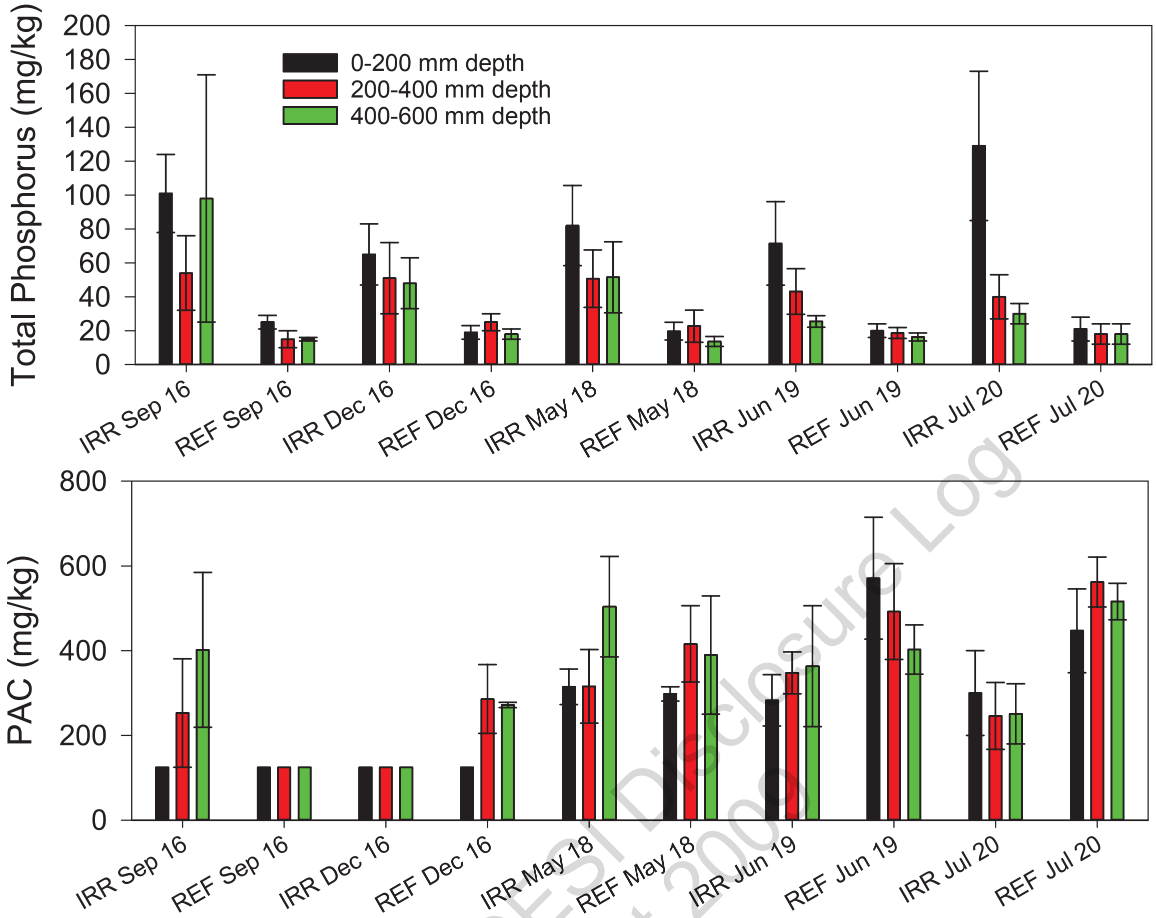

Figure 10 Mean total phosphorus concentrations and phosphate absorption capacity (PAC) at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2020. *Values are means ± se (n = 3 to 6).*

Total phosphorus, as well as the phosphate absorption capacity (PAC) of the soil was also quantified (Table 3). PAC provides an indication of the ability of the soil to absorb and retain phosphorus, making it unavailable for plant uptake. In the case of recycled water irrigation, a higher PAC is beneficial, with phosphorus from the recycled water removed and bound to soil particles. Therefore, any phosphorus in excess of plant uptake would be unable to move through to the groundwater.

Similar to the 2016 to 2018 surveys (but in contrast to the 2019 survey), during 2020 total phosphorus was significantly ($P < 0.05$) higher in the irrigation sites (30 to 129 mg/kg) than in the reference sites (18 to 21 mg/kg). No significant variation in total phosphorus concentrations was evident between soil depths (Table 3).

Significant ($P < 0.05$) differences in PAC were also evident between the irrigated and reference sites during 2020, with significantly higher PAC in the reference sites (447 to 562 mg/kg) than in the irrigation sites (246 to 300 mg/kg), most likely due to the lower levels of phosphorus in the reference area.

3.4 Soil Cations

The cation exchange capacity (CEC) was also quantified in the soil samples. The CEC is the quantity of exchangeable cations the soil can retain on its absorption complex at a given pH, with soils exhibiting a higher CEC able to retain nutrients more easily than low CEC soils (AMPC, 2012).

Exchangeable cations included calcium, magnesium, potassium and sodium ions. The mean CEC and individual exchangeable cation concentrations at each soil depth for the irrigation and reference locations are shown in Table 4 and Figures 11 and 12, while Tables 12 and 13 in Appendix list individual site and soil depths during 2020.

Table 4. Mean cation exchange capacity and exchangeable cations and anions at different soil depths in the irrigation area and reference locations in July 2020.
Values are means ± se (n = 3 to 6).

Parameter (meq/100g)	Irrigation Area			Reference Area		
	0-200 mm depth	200-400 mm depth	400-600 mm depth	0-200 mm depth	200-400 mm depth	400-600 mm depth
Exchange Capacity	3.3 ± 0.3	2.3 ± 0.3	3.8 ± 0.6	1.9 ± 0.6	2.0 ± 0.6	2.9 ± 1.4
Ex. calcium	1.2 ± 0.2	0.4 ± 0.1	0.4 ± 0.1	0.3 ± 0.1	0.2 ± 0.1	<0.2
Ex. magnesium	0.9 ± 0.1	0.8 ± 0.2	1.9 ± 0.3	0.9 ± 0.3	1.0 ± 0.4	1.8 ± 1.1
Ex. potassium	0.2 ± 0.0	<0.2	<0.2	<0.2	<0.2	<0.2
Ex. sodium	0.9 ± 0.1	0.9 ± 0.1	1.3 ± 0.3	0.3 ± 0.0	0.4 ± 0.1	0.6 ± 0.4

No significant difference in cation exchange capacity was evident between the irrigated and reference sites, indicating no apparent effect from irrigation with recycled water (Table 4). Additionally, there was no evidence of spatial variation across the three soil depths, or temporal variation in the cation exchange capacity across the five surveys (Figure 11).

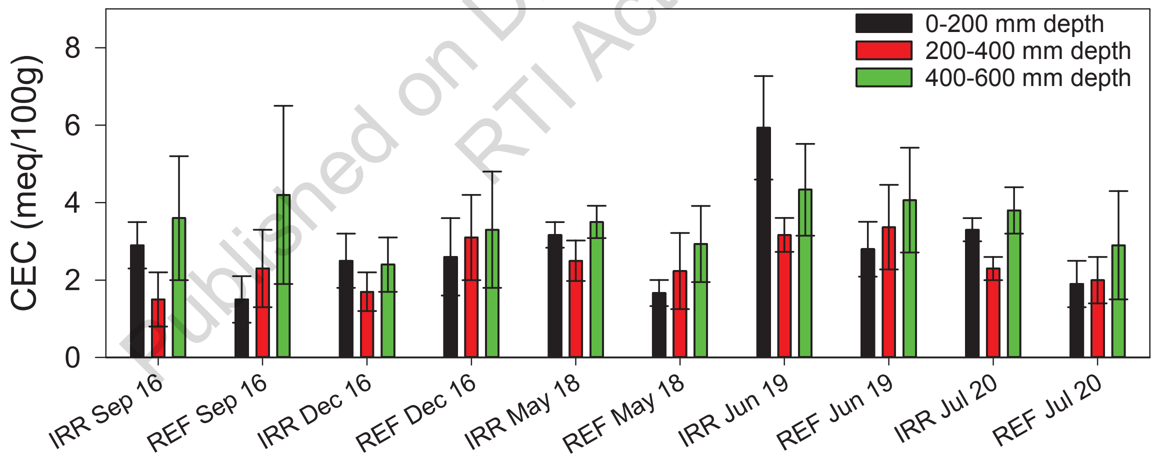

Figure 11 Mean Soil Cation Exchange Capacity (CEC) at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2020.
Values are means ± se (n = 3 to 6).

However, concentrations of exchangeable calcium, potassium and sodium were significantly ($P < 0.05$) higher in the irrigation area than in the reference area (Table 4) during 2020, and during the majority of the previous surveys (Figure 12). While exchangeable magnesium concentrations did not differ between the irrigation and reference areas, significantly higher concentrations were found at the 400 to 600 mm depth at all sites during 2020 (Table 4, Figure 12).

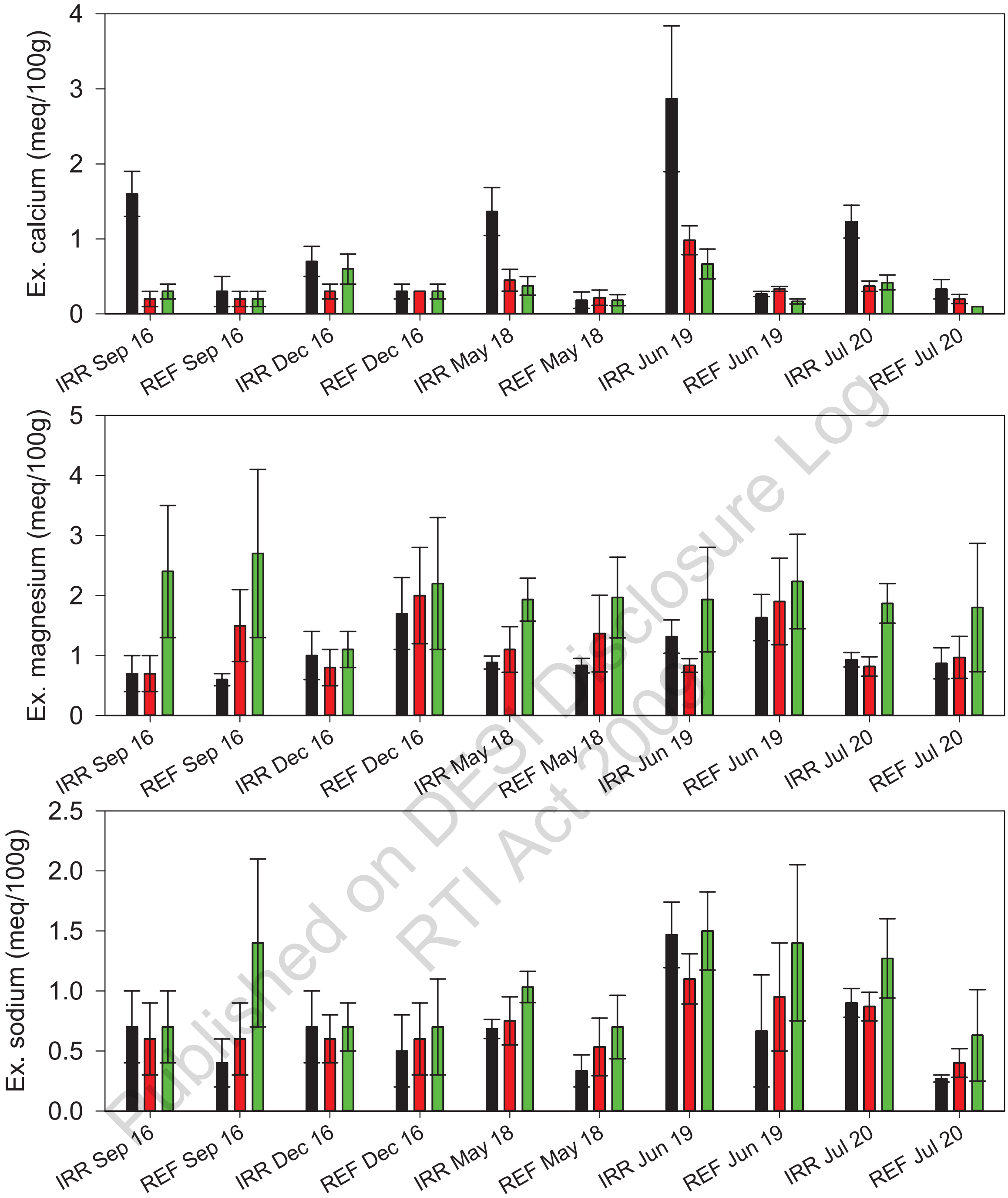

Figure 12 Mean exchangeable calcium, magnesium and sodium at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2020.
Values are means ± se (n = 3 to 6). Exchangeable potassium not plotted as mean values over surveys were generally ≤ LOR.

3.5 Soil Salinity/Sodicity

Soil salinity is indicated by high levels of salts in soils, while soil sodicity specifically indicates high sodium salt levels. Soil salinity or sodicity can be measured in a number of ways:

- Electrical conductivity, which is a measure of the soil solution to conduct electricity. Increased salts result in a higher conductivity, with an EC of > 4,000 µS/cm classified as saline soil;

- Total soluble salts (TSS), which refers to the total amount of dissolved salts in the soil;
- Exchangeable sodium percentage (ESP); the amount of sodium absorbed on soil particles as a percentage of the CEC; and
- Sodium Absorption Ratio (SAR), which is the ratio of sodium ions to magnesium and calcium ions in the soil. A SAR greater than 13 can indicate a sodic soil.

When soil salinity or sodicity increases, adverse effects on plant growth become evident (EPA, 2005). Plants affected by salinity or sodicity have a reduced growth rate, with increased salt concentrations potentially mobilising metals (particularly cadmium) into the soil and leading to metal contamination of the plant (NRMMC, 2006). Saline and sodic soils tend to have poor structure, making them less permeable, leading to runoff of irrigation (AMPC, 2012, EPA, 2005, NRMMC, 2006). When soil becomes saline or sodic, plants have difficulty extending their roots and may suffer from waterlogging and anoxia.

The mean conductivity, TSS, ESP and SAR for each soil depth at irrigation and reference locations are shown in Table 5 and Figure 13, while Tables 14 and 15 in the Appendix exhibit individual site and soil depths during 2020.

Table 5. Mean conductivity, total soluble salts (TSS), exchangeable sodium percentage (ESP) and sodium absorption ratio (SAR) at different soil depths in the irrigation area and reference locations in July 2020.
Values are means ± se (n = 3 to 6).

Parameter	Irrigation Area			Reference Area		
	0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Conductivity (µS/cm)	144 ± 47	91 ± 10	99 ± 21	224 ± 206	210 ± 199	260 ± 242
Total Soluble Salts (mg/kg)	468 ± 151	295 ± 31	321 ± 69	727 ± 666	683 ± 649	842 ± 784
Exchangeable sodium percentage (ESP %)	27 ± 3	39 ± 2	32 ± 3	19 ± 2	26 ± 5	26 ± 6
Sodium absorption ratio (SAR)	22 ± 4	28 ± 8	23 ± 6	12 ± 4	12 ± 6	14 ± 7

During 2020, concentrations of conductivity, TSS and SAR were similar across the irrigated and reference sites, while ESP was found to be significantly higher in the irrigation sites (27 to 39%) than in the reference sites (19 to 26%). During prior surveys, ESP, TSS and SAR were found to be significantly higher in the irrigated areas (Figure 13).

Conductivity values of all soil samples were well below 4,000 µS/cm, indicating none of these could be classified as saline. However, a mean SAR value of > 13 was recorded at all depths of most of the irrigation soil sites, and at reference site R2, suggesting that these soils may potentially be sodic (contain high sodium levels).

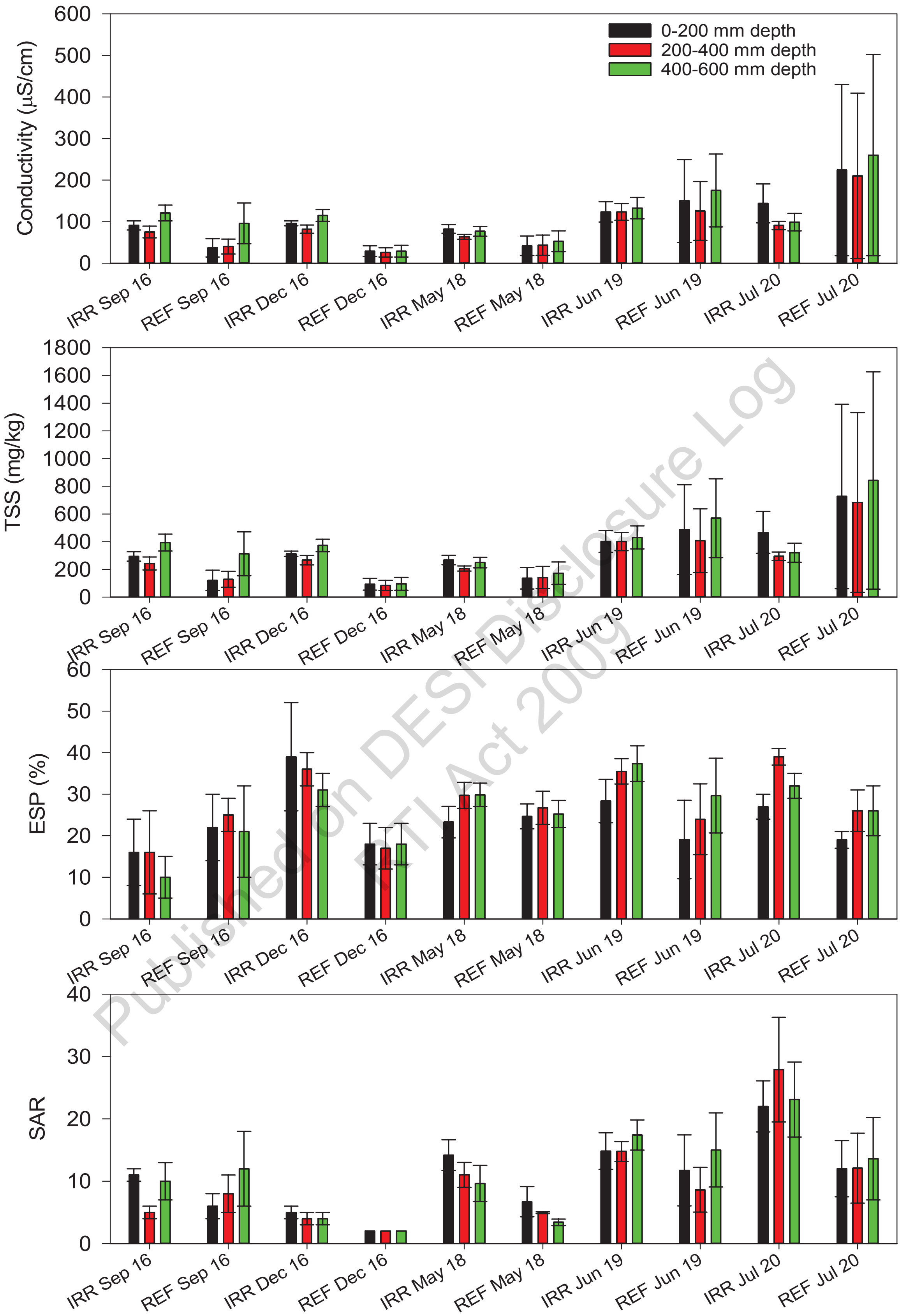

Figure 13 Mean conductivity, total soluble salts (TSS) exchangeable sodium percentage (ESP) and sodium absorption ratio (SAR) at different sample depths across irrigation (IRR) and reference (REF) locations in surveys from 2016 to 2020.
Values are means ± se (n = 3 to 6).

4 SUMMARY AND RECOMMENDATIONS

Overall, soils tested in the irrigation area in July 2020 were similar to those in reference locations for many parameters, including concentrations of nitrogen forms, cation exchange capacity, exchangeable magnesium and soil conductivity, total soluble salts (TSS), and sodium absorption ratio (SAR).

Several parameters have been shown to consistently vary between the irrigated and reference areas over the past five surveys. These include soil moisture, most likely due to the regular application of irrigation to these sites; pH, although as mean values remain within the optimal range for plant growth, adverse impacts are unlikely; total phosphorus concentrations and phosphorus adsorption capacity (PAC); and exchangeable calcium, potassium and sodium.

Significant temporal variation was evident after the 2019 survey, with lower pH and higher PAC, conductivity, TSS, ESP and SAR compared to the prior surveys. However, soil parameters during the 2020 survey were similar to the 2016 and 2018 surveys, indicating long-term spatial patterns. Similar to previous surveys, while the soils are not yet classified as saline, soil sodicity is indicated across both irrigated and reference locations, which may result in reduced plant growth rate.

As per the Agnes Water STP IMP (Vision Environment, 2016a), the following actions are recommended:

- Continue with annual monitoring in 2021, particularly for soil salinity measurements;
- Continue to undertake temporal comparisons of soil parameters when additional data has been obtained in order to elucidate any temporal trends; and
- Undertake monitoring of soil type and structure (particle size distribution and Emerson Aggregate Test) in 2022. These parameters are required to be monitored triennially.

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6 APPENDIX

Table 6. GPS locations of monitoring sites captured in WGS84 and decimal degrees.

Location	Site	GPS Location
Irrigation Plots	IR1	S24.2781 E151.902
	IR2	S24.279 E151.902
	IR3	S24.2788 E151.902
	IR4	S24.2809 E151.902
	IR5	S24.2806 E151.902
	IR6	S24.2797 E151.902
Reference	R1	S24.2783 E151.902
	R2	S24.2749 E151.902
	R3	S24.2713 E151.902

Table 7. Summary of ALS Quality Control Data.

Report number	EB2018761
Laboratory Method Blank Concentration	Acceptable
RPD Laboratory duplicate	Acceptable
Recovery from laboratory control sample (LCS)	Acceptable
Recovery from matrix spike (MS) sample	Acceptable

Table 8. Soil moisture and pH in soils at different sample depths.

Location	Site	Soil Moisture (%)			pH		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	14	15	14	7.0	7.0	7.2
	IR2	25	17	15	7.1	6.9	6.5
	IR3	39	15	13	7.4	7.5	7.7
	IR4	25	17	18	7.2	7.8	7.8
	IR5	25	18	17	7.5	7.2	6.7
	IR6	15	17	13	7.6	7.1	7.7
Reference	R1	7	9	8	5.7	5.6	5.5
	R2	9	9	11	5.7	6.7	7.4
	R3	6	6	6	6.1	6.0	6.6

Table 9. Concentration of Total Kjeldahl Nitrogen and total nitrogen in soil at different sample depths.

Location	Site	Total Kjeldahl Nitrogen (mg/kg)			Total Nitrogen (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	210	180	150	210	180	150
	IR2	840	240	170	840	240	170
	IR3	2510	170	260	2510	170	260
	IR4	850	300	170	850	300	170
	IR5	600	300	250	600	300	250
	IR6	630	370	140	630	370	140
Reference	R1	680	740	550	680	740	550
	R2	430	290	100	430	290	100
	R3	340	290	90	340	290	90

Table 10. Concentration of ammonia, nitrite and nitrate in soils at different sample depths.

Location	Site	Ammonia (mg/kg)			Nitrate (mg/kg)			Nitrite (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	<20	<20	<20	<0.1	0.1	<0.1	<0.1	<0.1	<0.1
	IR2	<20	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	IR3	<20	<20	<20	0.2	0.2	<0.1	<0.1	<0.1	<0.1
	IR4	<20	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	IR5	<20	<20	<20	1.5	0.5	<0.1	<0.1	<0.1	<0.1
	IR6	<20	<20	<20	1.1	0.3	<0.1	<0.1	<0.1	<0.1
Reference	R1	<20	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	R2	<20	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	R3	<20	<20	<20	<0.1	<0.1	0.2	<0.1	<0.1	<0.1

Table 11. Concentration of total phosphorus and phosphorus sorption capacity in soil at different sample depths.

Location	Site	Total Phosphorus (mg/kg)			Phosphorus Sorption Capacity (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	126	102	47	745	556	306
	IR2	324	51	48	404	421	259
	IR3	171	21	28	275	<250	565
	IR4	47	18	19	<250	<250	<250
	IR5	42	18	19	<250	<250	<250
	IR6	64	30	20	<250	<250	<250
Reference	R1	34	29	30	251	642	592
	R2	17	14	13	522	448	513
	R3	11	10	10	568	596	442

Table 12. Cation exchange capacity and exchangeable calcium and magnesium in soil at different sample depths.

Location	Site	Cation Exchange Capacity (meq/100g)			Exchangeable Calcium (meq/100g)			Exchangeable Magnesium (meq/100g)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	3.1	3.0	3.0	0.6	0.6	0.6	0.9	1.0	1.2
	IR2	4.0	2.2	2.8	1.2	0.3	0.2	1.4	0.8	1.4
	IR3	2.9	0.8	6.7	1.0	0.3	0.3	0.9	<0.2	3.3
	IR4	4.4	2.7	3.3	2.2	0.4	0.6	1.1	1.2	1.5
	IR5	2.5	2.7	4.5	1.0	0.5	0.7	0.6	1.0	2.3
	IR6	2.9	2.2	2.6	1.4	0.1	<0.2	0.7	0.8	1.5
Reference	R1	2.7	2.9	2.8	0.6	0.3	0.3	0.9	1.1	1.1
	R2	2.2	2.2	5.3	0.2	0.2	<0.2	1.3	1.5	3.9
	R3	0.8	1.0	0.6	0.2	<0.2	<0.2	0.4	0.3	0.4

Table 13. Exchangeable potassium and sodium in soil at different sample depths.

Location	Site	Exchangeable Potassium (meq/100g)			Exchangeable Sodium (meq/100g)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	0.3	0.2	0.2	1.3	1.0	0.9
	IR2	0.3	0.2	0.2	1.1	0.8	0.8
	IR3	0.2	<0.2	0.2	0.8	0.3	2.9
	IR4	0.2	<0.2	<0.2	1.0	1.0	1.0
	IR5	<0.2	0.2	0.2	0.6	1.0	1.1
	IR6	<0.2	<0.2	<0.2	0.6	1.1	0.9
Reference	R1	<0.2	<0.2	<0.2	0.3	0.6	0.3
	R2	<0.2	<0.2	<0.2	0.3	0.4	1.4
	R3	<0.2	<0.2	<0.2	0.2	0.2	0.2

Table 14. Conductivity and total soluble salts in soil at different sample depths.

Location	Site	Conductivity (µS/cm)			Total Soluble Salts (mg/kg)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	107	93	72	347	302	234
	IR2	87	52	48	282	168	154
	IR3	377	96	186	1220	313	604
	IR4	106	124	136	344	403	444
	IR5	90	82	67	293	266	216
	IR6	98	97	84	319	315	272
Reference	R1	21	9	17	68	30	54
	R2	635	608	743	2060	1980	2410
	R3	16	12	19	54	38	62

Table 15. Sodium Absorption Ratio and exchangeable sodium (%) in soil at different sample depths.

Location	Site	Sodium Absorption Ratio			Exchangeable Sodium (%)		
		0-200mm depth	200-400mm depth	400-600mm depth	0-200mm depth	200-400mm depth	400-600mm depth
Irrigation Plots	IR1	40	67	29	42	34	31
	IR2	20	31	22	28	38	29
	IR3	27	27	50	26	39	43
	IR4	15	15	16	22	36	30
	IR5	15	15	13	25	37	25
	IR6	15	12	9	22	49	36
Reference	R1	10	6	5	18	27	16
	R2	21	23	27	16	18	27
	R3	6	7	9	22	33	36

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JUNE 2020 ANNUAL REPORT

September 2020
J169864

Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

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JUNE 2020 ANNUAL REPORT

Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

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JUNE 2020 ANNUAL REPORT

Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

Definitions and Acronyms

Acronym	Definition
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZS 5667:11	Water Quality Sampling Part 11: Guidance on sampling of groundwaters (1998)
CoC	Chain of Custody
EHP	Department of Environment and Heritage Protection
ERA	Environmentally Relevant Activity
Greencap	Greencap Pty Ltd
IWTP	Integrated Water Treatment Plant
m AHD	metres Australian Height Datum
mg/L	milligrams per litre
ML	Mega Litre
NATA	National Association of Testing Authorities
NEPM	*National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as amended May 2013
QA/QC	Quality Assurance / Quality Control
RPD	Relative Percent Difference
SWL	Standing Water Level
TOC	Top of Casing
Trility	Trility Pty Ltd
µS/cm	microsiemens per centimetre
µg/L	mircograms per litre
WwTP	Wastewater Treatment Plant

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Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

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1 INTRODUCTION

1.1 Background

In 2015, Greencap Pty Ltd (Greencap) was commissioned by Trility Pty Ltd (Trility) to provide advice regarding the site groundwater conditions and monitoring of groundwater at the Gladstone Regional Council owned and Trility operated Integrated Water Treatment Plant (IWTP) and Wastewater Treatment Plant (WwTP) facilities located in Agnes Water, Queensland (**Table 1-1**).

Table 1-1 Location and ERAs of Facilities

Facility	Environmental Relevant Activity	Location
Integrated Water Treatment Plant (IWTP)	ERA64-(1a) Water Treatment > 0.5 ML but < 5ML water day	Springs Road Agnes Water - (Lot 52 Plan SP155903 and Lot 41 Plan SP 206868 (**Figure 2-1)**
Wastewater Treatment Plant (WwTP)*	ERA63 (1d) Sewage Treatment >4000 to 10,000EP	Streeter Drive Agnes Water (Lot 20 Plan FD991 and Lot 21 Plan SP168519) (**Figure 2-2**)

*It is acknowledged that the treated effluent from the WwTP is irrigated to land as identified in the lot and plan provided above.

These two facilities are administered in accordance with the Department of Environment and Heritage Protection (EHP) Environmental Authority EPPR00959913 (hereafter referred to as the Environmental Authority) issued to Gladstone Regional Council on 1 September 2015, with a revised version issued on 14 May 2020.

In accordance with condition WT7-AW of the Environmental Authority, Greencap was engaged to prepare a Preliminary Groundwater Assessment Report for the IWTP in August 2015 and the WwTP in February 2016. The reports presented an overview of the local geological and hydrogeological conditions, and a number of recommendations identified during the assessment were implemented in September 2016. These included Greencap's recommendations:

IWTP

- Prepare and document a groundwater monitoring program, and provide this to EHP for approval, as required by the Environmental Authority EPPR00959913 (the Environmental Authority);
- Install three additional groundwater monitoring wells at the site, in accordance with the Groundwater Monitoring Program; and
- Ongoing groundwater monitoring, in accordance with the Groundwater Monitoring Program.

WwTP

- Undertake collar surveys of the existing groundwater monitoring bores so that groundwater level elevations can be determined in reference to Australian Height Datum (AHD);
- Install two up inferred hydraulic gradient bores to enable monitoring of background groundwater conditions;
- Prepare a groundwater management system in accordance with the Environmental Authority conditions that meet the requirements of the Environmental Authority in relation to monitoring groundwater for potential contamination; and
- Undertake the required assessment and reporting of groundwater monitoring results.

Trility reviewed these reports and agreed to Greencap's recommendations. These recommendations were implemented, commencing May 2016 and groundwater monitoring commenced at the IWTP and WwTP in September 2016 and continues with monthly groundwater level gauging and quarterly water quality monitoring events undertaken by Trility.

1.2 Objective

The overarching objective is to comply with requirements of the Environmental Authority issued by EHP in relation to the monitoring of groundwater for the Gladstone Regional Council owned and Trility operated IWTP and WwTP facilities.

The objective of this annual report is to present the quarterly groundwater monitoring results at the WwTP and IWTP from April to June 2020 and summarise the results of monitoring for the annual period July 2019 to June 2020 in accordance with Conditions WT8-AW, WT9-AW, WT10-AW and WT11-AW of the Environmental Authority.

2 SITE DESCRIPTION

2.1 Integrated Water Treatment Plant

2.1.1 Geology

The IWTP is located at Springs Road, Agnes Water on (Lot 6 on SP150900, Lot 40 Plan SP206868, Lot 52 Plan 155903 and Lot 41 Plan SP206868) and is positioned on the coastal dune system between the Reedy Creek coastal swamp and the Coral Sea (**Figure 2-1**).

The basement rocks in the area are the Lower to Middle Triassic age Agnes Water Volcanics. The shoreline to the east of the IWTP is characterised by rocky outcrops and form coastal headlands to the north and south of the IWTP. These volcanics are widespread to the inland of the site. Overlying the volcanics are Tertiary age Elliot Formation sandstones and alluvial sediments. The Elliot Formation is mapped as outcropping in the elevated areas to the west of the Agnes Water.

The Quaternary age coastal dune deposits are a linear sand deposit located immediately adjacent the Coral Sea. These dune deposits reach heights of 50 m AHD in the vicinity of the IWTP. The Reedy Creek Swamp area to the west of the IWTP is mapped as consisting of Quaternary age alluvium.

2.1.2 Operations

The IWTP operations can be summarised as follows:

- The IWTP extracts raw water from the adjoining Pacific Ocean via an intake system sited at Chinaman's Beach, and bore water from the Springs Road bores (**Figure 3-1**);
- Water received at the IWTP is processed via filtration and reverse osmosis systems;
- Water is then chemically dosed to adjust the water properties before distribution to the Gladstone City Council operated potable water network.

The IWTP incorporates the storage and usage of chemicals involved in the water treatment process. These chemicals are stored under cover in designated chemical storage locations and managed in accordance with the IWTP Environmental Management Plan provisions.

2.1.3 Potential for Leaks

The potential for impacts on groundwater from IWTP activities are generally restricted to:

- Release of chemicals and materials during their transfers to and around the treatment facility;
- Loss of integrity of bunding and/or containment systems in chemical storage areas;
- Leakages from transfer systems in the plant operational area;
- Sewage pipe leakages; and
- Brine disposal pipe leakages.

Any releases of chemicals, raw materials and/or process by products have the potential to impact on the existing shallow dune aquifer above the rock layer and potentially move west, the inferred groundwater flow direction.

2.2 Wastewater Treatment Plant and Irrigation Area

2.2.1 Geology

The WwTP is located at Streeter Drive, Agnes Water (Lot 21 on SP168519 and Lot 20 on FD991), and is positioned some 4.5 km inland to the west of the Coral Sea, south-east of a local topographic feature known as Round Hill, within the Deepwater Creek catchment area (**Figure 2-2**).

The WwTP is situated within the Lower to Middle Triassic age Agnes Water Volcanics. These rocks commonly outcrop in the elevated landforms surrounding and to the north of the WwTP. In addition, these rocks form coastal headlands to the east of the WwTP.

These volcanics are a mixture of igneous rock types, thought to have been deposited in a terrestrial environment. Overlying the volcanics in the WwTP area are Quaternary Age alluvium and colluvium.

2.2.2 Operations

The operations of the wastewater treatment plant on site can be summarised as follows:

- Sewage from Agnes Water township is pumped to the site via a number of designated pumping stations, at a volume of no more than 10,000 equivalent persons (EPs);
- Sewage undergoes tertiary treatment (to class B standard) on site through aerobic digestion;
- Following tertiary treatment, treated effluent is retained in a series of specially constructed lagoons; and
- Treated effluent is discharged via irrigation to the designated irrigation area.

2.2.3 Potential for Leaks

The potential for impacts on groundwater from WwTP activities is generally restricted to:

- Release of chemicals and materials during transfer to and around the treatment facility;
- Loss of integrity from bunding and/or containment systems in chemical storage areas;
- Leakages from transfer systems in the plant operational area;
- Sewage pipe leakages;
- Leaks from the liner of the treated effluent pond; and
- Deep drainage from inappropriate irrigation practices in the irrigation area.

Any leaks of chemicals and/or contaminants arising from the operation have the potential to impact the aquifer in the Agnes Water Volcanics and shallow alluvial material at the WwTP site.

As groundwater flow is inferred as flowing in a southerly direction, impacts from the release of chemicals and/or contaminants on residents drawing water from this aquifer at Agnes Water is unlikely.

Within the irrigation area, both the shallow local alluvial aquifer and the deeper Agnes Water Volcanics may be present. In both areas, groundwater flow direction inferred to be generally in a southern direction and hence have the potential to be impacted upon by any chemical and/or contaminant releases.

Lot Boundary

Site Location of Integrated Water Treatment Plant

Figure 2-1

Trility Pty Ltd

Date: *10/05/2018*

Author: Personal

Map Scale: 1:8,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 56

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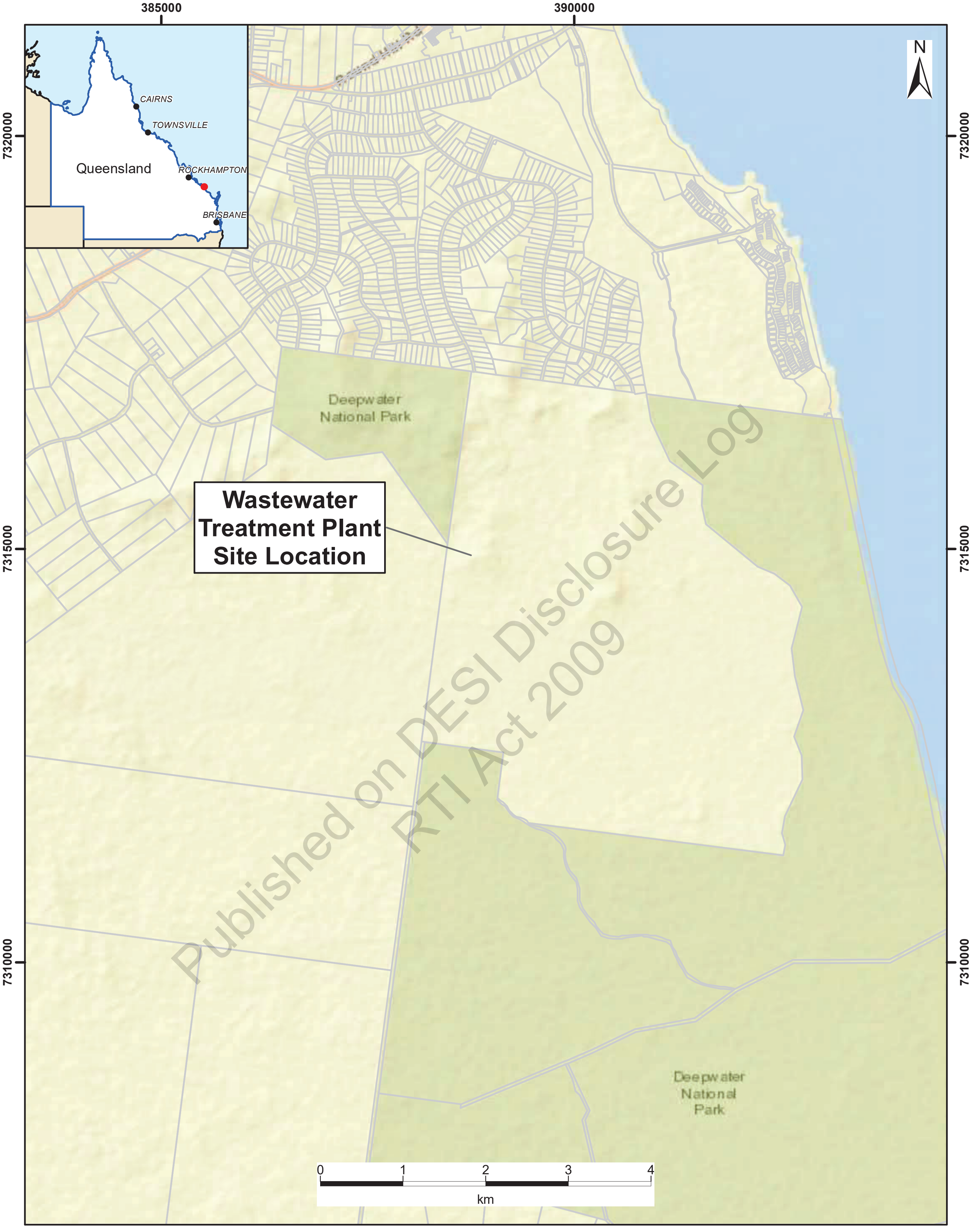
Imagery (2014) © State of Queensland.
R:_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\J143710-01_Sept_2017_QR\mxd\FIG_2_1_IWTP_site_location_171221.mxd



Lot Boundary

Site Location of Wastewater Treatment Plant		
Figure 2-2	**Trility Pty Ltd**	
Date: *10/05/2018*	**Author** Personal **Map Scale:** 1:60,000	GREENCAP
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 56	

R:_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\J143710-01_Sept_2017_QR\mxd\FIG_2_2_WwTP_site_location_171221.mxd

3 GROUNDWATER BORE MONITORING NETWORK

3.1 Integrated Water Treatment Plant

Greencap attended the IWTP on 23 May 2016 to supervise the installation of three groundwater monitoring bores in accordance with condition WT22-AWDP. A surveyor was engaged to provide the coordinates for each monitoring bore and to determine the relative elevation levels.

Following development of the bores, groundwater level gauging was also conducted by Greencap and documented on 25 May 2016 to identify the level of groundwater within the bores. **Table 3-1** below summarises the details of the IWTP groundwater monitoring bores. The locations of the IWTP groundwater bores are shown in **Figure 3-1.**

Table 3-1 Integrated Water Treatment Plant Groundwater Monitoring Bores

Well Name	Easting	Northing	Depth of Well (m)	Relative Level (m)	Depth to Water (m)[1]	Relative Height Data (m AHD)
DESAL1	390050.613	7320897.615	6.5	19.117	2.287	16.830
DESAL2	390045.732	7320949.351	6.0	19.555	2.483	17.072
DESAL3	390005.808	7320906.402	5.0	18.739	3.014	15.725

[1] As measured on 25 May 2016.

3.2 Wastewater Treatment Plant and Irrigation Area

Groundwater monitoring bores (MP97/01 to MP97/05, MP00/07 and MP00/08) were installed at the WwTP prior to 2008. This was also prior to the management of the facility by Trility. Monitoring of water quality from the supply pipe from the existing bores commenced in September 2008 and has been ongoing on a regular basis.

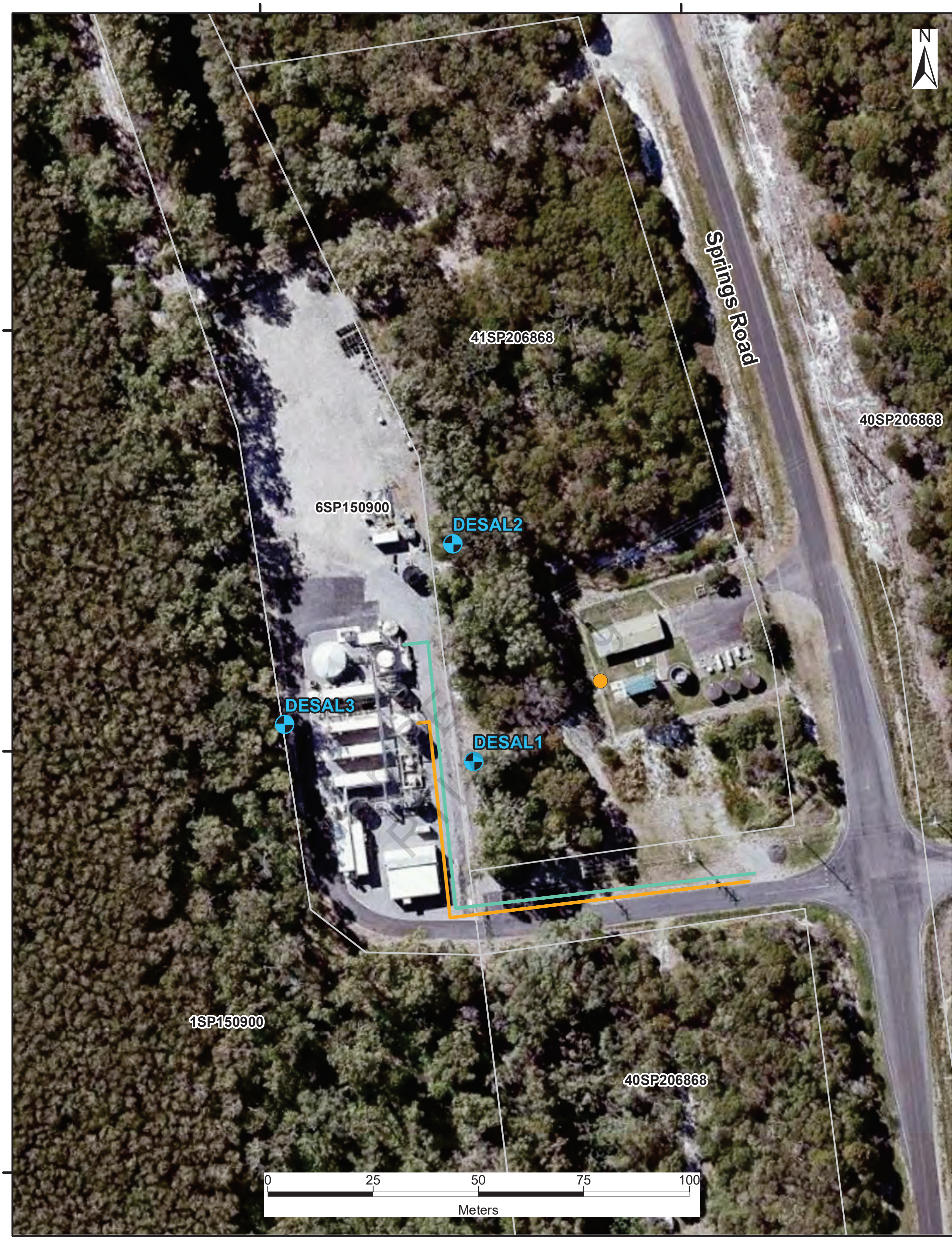
On 25 May 2016 Greencap inspected all the existing bores and identified that they appeared to be shallow but in good working condition and suitable for monitoring purposes if groundwater is present. At this time Greencap also supervised the installation of two additional groundwater monitoring bores at the WwTP, identified as STP1 and STP2, for the purposes of obtaining information on the background groundwater quality in the area to be able to identify wastewater impacts in comparison with background groundwater quality. A surveyor was engaged to provide the coordinates for all the existing and newly installed monitoring bores at the WwTP and to determine the levels relative to AHD.

Groundwater level gauging was also conducted by Greencap and documented on 25 May 2016 to identify the level of groundwater within bores. **Table 3-2** below summaries the details of the WwTP groundwater monitoring bores. The locations of the WwTP groundwater bores are shown in **Figure 3-2.**

Table 3-2 Wastewater Treatment Plant Groundwater Monitoring Bores

Well Name	Easting, MGA94	Northing, MGA94	Depth of Well (m)	Relative Level	Depth to Water (m)[1]	Relative Height Data (m AHD)
STP1	388929.148	7315839.541	15.36	31.081	0.607	30.474
STP2	389440.292	7314580.914	13.14	10.880	2.915	7.965
MP97/01	388501.285	7315186.657	1.10	19.938	0.959	18.979
MP97/02	388820.691	7313990.578	1.70	9.422	1.154	8.268
MP97/03	389158.188	7313938.606	1.69	8.479	1.342	7.137
MP97/04	389280.803	7313491.850	1.57	7.130	1.108	6.022
MP97/05	388379.765	7312693.071	1.02	6.074	0.784	5.290
MP00/07	388376.341	7314916.325	1.80	15.835	DRY	NA
MP00/08	388215.935	7314808.284	1.785	14.120	1.706	12.414

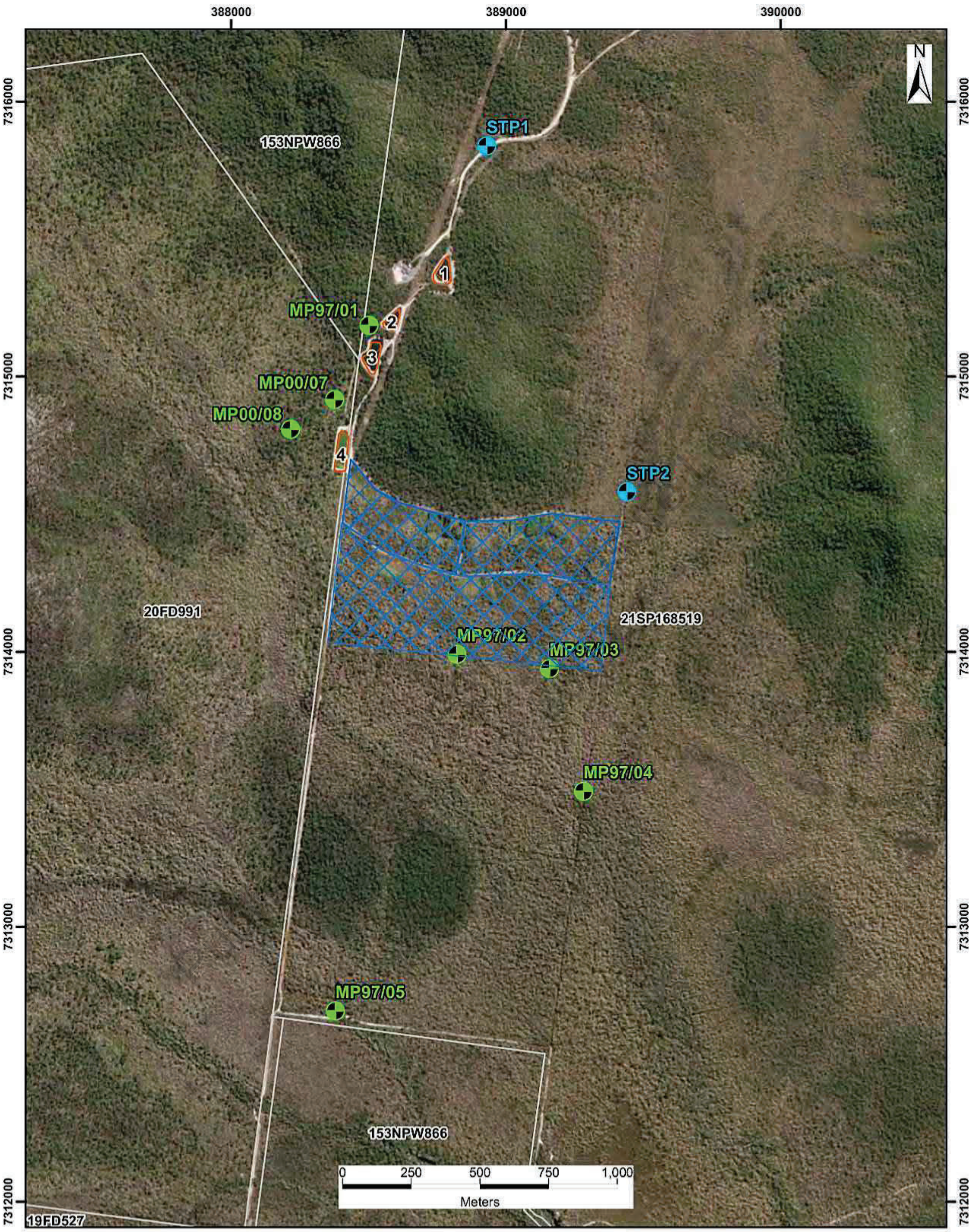
[1] As measured on 25 May 2016.



Lot Boundary
Groundwater Bore (Greencap May 2016)
Indicative Location of Treated Water Flush Point
Indicative Location of Brine Pipe
Indicative Location of Seawater Pipe

Location of IWTP Groundwater Bores		
Figure 3-1	Trility Pty Ltd	
Date: 9/07/2018	Author: ersona Map Scale: 1:1,200	GREENCAP
Revision: R1	Coordinate System: GDA 1994 MGA Zone 56	

R:_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\J143710-01-01-01_Mar_2018_QR\mxd\FIG_3_1_IWTP_GW_bore_loc_180709.mxd



Lot Boundary
Lagoon
Recycled Water Irrigation Area

Groundwater Bore
Greencap (May 2016)
Previously Existing

Location of WwTP Groundwater Bores		
Figure 3-2	**Trility Pty Ltd**	
Date: 6/08/2018	Author: [redacted] Personal Map Scale: 1:18,000	GREENCAP
Revision: R1	Coordinate System: GDA 1994 MGA Zone 56	

R1_Projects\C114943_Trility Pty Ltd\GIS\Agnes Water\Annual 2018\mxd\FIG_3_2_WwTP_GW_bore_loc_180806.mxd

4 MONITORING PARAMETERS AND TRIGGER VALUES

The Environmental Authority for the WwTP sets out which parameters will be monitored and the associated trigger values as part of the regular groundwater monitoring program. These are summarised in **Table 4-1**.

Table 4-1 Monitoring Parameters and Trigger Values

Quality Characteristic	Units	Trigger Values
Dissolved Oxygen	mg/L	20% change from background[1]
Total Nitrogen	mg/L as Nitrogen	
Nitrate	mg/L as Nitrogen	
Ammonia	mg/L as Nitrogen	
Total Phosphorous	mg/L	
Chloride	mg/L	
Electrical Conductivity	uS/cm	
Sulphate	mg/L	No change from background[2]
Boron	mg/L	
pH	pH unit	
Faecal Coliforms	Colony forming units/100ml	
Enterococcus Organisms	Colony forming units/100ml	
Total Metals: (Al, Fe, Mn, As, Cd, Cr, Co, Cu, Pb, Hg, Ni, Se, Ag, Sn, Zn).	mg/L or ug/L	Within ANZECC Guidelines
Dissolved Metals: (Al, Fe, Mn, As, Cd, Cr, Co, Cu, Pb, Hg, Ni, Se, Ag, Sn, Zn).	mg/L or ug/L	

[1] Trigger values are defined as an upper limit (20% increase from background) with the exception of dissolved oxygen, which is defined as a lower limit (20% decrease from background).
[2] Trigger values are defined as an upper limit – an exceedance is any increase from the background value, with the exception of pH which is defined as any change up or down from the background value.

As the Environmental Authority does not define background data and there is no suitable baseline data for the area, the background value is considered to be the results from the first sampling event for each of the bores. The first sampling event recorded for each bore is listed in **Table 4-2**.

Trigger values for total and dissolved metals are detailed in the Agnes Water Groundwater Management Program and are in accordance with *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council [ANZECC] and the Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ], 2000a) (ANZECC Guidelines).

The Environmental Authority for the IWTP does not specify any particular requirements for groundwater monitoring parameters and trigger values. On this basis, the groundwater monitoring parameters and trigger values set out in **Table 4-1** above also apply to the IWTP.

Table 4-2 First sampling event at IWTP and WwTP bores

Bore	Month of first sampling event
STP1	September 2016
STP2	September 2016
MP97/01	September 2016
MP97/02	December 2017 (All parameters Except *E. Coli* and Enterococci)
MP97/03	Not sampled
MP97/04	December 2017
MP97/05	December 2017 (All parameters Except *E. Coli* and Enterococci)
MP00/07	Not sampled
MP00/08	Not sampled
DESAL1	September 2016
DESAL2	September 2016
DESAL3	September 2016

5 SAMPLING METHODOLOGY

Monthly groundwater level gauging in WwTP and IWTP bores has been undertaken by Trility in parallel with the quarterly groundwater sampling each September, December, April and June, with reference to industry standards including AS/NZS 5667.11:1998 *Water Quality Sampling – Guidance on sampling of groundwater* (AS/NZS 5667.11).

Groundwater sampling was conducted using low-flow sampling techniques to obtain samples representative of groundwater within the uppermost aquifer which may be impacted. This technique has been recognised by *National Environmental Protection (Assessment of Site Contamination) Measure 1999,* as amended May 2013 (NEPM [2013]).

As indicated by Trility, groundwater bores were purged using a peristaltic pump and sampled via dedicated low-density polyethylene tubing at each location. During purging, groundwater level measurements were recorded to confirm that drawdown within the bores stabilised as required by the low-flow groundwater sampling procedure.

Groundwater quality parameters including pH, temperature, electrical conductivity (EC), salinity, dissolved oxygen (DO), and oxidation reduction potential (ORP) were recorded continually during the purging process using a calibrated YSI Professional Plus multi-parameter water quality meter fitted with a flow-through cell. The samples were collected when these parameters stabilised i.e the purged groundwater is representative of the aquifer conditions. The groundwater sampling records provided by Trility are given in **Appendix A.**

It is understood that decontamination of non-dedicated sampling equipment between each sampled bore was undertaken using a phosphate-free detergent and rinsed with laboratory grade deionised water between sampling locations, in accordance with AS/NZS 5667:11.

Samples used for dissolved metals analysis were filtered in the field using a 0.45 µm filter and placed in the appropriately preserved sample bottles provided by the testing laboratory as required for individual analyses.

Samples were stored in a chilled portable cooler immediately after collection and were delivered under similar conditions to the analytical laboratories with accompanying chain of custody (COC) documentation.

The laboratory used for the program was Australian Laboratory Services Pty Ltd (ALS), a laboratory accredited by the National Association of Testing Authorities (NATA) with analysis of the samples being conducted under NATA approved methodologies as required under condition G15-AW (b) of the Environmental Authority.

6 MONITORING RESULTS

A summary of the analytical results is provided in **Appendix B** and is discussed in the sections below. Laboratory certificates and chain of custody (COC) documentation provided by Trility are given in **Appendix C**.

6.1 Rainfall

The rainfall recorded for the April to June 2020 quarter was 170.7 mm for the WwTP and 149.2 mm for the IWTP. This was significantly less rainfall compared with the rainfall recorded for the same quarter in 2019 which had 241.6 mm and 289 mm of rainfall at the WwTP and IWTP respectively.

The total annual rainfall recorded at the WwTP and IWTP was 949.5 mm and 929.5 mm respectively for the annual monitoring period (**Table 6-1**). This indicates dryer wet season compared to previous wet season rainfall figures of 1,191.9 mm and 996 mm recorded at locations for the WwTP and IWTP respectively. Rainfall was the highest in February 2020 with the volume comparative to the total volume for the entire October 2019 - March 2020 wet season.

Table 6-1 Rainfall Data

Month	WwTP	IWTP
Jul-19	7.5	12
Aug-19	14.5	17
Sep-19	1.5	0
Oct-19	113.9	117.5
Nov-19	16.75	7.8
Dec-19	46.2	36.05
Jan-20	67.8	54.05
Feb-20	422.65	451.95
Mar-20	88.0	83.7
Apr-20	91.2	77
May-20	38.5	36.0
Jun-20	41.0	36.2
Total	**949.5**	**929.25**

6.2 Field Observations during Groundwater Sampling

Groundwater level contour maps for each month within the April to June 2020 quarter for IWTP are presented in Figure 6-1 to Figure 6-6and for WwTP are presented in Figure 6-4 to Figure 6-6**.**

6.2.1 IWTP

Groundwater level gauging results for the monitoring period for IWTP bores are presented in **Table 6-2**.

Table 6-2 Groundwater Gauging Data, IWTP July 2019 – June 2020

Month	Groundwater Elevation (m AHD)[1]		
	DESAL1	DESAL2	DESAL3
July 2019	16.639	16.769	15.558
August 2019	16.535	16.723	15.512

Month	Groundwater Elevation (m AHD)[1]		
	DESAL1	DESAL2	DESAL3
September 2019	16.49	16.606	15.433
October 2019	16.57	16.704	15.649
November 2019	16.357	16.49	15.657
December 2019	16.333	16.415	16.311
January 2020	16.174	16.311	15.087
February 2020	17.013	17.11	15.96
April 2020	16.874	17.032	15.779
May 2020	16.687	16.860	15.667
June 2020	16.674	16.82	15.659

[1] m AHD = metres Australian Height Datum

During the September, December, April and June sampling events the following physical characteristics of the bores were noted by Trility representatives:

- Water colour was generally ranging between light brown and very dark brown; and

The water odours ranged from no odour to very odorous.

6.2.2 WwTP

Groundwater level gauging for the monitoring period for WwTP is summarised in **Table 6-3**.

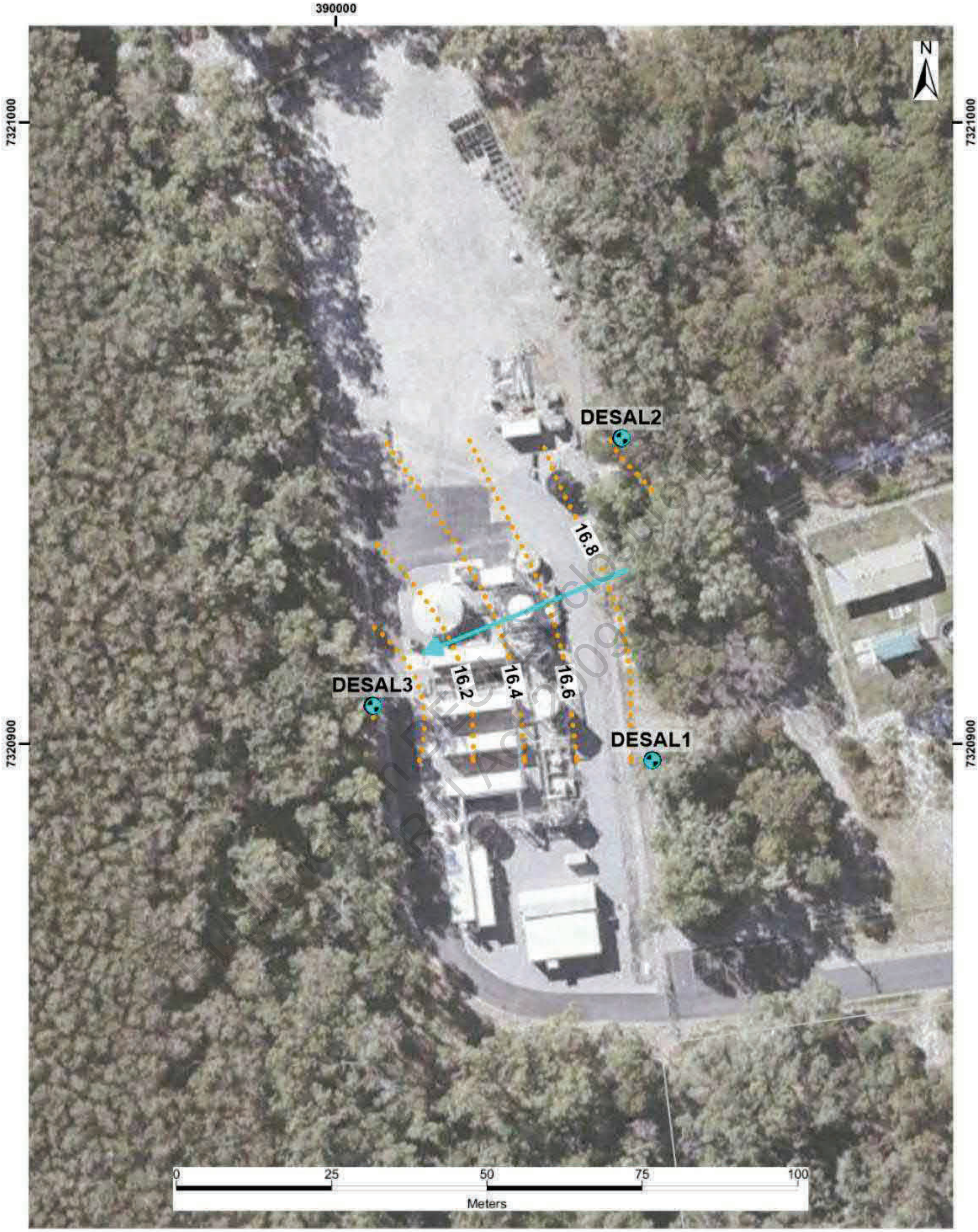
Table 6-3 Groundwater Gauging Data, WwTP July 2019 – June 2020

Month	Groundwater Elevation (m AHD)[1]								
	STP1	STP2	MP97/01	MP97/02	MP97/03	MP97/04	MP97/05	MP00/07	MP00/08
July 2019	29.243	6.888	Dry	Dry	Dry	Dry	Dry	Dry	Dry
August 2019	29.109	6.794	Dry	Dry	Dry	Dry	Dry	Dry	Dry
September 2019	29.013	6.685	Dry	Dry	Dry	Dry	Dry	Dry	Dry
October 2019	28.879	6.560	18.908	8.102	7.124	6.020	5.309	Dry	Dry
November 2019	28.818	6.499	18.658	Dry	Dry	Dry	Dry	Dry	Dry
December 2019	28.776	6.388	Dry	Dry	Dry	Dry	Dry	Dry	Dry
January 2020	28.678	6.252	Dry	Dry	Dry	Dry	Dry	Dry	Dry
February 2020	28.836	6.510	Dry	Dry	8.209	Dry	5.749	15.355	13.470
April 2020	28.833	6.738	19.100	8.152	7.129	6.020	5.314	Dry	12.680
May 2020	28.906	6.780	18.974	8.117	7.127	6.015	5.304	Dry	12.445
June 2020	28.856	6.707	19.258	8.112	7.363	6.370	5.948	Dry	Dry

[1] m AHD = metres Australian Height Datum

During the September, December, April and June sampling events the following physical characteristics of the groundwater were noted by Trility representatives:

- Water colour was generally clear at the STP1 and STP2 bores;
- The water in STP1 was mostly odourless;
- The water at STP2 on occasion was noted to have had a low odour; and
- The MP bores were found to be dry for almost the entire year, likely due to the relatively low rainfall experienced during this annual period compared to previous years.



Lot Boundary

Groundwater Bore

Greencap (May 2016)

Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

IWTP Inferred Groundwater Flow Direction, April 2020

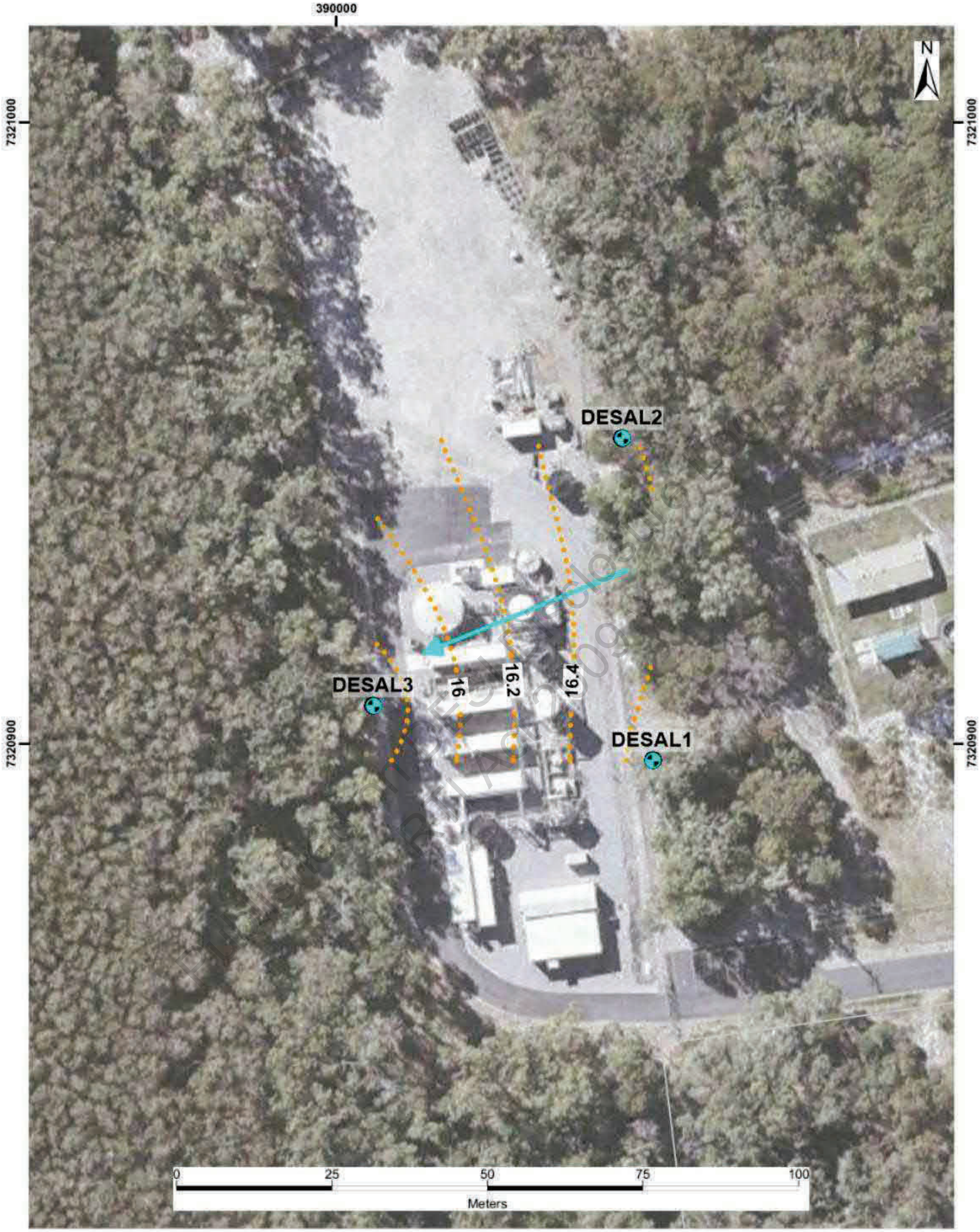
Figure 6-1

Trility Pty Ltd

Date: 4/06/2020

Author: Personal

GREENCAP



Lot Boundary

Groundwater Bore

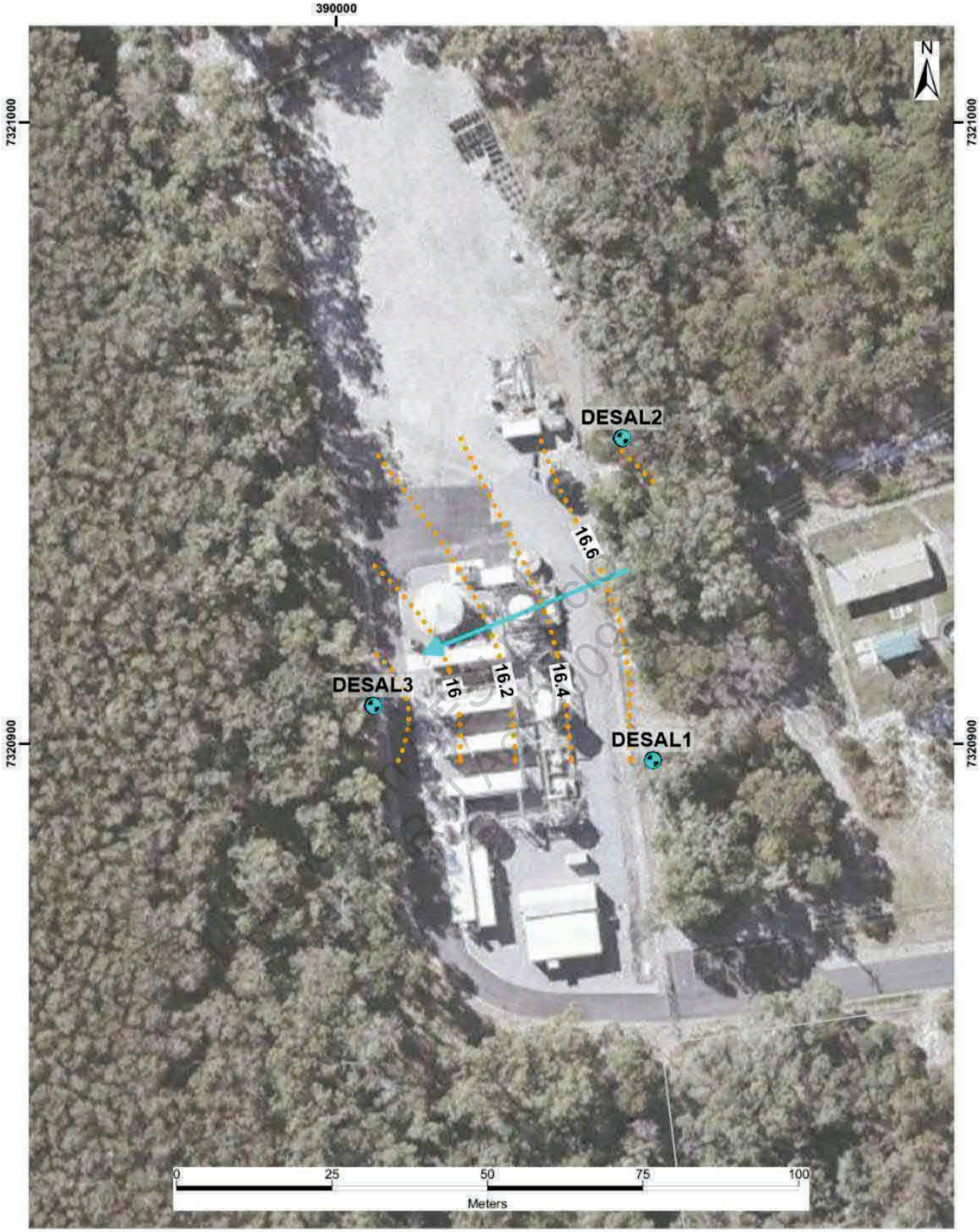
Greencap (May 2016)

Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

IWTP Inferred Groundwater Flow Direction, May 2020	
Figure 6-2	**Trility Pty Ltd**
Date: 4/06/2020	Author Personal — GREENCAP

Personal



Lot Boundary

Groundwater Bore

Greencap (May 2016)

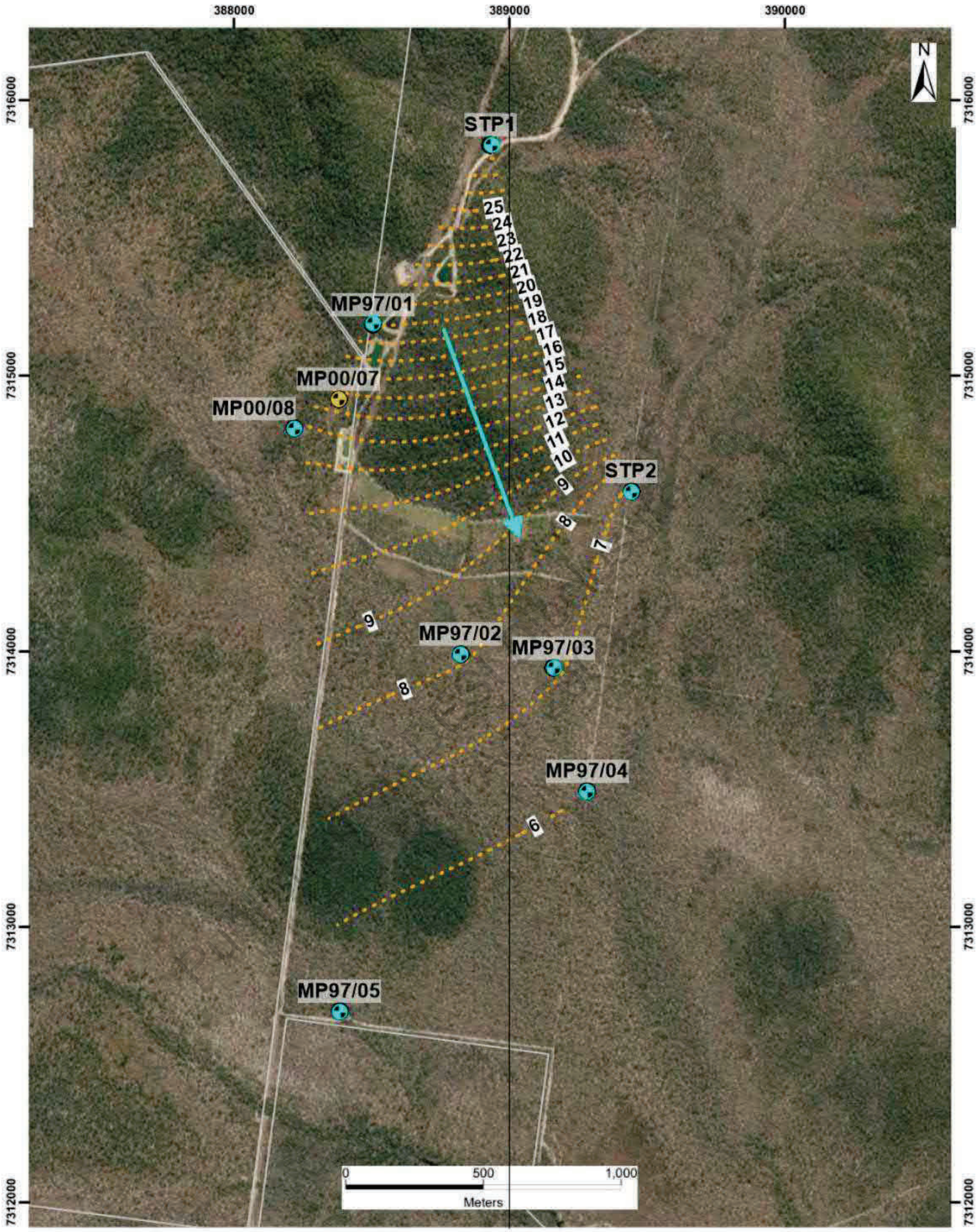
Groundwater Level Contours (mAHD)

Inferred Groundwater Flow Direction

IWTP Inferred Groundwater Flow Direction, June 2020

Figure 6-3	**Trility Pty Ltd**
Date: 4/06/2020	Author: Personal

GREENCAP



Lot Boundary

Groundwater Bore

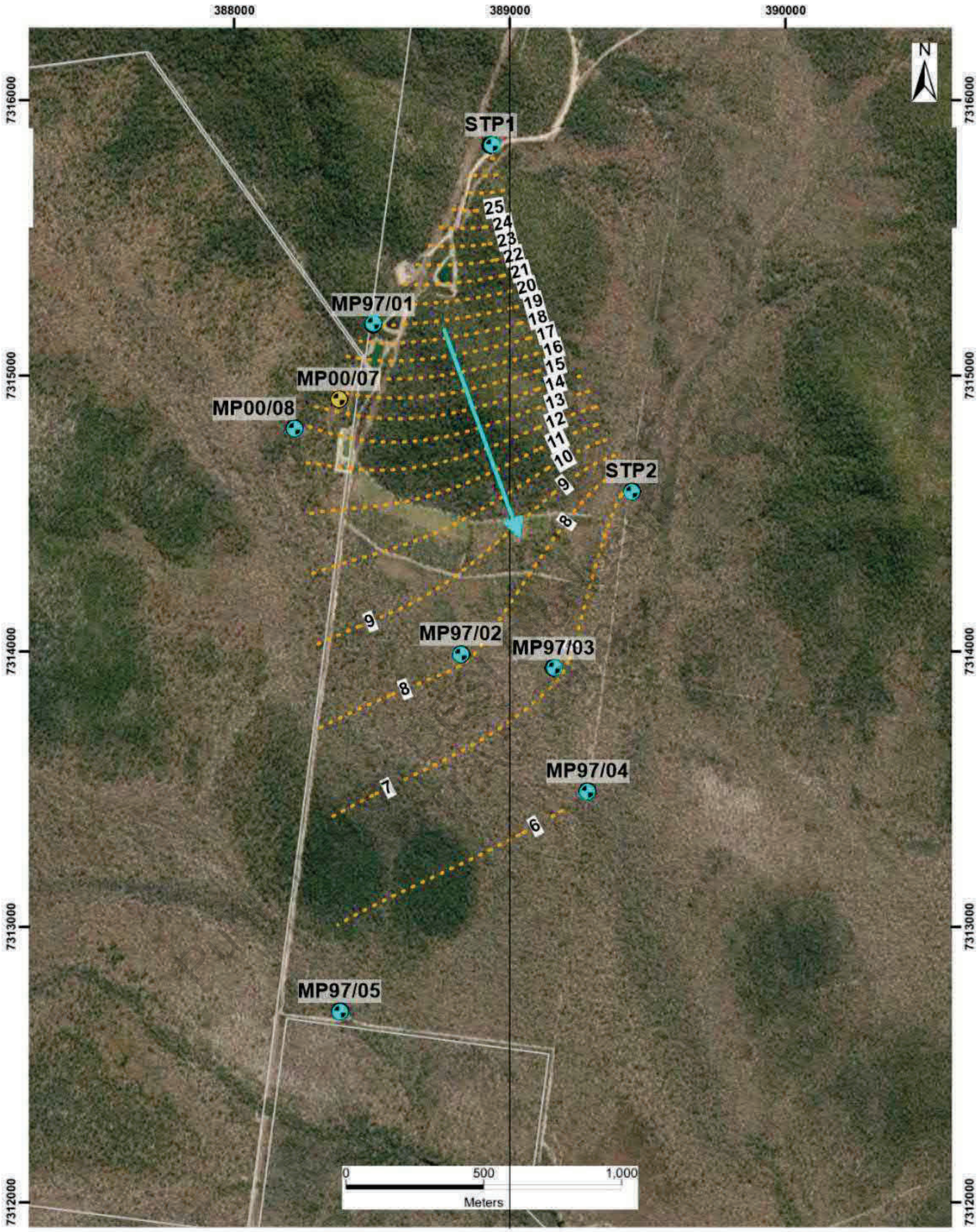
Sampled

Dry

Inferred Groundwater Flow Direction

Groundwater Level Contours (mAHD)

WwTP Inferred Groundwater Flow Direction, April 2020	
Figure 6-4	**Trility Pty Ltd**
Date: 4/06/2020	Author: [redacted] GREENCAP



Lot Boundary

Groundwater Bore

Sampled

Dry

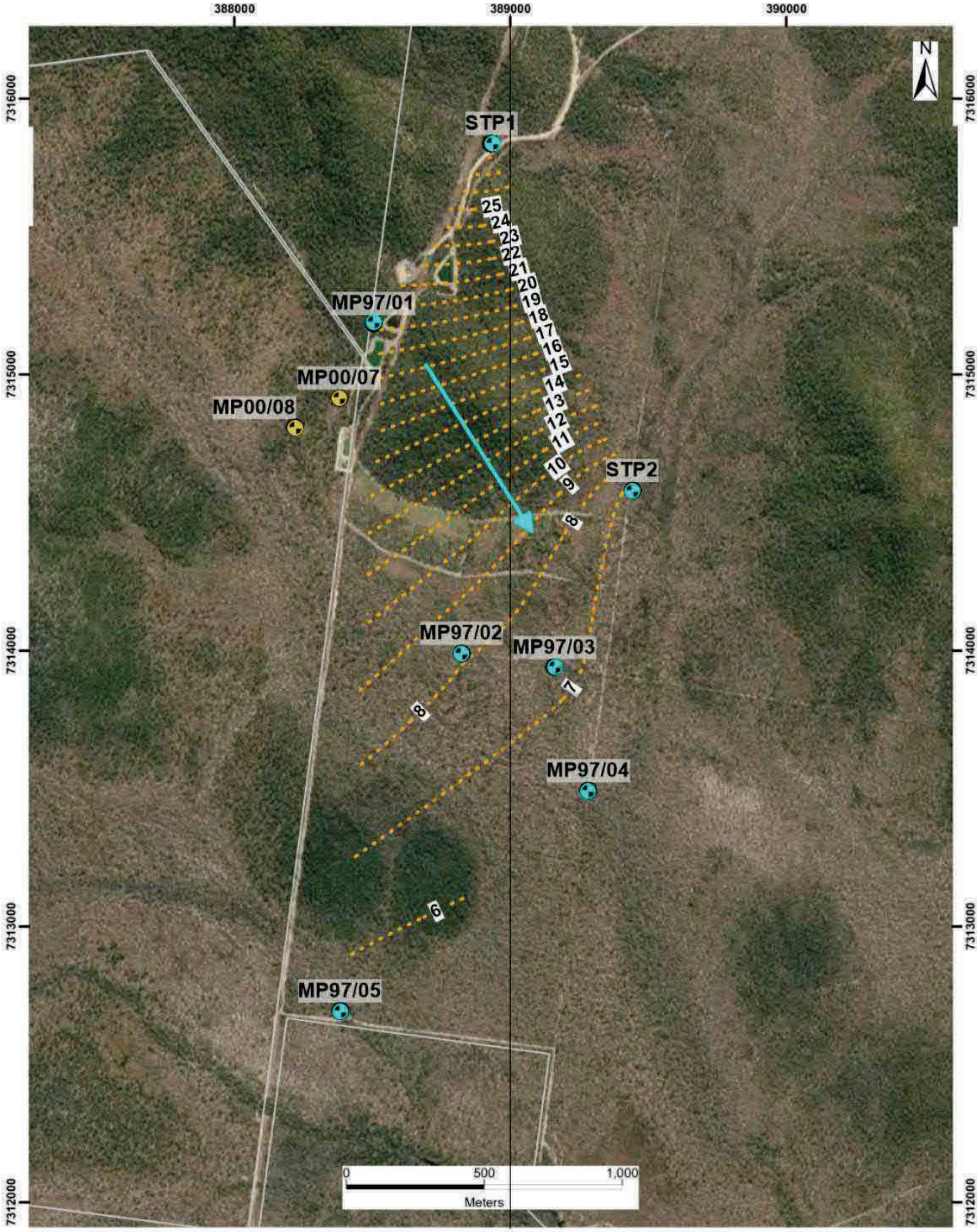
Inferred Groundwater Flow Direction

Groundwater Level Contours (mAHD)

WwTP Inferred Groundwater Flow Direction, May 2020		
Figure 6-5	**Trility Pty Ltd**	
Date: 4/06/2020	Author [redacted]	GREENCAP
Revision: R1	Coordinate System: GDA 1994 MGA Zone 56	

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

C:\Users\[redacted]



Lot Boundary

Groundwater Bore

Sampled

Dry

Inferred Groundwater Flow Direction

Groundwater Level Contours (mAHD)

WwTP Inferred Groundwater Flow Direction, June 2020	
Figure 6-6	**Trility Pty Ltd**
Date: 4/06/2020	Author: Persona

GREENCAP

Personal

6.3 Field Parameter Measurements

Physico-chemical groundwater quality parameters were monitored during purging and prior to sampling. Parameters measured were pH, electrical conductivity (EC), dissolved oxygen (DO), temperature and oxidation reduction potential (ORP). Samples were collected and tested at all IWTP and WwTP bores that were not dry.

6.3.1 June 2020 Quarterly Results

The June 2020 quarterly results are presented in the table below. Gray shading indicates an exceedance of the adopted trigger values (refer Section 4).

Table 6-4 Field Measured Water Quality Parameters, June 2020

	Physico-Chemical Parameters				
Monitoring locations	pH [1] (pH Units)	EC [2] (µS/cm)	DO [2] (mg/L)	Temperature [3] (°C)	ORP [3] (mV)
WwTP					
STP1	6.67	3,844	0.85	23.7	1.0
STP2	6.50	12,069	0.49	23.8	80.0
IWTP					
DESAL1	4.1	343.1	0.18	24.5	
DESAL2	4.3	238.2	0.32	23.8	
DESAL3	5.07	202	0.34	26.3	

[1] The criteria for pH exceedance is any change from the background-derived trigger value,

[2] The criteria for dissolved oxygen and electrical conductivity exceedance is a 20% change down from the background value,

[3] No associated trigger value

These results indicate that the groundwater within the WwTP bores is generally neutral and within IWTP bores is acidic. These results are consistent with previous quarterly results. The dissolved oxygen is low, which is expected in groundwater aquifers.

The salinity of the IWTP groundwater is indicative of fresh water, whilst the salinity of the background WwTP bores is highly variable and tending towards saline.

6.3.2 IWTP Annual Summary

The field results collected from IWTP bores during the monitoring period are summarised as follows:

- Measured pH ranged from 4.1 to 5.07 pH units at the IWTP sites, indicating acidic groundwater;
- Electrical conductivity (EC) results ranged from 202 to 343.1 µS/cm at the IWTP, indicating freshwater;
- Dissolved oxygen (DO) was relatively consistent across the IWTP bores, ranging from 0.18 to 0.34 mg/L;
- Temperature was relatively consistent across the IWTP bores, ranging from 23.8 to 26.3 ˚C; and
- Oxidation reduction potential (ORP) ranged from -174.6 mV at the downgradient bore DESAL3 to +381 mV at upgradient bore DESAL2. (note: no ORP readings were recorded during June 2020 monitoring event).

Of the parameters listed above, trigger values apply to pH, EC and DO. The following exceedances of the adopted background trigger values were recorded during the monitoring period:

- pH exceedances ranging from 3.6 to 4.74 pH units in all monitoring rounds;
- EC exceedances ranging from 194 to 298.7 µS/cm in all monitoring rounds; and
- DO exceedances ranging from 0.32 to 0.88 mg/L in all monitoring rounds.

6.3.3 WwTP Annual Summary

The field results collected from the background WwTP bores during the monitoring period are summarised as follows:

- Measured pH ranged from 6.5 to 6.67 pH units, indicating slightly acidic groundwater;
- Electrical conductivity (EC) results ranged from 3,844 to 12,069 µS/cm at the WwTP, indicating a high degree of variability in salinity levels across the bores at the WwTP;
- Dissolved oxygen (DO) was relatively consistent across the WwTP bores, ranging from 0.49 to 0.85 mg/L;
- Temperature was relatively consistent across the WwTP bores, ranging from 23.7 to 23.8°C; and
- Oxidation reduction potential (ORP) ranged from -24.6 to 119.4 mV.

Of the parameters listed above, trigger values apply to pH, EC and DO. The following exceedances of the adopted trigger values at the background WwTP were recorded during the monitoring period:

- pH exceedances ranged from 6.35 to 6.71 pH units in all monitoring rounds;
- DO exceedances ranged from 0.25 to 1.13 mg/L in all monitoring rounds.

6.4 Laboratory Results

6.4.1 June 2020 Quarterly Results

Only background bores STP1 and STP2 were found to contain groundwater during the June 2020 quarterly event at WwTP. Other monitoring bores were found to be dry. The groundwater quality exceeded adopted trigger values at the background WwTP bores for:

- Ammonia;
- Chloride;
- Total Nitrogen;
- Total Phosphorus;
- Sulphate as S;
- Dissolved Cobalt;
- Cobalt;
- Nickel;
- Zinc
- Chromium

All three groundwater bores at IWTP were sampled during the June 2020 monitoring event. The groundwater quality exceeded adopted trigger values within the IWTP bores for:

- Ammonia;
- Chloride;
- Nitrate;
- Total Nitrogen;
- Total Phosphorus;
- Aluminium;

- Dissolved Aluminium;
- Total Chromium;
- Dissolved Chromium;
- Dissolved Copper and
- Dissolved Zinc.

These exceedances are summarised in **Table 6-5**, and **Appendix B-1** presents a summary of the June 2020 reported results, trigger values and exceedances.

Table 6-5 Groundwater Trigger Value Exceedances, June 2020

Parameter	Trigger Value	Bores Exceeding Trigger Value	Range of Reported Exceedances
Background WwTP Bores			
Ammonia	20% change from background	STP1, STP2	0.03 mg/L
Chloride	20% change from background	STP1, STP2	1,020 – 3,850 mg/L
Total Nitrogen	20% change from background	STP1, STP2	0.1 – 0.4 mg/L
Total Phosphorus	20% change from background	STP1, STP2	0.1 – 0.07 mg/L
Sulphate as S	No change from background	STP1, STP2	97 - 379 mg/L
Dissolved Cobalt	1.4 µg/L	STP2	2.0 µg/L
Cobalt	1.4 µg/L	STP2	50 µg/L
Nickel	11 µg/L	STP1	12.0 µg/L
Zinc	8 µg/L	STP2	17.0 µg/L
Chromium	1 µg/L	STP1	2.0 µg/L
IWTP			
Ammonia	20% change from background	DESAL1, DESAL2, DESAL3	0.12 – 0.47 mg/L
Chloride	20% change from background	DESAL1, DESAL2, DESAL3	42 – 77 mg/L
Nitrate	20% change from background	DESAL1	0.3 mg/L
Total Nitrogen	20% change from background	DESAL1	1.4 mg/L
Total Phosphorus	20% change from background	DESAL1, DESAL2, DESAL3	0.01 – 0.14 mg/L
Aluminium	55 µg/L	DESAL1, DESAL2, DESAL3	620 – 840 µg/L
Dissolved Aluminium	55 µg/L	DESAL1, DESAL2, DESAL3	610 – 1,000 µg/L
Total Chromium	1.0 µg/L	DESAL1	3.0 µg/L
Dissolved Chromium	1.0 µg/L	DESAL1	3.0 µg/L
Dissolved Copper	1.4 µg/L	DESAL1, DESAL2	2.0 µg/L
Dissolved Zinc	8 µg/L	DESAL2	9.0 µg/L

6.4.2 IWTP Annual Summary

Groundwater exceeded adopted trigger values at some of the IWTP bores for ammonia, chloride, nitrate, total nitrogen, total phosphorous, sulphate, total and dissolved chromium and total copper over the reporting period (refer **Table 6-6**). **Appendix B-2** presents a summary of all reported results and exceedances.

Table 6-6 Groundwater Trigger Value Exceedances, IWTP July 2019 – June 2020

Parameter	Monitoring Period	Bores Exceeding Trigger Value	Range of Reported Exceedances
Ammonia	September 2019, December 2019, April 2020, June 2020	DESAL1, DESAL2, DESAL3	0.08 – 0.39 mg/L
Chloride	September 2019, December 2019, April 2020, June 2020	DESAL1, DESAL2, DESAL3	47 – 77 mg/L
Nitrate	September 2019, December 2019, April 2020, June 2020	DESAL1, DESAL2	0.02 – 0.76 mg/L
Total Nitrogen	December 2019, April 2020	DESAL1, DESAL2	1.0 – 2.0 mg/L
Total Phosphorous	September 2019, December 2019, April 2020, June 2020	DESAL1, DESAL2, DESAL3	0.01 – 0.14 mg/L
Sulphate as S	September 2019, April 2020	DESAL1, DESAL2	2.0 – 5.0 mg/L
Total Chromium	September 2019, December 2019, April 2020, June 2020	DESAL1, DESAL2, DESAL3	3.0 – 4.0 µg/L
Dissolved Chromium	September 2019, December 2019, April 2020, June 2020	DESAL3	2.0 – 3.0 µg/L
Total Copper	September 2019, April 2020	DESAL2, DESAL3	2.0 µg/L

6.4.3 WwTP Annual Summary

Groundwater exceeded adopted trigger values only at the background WwTP bores STP1 and STP2 for ammonia, total nitrogen, total phosphorous, sulphate and boron (**Table 6-7**), noting that these 'exceedances" are not associated with WwTP activities. **Appendix B-3** presents a summary of all reported results and exceedances.

Table 6-7 Groundwater Trigger Value Exceedances, WwTP July 2019 – June 2020

Parameter	Monitoring Period	Bores Exceeding Trigger Value	Range of Reported Exceedances
Ammonia	September 2019, December 2019, April 2020	STP1, STP2	0.18 – 0.25 mg/L
Total Nitrogen	April 2020, June 2020	STP1, STP2	0.1 – 0.4 mg/L
Total Phosphorous	September 2019, December 2019, April 2020, June 2020	STP1, STP2	0.01 – 0.07 mg/L
Sulphate as S	September 2019, December 2019, April 2020, June 2020	STP1, STP2	92 – 381 mg/L
Boron	September 2019, December 2019, April 2020, June 2020	STP1, STP2	<50 – 80 µg/L

7 QUALITY ASSURANCE AND QUALITY CONTROL

7.1 June 2020 Quarterly QA/QC

7.1.1 Field Duplicates

Only intra-laboratory duplicates were collected and tested during the June 2020 groundwater sampling. Calculated relative percent differences (RPD) between primary and duplicate samples were below the acceptable threshold of 50%.

7.1.2 Laboratory

A summary of laboratory quality assurance and quality control (QA/QC) data is presented in **Table 7-1**.

Table 7-1 Laboratory QA/QC data

Report #	Analysis Within Holding Time	Lab. Duplicate RPD %	Lab Matrix Spike Recovery	Lab. Control Sample	Lab Method Blank
EB2016548 (IWTP)	P	P	P	P	P
EB2016812 (WwTP)	P	P	P	P	P

P= Pass X = Fail - = not required * = refer to report text

Quality Assurance Criteria	Quality Control Criteria
Holding Times	**Accuracy**
Volatile Organic Carbons 14 days soil and water Semi Volatile Organic Carbons 7 days water, 14 days soil Metals 6 months, Mercury 28 days	Matrix spike, control sample: 70-130%, depending on analyte. Surrogate recovery: 50-150%, depending on analyte.
	Precision
	Method Blank: Not detected Duplicate: No limit (<10xLOR), 0-50% (10-20xLOR), 0-20% (>20xLOR)

As shown in **Table 7-1** all analytical laboratory quality control data was within acceptable limits.

7.2 Annual Field QA/QC Results

The QA/QC samples collected include:

- Intra-laboratory sample (duplicate – assesses reproducibility of results through by the primary NATA-accredited laboratory);
- Inter-laboratory sample (triplicate – assesses reproducibility of results through a second NATA-accredited laboratory);
- Field rinsate blank sample (assesses effectiveness of sampling equipment decontamination procedures);
- Field blank sample (assesses potential for sample contamination during sampling); and
- Trip blank sample (assesses for contamination during transportation).

The duplicate/triplicate results were within the adopted acceptance criteria of 30-50% (Australian Standard AS4482.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds*) relative percent difference (RPD), for samples where results were greater than 10 times the laboratory's limit of reporting.

All blank results we reported below laboratory limits of reporting indicating no cross contamination between samples occurred.

Issues have arisen where laboratory results for dissolved metals have returned higher concentrations than the associated total metal. As indicated by the analytical laboratory used this is likely to be a result of the use of different methods for total and dissolved chemicals. This will be further verified during the next sampling rounds.

7.3 Annual Laboratory QA/QC Data

7.3.1 Quality Control Measures

Quality assurance and quality control measures for this investigation included:

- Use of standard water sampling procedures, including decontamination of equipment;
- Appropriate sampling containers, sample labelling, preservation, storage and transport under COC procedures;
- Samples submitted to laboratory within appropriate holding times to extract and conduct sample analyses; and
- Use of laboratories that hold National Association of Testing Authorities (NATA) accreditation for the analyses undertaken.

7.3.2 Laboratory Quality Control

The analysis of matrix spikes, surrogate spikes, control spike recoveries and laboratory duplicates was undertaken by the laboratory. A review of laboratory quality control is summarised below:

- All samples were received by the laboratory in good condition, chilled and within appropriate holding times for analysis, with the following exception;
- All samples were extracted and analysed within the recommended holding times;
- Laboratory limits of reporting were less than the adopted trigger values in most analytes with the exception of mercury (LOR - 0.1 µg/L, Trigger Value – 0.06 µg/L) and selenium (LOR - 10 µg/L, Trigger Value – 5.0 µg/L. However, these analytes are not chemicals of concern and are not considered significant to the outcome of this report.

- The majority of matrix spike recoveries, surrogate spike recoveries and control spike recoveries were within an acceptable range (laboratory's historical statistical range). Some matrix spike outliers occurred during testing. The laboratory advised that the matrix spike recovery was not determined as the background level was greater than or equal to 4x spike level, or that the spike recovery was greater than the upper data quality objective. This was not considered to affect the validity of the data. These analytes were:
  - Samples associated with the WwTP and IWTP batches analysed for sulphate and chloride in September 2019;
  - One sample associated with the IWTP batch analysed for ammonia in December 2019;
  - One sample associated with the IWTP batch analysed for chloride in April 2020;
  - Samples associated with the WwTP and IWTP batches analysed for Sulphate in June 2020

- Surrogate spike recoveries were reported within the laboratory control limits for all samples; and
- All laboratory sample RPDs were within the acceptable range.

The laboratory noted that total concentrations were less than dissolved concentrations for some metal analytes in both WwTP and IWTP samples at various points during the monitoring period, however the laboratory considered that the difference was within experimental variation. Further explanation should be requested from the laboratory.

8 DISCUSSION AND TREND ANALYSIS

The following sections discuss the results of groundwater sampling events conducted during the July 2019 – June 2020 annual monitoring period.

It is important to note that the exceedances for most parameters reported in quarterly reports and in **Section 6** of this report were based on comparison with the results of the initial groundwater monitoring undertaken in September 2016. The result from this single round have been used to develop a set of trigger levels discussed in **Section 4**.

Based on the groundwater sampling results collected to date some variations in chemical concentrations were noted which may be attributable to seasonal variation associated with groundwater level fluctuations and rainfall recharge, rather than groundwater impacts associated with site activities.

Aside from trigger values developed based on the initial groundwater monitoring event, concentrations of metals were also compared against water quality criteria specified by the ANZECC 2000 guideline. Although some exceedances were noted against these criteria, the reported concentrations of metals are likely to be naturally elevated as they we reported in the bores which monitor the background quality of groundwater. Such seasonal variations would need to be assessed to establish true background levels and enable identifications of impacts associated with the site activities.

This section summarises the annual trends in groundwater results and discusses potential causes for the changes in reported concentrations of chemicals of concern and other water quality parameters.

A summary of sampling results is presented in **Appendix B**, and graphs are presented in **Appendix E**.

8.1 IWTP

8.1.1 Groundwater Levels

Groundwater levels at the IWTP bores remained relatively consistent during the annual monitoring period, with groundwater level ranging from approximately 15.1 mAHD at DESAL3 to 17.1 mAHD at DESAL2 (**Figure 8-1**).

The groundwater level contours plotted using September 2019 (dry season) and February 2020 (wet season) gauging data (**Figures D-3** and **D-14**, **Appendix D**) show that the direction of the groundwater flow was to the west and south west (away from the coastline). This remained consistent through both seasons and was consistent with previous monitoring rounds.

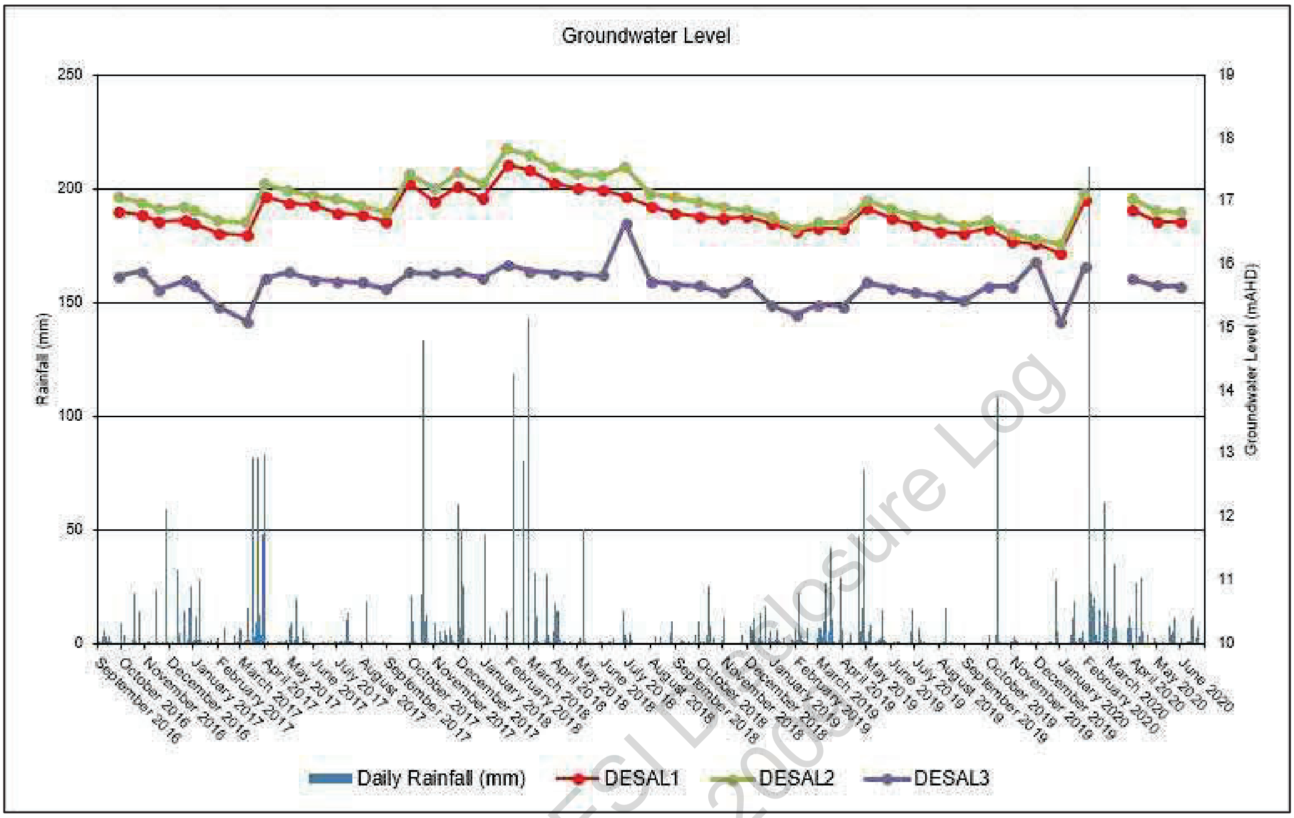


Figure 8-1 IWTP Groundwater Levels, September 2016 – June 2020

8.1.2 Field Parameters

Field parameter which have trigger values assigned include dissolved oxygen (DO), electrical conductivity (EC) and pH. The trigger values for DO, EC and pH are based on percentage change or any change from the adopted background value. The data used to assess trends is presented in **Appendix B-2** and the reported values plotted against rainfall are shown in **Figures 1** to **3,** (**Appendix E**).

The following observations were made for field parameters at the IWTP for the annual monitoring period:

- No continuous increasing and/or decreasing trends in DO in all three bores (DESAL1, DESAL2, DESAL3) were noted. DO variations appeared to be associated with rainfalls;
- EC levels in the downgradient bore DESAL3 were similar to the background bores DESAL1 and DESAL2, indicating no noticeable impacts have occurred.
- pH levels remained generally consistent at all three bores, including background and downgradient. pH levels indicated that groundwater was generally acidic at the IWTP.

8.1.3 Chloride and Sulphate

Graphs for chloride and sulphate plotted against rainfall are presented in **Figures 4** to **5** (**Appendix E**).

The following observations were made for the annual monitoring period:

- Chloride concentrations showed similar pattern to EC levels (discussed above) with no indication of impacts in the downgradient bore DESAL3 throughout the annual monitoring period; and
- Sulphate was not detected within the groundwater with the exception of background bores DESAL2 in January 2020 and DESAL1 in May 2020.

Overall, no particular trends were noted for the monitoring period.

8.1.4 Nutrients

Graphs for ammonia, nitrate, total nitrogen and total phosphorus plotted against rainfall are presented in **Figures 6** to **9** (**Appendix E**).

The following observations were made for nutrients at the IWTP for the annual monitoring period:

- Ammonia concentrations increased in all three bores over the annual monitoring period but is still within the historical range. Ammonia level in the background bore DESAL3 has always been higher compared to background bores DESAL1 and 2, with no notable long-term increasing trends.
- Nitrate returned the highest concentration since monitoring began in 2016 at the background bore DESAL2 in July 2019, but has steadily decreased over the monitoring period, consistent with historical results. Nitrate levels fluctuated in the background bore DESAL1 over the monitoring period but were consistent with historical results. Nitrate was not detected within DESAL3 over the annual monitoring period.
- Total nitrogen returned the highest concentration since monitoring began in 2016 at DESAL2 in August 2019, but has steadily decreased over the monitoring period, consistent with historical results.

Variations in nutrients may occur as a result of alteration of the physicochemical conditions in the groundwater. This may result in the conversion of ammonia to nitrate and vice versa as a result of variation in ORP levels. There appears to be no consistent seasonal influences on nutrient concentrations, however as DESAL3 is downgradient and has the lowest nutrient concentrations, nutrients found in the groundwater are unlikely to be a result of site activities.

8.1.5 Metals

Graphs for (all dissolved) aluminium, cadmium, chromium (III+VI), cobalt, copper, iron, manganese, mercury, nickel, selenium, tin, and zinc, as well as boron, are plotted against rainfall and presented in **Figures 10** to **22** (**Appendix E**). For the purposes of this discussion, emphasis has been given to the dissolved rather than the total metal results, as metals in the dissolved phases can migrate with groundwater and provide a better indication of potential groundwater contamination.

The following observations were made for metals at the IWTP during the annual monitoring period:

- DESAL1 and DESAL3 showed the same trend in fluctuations of dissolved aluminium, whilst DESAL2 decreased in concentrations over the annual monitoring period. The levels of aluminium in the downgradient DESAL 3 was reported to be higher than background levels
- No concentrations of boron, dissolved cadmium, dissolved mercury, dissolved selenium or dissolved tin were detected above laboratory limits of reporting within any of the three bores over the monitoring period.

- Dissolved chromium and dissolved cobalt were detected within the downgradient DESAL3 in all four monitoring events, however they were not detected within background bores DESAL1 or DESAL2.
- Dissolved manganese and dissolved nickel returned higher concentrations at the downgradient bore DESAL3 compared to the background levels at DESAL1 and DESAL2. The reported levels of these metals have a notable decreasing trend in DESAL3 since initial monitoring rounds in 2016.
- DESAL2 and DESAL3 showed the same trend in fluctuations of dissolved zinc potentially associated with seasonal variations, whilst no dissolved zinc was detected within DESAL1 over the annual monitoring period.

Fluctuations of dissolved metal concentrations during this annual monitoring period do not correlate with changes in the physiochemical parameters (pH, EC, DO). DESAL3, which is downgradient bore, generally has higher concentrations of several dissolved metals compared to DESAL1 and DESAL2, although no increasing trends were evident.

This will be reviewed as data from subsequent monitoring becomes available.

8.1.6 Microbiological Parameters

Concentrations of *E. Coli* and Enterococci at the IWTP bores were below the limit of reporting for the entire monitoring period. No further discussion was considered necessary.

8.2 WwTP

Groundwater monitoring at the WwTP area is required to assess potential impacts on groundwater quality from treated wastewater disposed via irrigation on an area shown on **Figure 2-2** or as a result of wastewater seepage from the treatment ponds.

As discussed in **Section 6**, several bores (97/01, 97/02, 97/03, 97/04, and 97/05) located down inferred hydraulic gradient from the WwTP facilities and irrigation area were found to be ether dry or did not have sufficient volume of water to collect a sample during all four sampling rounds conducted within this annual period.

8.2.1 Groundwater Levels

Groundwater levels at the background WwTP bores remained relatively stable with minor seasonal variations during the annual monitoring period, with groundwater levels ranging from approximately 28.68 to 29.24 mAHD at STP1 and 6.25 to 6.94 mAHD at STP2 (**Figure 8-2**). This range in groundwater elevation is driven by the variation in ground levels.

The groundwater level contours plotted using September 2019 (dry season) and February 2020 (wet season) gauging data (**Figures D-6** and **D-16**, **Appendix D**) show that the inferred direction of the groundwater flow was in a south-easterly direction. This remained consistent through both seasons.

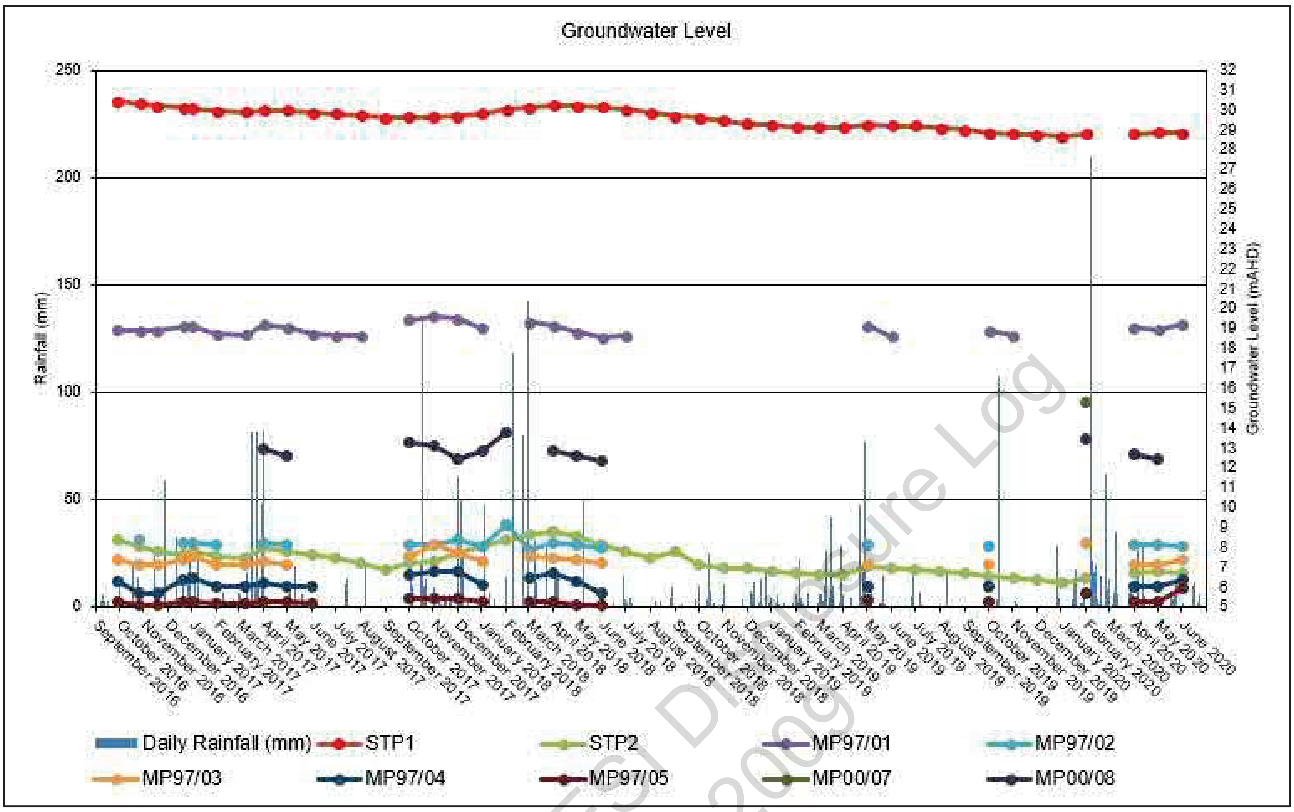


Figure 8-2 WwTP Groundwater Levels, September 2016 – June 2019

8.2.2 Field Parameters

The trigger values for dissolved oxygen (DO), electrical conductivity (EC) and pH are based on changes from the background values based on the initial monitoring event conducted in September 2016.

The annual data is presented in **Appendix B** and plotted against rainfall in **Figures 23** to **25** (**Appendix E**).

It is also noted that only background bores were sampled during this reporting period and the variations in reported values are not attributable the WwTP activities.

The following observations were made for field parameters at the WwTP for the annual monitoring period:

- Variations in DO may be associated with rainfall events;
- Relatively consistent EC levels across the monitoring period with STP1 indicating that the groundwater is slightly saline and STP2 indicating that the groundwater is highly saline; and
- pH levels were relatively consistent, with the pH level indicating slightly acidic to near neutral pH levels.

8.2.3 Chloride and Sulphate

Graphs for chloride and sulphate plotted against rainfall are presented in **Figures 26** to **27** (**Appendix E**).

Overall, no notable trends were observed during the monitoring period for chloride and sulphate in the background groundwater.

8.2.4 Nutrients

Graphs for ammonia, nitrate, total nitrogen, and total phosphorus plotted against rainfall are presented in **Figures 28** to **31** (**Appendix E**).

The following observations were made for nutrients levels in the background groundwater at the WwTP for the annual monitoring period:

- Ammonia results showed a decreasing trend over the annual monitoring period in STP1 after a spike concentration detected in June 2019. Conversely an increase in ammonia occurred in January 2020 at STP2.
- A small spike in nitrate was detected in April 2020 at STP1 but returned to non-detect in June 2020.
- A small spike in total nitrogen occurred at both STP1 and STP2 in April 2020 but returned to non-detect in June 2020.
- A large spike in total phosphorous was detected in April 2020 at STP2 but returned to non-detect in June 2020. Total phosphorous levels remained consistent throughout the annual monitoring period at STP1.

As these two bores are only background bores were sampled no comments can be made in relation to any impacts from site activities. This will be assessed further when more data becomes available.

8.2.5 Metals

Graphs for (all dissolved) aluminium, cadmium, chromium (III+VI), cobalt, copper, iron, manganese, mercury, nickel, selenium, tin, and zinc, as well as boron, are plotted against rainfall and presented in **Figures 32** to **44** (**Appendix E**). For the purposes of this discussion, emphasis has been given to the dissolved rather than the total metal results, as metals in the dissolved phase can migrate with groundwater and provide a better indication of potential groundwater contamination.

The following observations were made for metals in the background groundwater at the WwTP for the annual monitoring period:

- Some variation in boron was noted at STP1 and STP2, with concentrations increasing in December 2019;
- Dissolved copper increased at both bores in August 2019, but was below the laboratory's limit of reporting from October 2019 onwards; and
- Dissolved aluminium, cadmium, chromium, mercury, selenium, tin zinc remained undetected in both bores.

As only background bores were sampled no comments can be made in relation to any impacts from site activities. This will be assessed further when more data becomes available.

8.2.6 Microbiological Parameters

Graphs for *E. Coli* and Enterococci plotted against rainfall and presented in **Figures 45** to **46** (**Appendix E**). *E. Coli and* Enterococci were not reported to be present in the background bores STP1 and STP2.

9 CONTAMINATION ASSESSMENT & CONCLUSIONS

While some variations in groundwater parameters were noted at both the IWTP and WwTP sites, these variations were not interpreted to be associated with the onsite activities.

It is important to note that monitoring at the WwTP is limited to only background bore as the bores down-gradient from site activities and infrastructure are dry most of the time or the volume of groundwater is not sufficient to fill necessary sampling containers. It is also noted that the depth of pre-existing bores MP97/01, MP97/02, MP97/03, MP97/04, MP97/05, MP00/07 and MP00/08 are all less than 2m, and to obtain better indication of down-gradient groundwater quality, it is recommended that deeper wells are installed in these locations.

On the basis of the information set out above, and the limited record of data as discussed above, the monitoring data reported by Trility during the annual monitoring period at both the WwTP and the IWTP did not indicate the presence of groundwater contamination associated with the onsite activities.

A review of trigger levels was conducted in July 2020 and the results of this review should be adopted and used during the next monitoring events.

Level 8 / 133 Mary Street
Brisbane QLD 4000
Australia

JUNE 2020
ANNUAL REPORT
Trility Pty Ltd

Integrated Water Treatment Plant and Wastewater Treatment Plant, Agnes Water

Appendix A: Groundwater Field Sampling Records

ALS

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680
Ph: 07 4978 7944 E: ALSEnviro.gladstone@alsglobal.com

CLIENT: TRILITY	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):
OFFICE: AGNES WATER	
PROJECT: GROUNDWATER MONITORING PROJECT NO.:	ALS QUOTE NO.: BN/222/16
ORDER NUMBER: PURCHASE ORDER NO.: 4500054738	COUNTRY OF ORIGIN:
PROJECT MANAGER: [redacted]	*CONTACT PH: (07) 4974 7975*
SAMPLER: [redacted]	SAMPLER MOBILE: [redacted]
COC Emailed to ALS? (YES / NO)	EDD FORMAT (or default):
Email Reports to : [redacted]@TRILITY.com.au; awatergroup@trility.com.au	
Email Invoice to (will default to PM if no other addresses are listed): accountspayable@trility.com.au	

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
DATE/TIME: 16.9.19 12.00	DATE/TIME:	DATE/TIME:	DATE/TIME:

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME 16-9-19	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	TABLE 1	pH FIELD	Temp FIELD	D.O FIELD	Cond FIELD	ORP FIELD			Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	DESAL 1	9.15	W		5	X		23.4	0.13	239	306			
2	DESAL 2	10.00	W		5	X	3.60	23.0	0.15	212	334			
3	DESAL 3	10.40	W		5	X	4.74	25.0	0.15	222	-171.8			
4	DESAL 1 Duplicate	9.15	W		5	X	3.92	23.4	0.13	239	306			
				TOTAL	20									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility
Project:	Groundwater bore installation and sampling
Location:	Agnes Water, Qld
Job No:	
Sampled by:	4p4(6) Personal informa
Date:	16-9-19

Desal 1

WELL DETAILS		
Well depth:	6.5	(m)
Well diameter:	50 mm	
Casing type:	PVC	
Initial water level:	2677	(m)

SAMPLING EQUIPMENT	
Sampling device: Peristaltic (low flow)	
GEO#	✓
Water meter: YSI#	✓
Turbidity Meter: TM#	
Interphase probe: IP#	

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
8.45	2L	2L	2635	23.5	0.59	256.4	-	3.95	322	-
8.49	2L	4L	2638	23.4	0.57	249.0	-	3.92	317	-
8.53	2L	6L	2634	23.4	0.36	238.0	-	3.90	319	-
8.57	2L	8L	2634	23.4	0.18	240.5	-	3.93	313	-
9.01	2L	10L	2635	23.4	0.12	242.5	-	3.89	308	-
9.05	2L	12L	2635	23.4	0.11	238.6	-	3.92	308	-
9.09	2L	14L	2635	23.4	0.13	239.9	-	3.92	306	-
9.13	2L	16L	2635	23.4	0.13	239.4	-	3.92	306	-
			sample collected							
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

fine, light winds, warm temperatures.

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Ibservations during Sampling:-
ig. Odours, sheens, turbidity, water colour

Light tannin stained, low odour.

Samples Taken	Number	Duplicate: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

ONITORING WELL VOLUMES:-

iameter of well casing:	mm		
iameter of hole drilled:	mm		
) Volume of casing only	0.000000 m3 (kL)	0.00 L per metre	
) Volume of drill-hole	0.000000 m3 (kL)	0.00 L per metre	
) Volume of annulus around casing	0.000000 m3 (kL)	0.00 L per metre	
) Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000 m3 (kL)	0.0 L /m	

eld Technician #1

Field Technician #2

GREENCAP

:EENCAP
adin Point
oundwater Sampling Record

ent:	Trility	Job No:	4(6) Personal infor
oject:	Groundwater bore installation and sampling	Sampled by:	
cation:	Agnes Water, Qld	Date:	16-9-19

Desal 2

WELL DETAILS			SAMPLING EQUIPMENT	
Well depth:	6.0	(m)	Sampling device: Peristaltic (low flow)	GEO# ✓
Well diameter:	50 mm		Water meter:	YSI# PRO ✓
Casing type:	PVC		Turbidity Meter:	TM# ✗
Initial water level:	2949	(m)	Interphase probe:	IP# ✗

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
9.30	2L	2L	2950	23.1	0.73	218	—	3.81	329	—
9.34	2L	4L	2951	23.0	0.61	217	—	3.70	352	—
9.38	2L	6L	2952	23.0	0.38	216	—	3.84	327	—
9.42	2L	8L	2951	23.0	0.31	215	—	3.64	339	—
9.46	2L	10L	2951	23.0	0.21	213	—	3.80	323	—
9.50	2L	12L	2951	23.0	0.19	203	—	3.62	337.6	—
9.54	2L	14L	2951	23.0	0.16	212	—	3.60	335	—
9.58	2L	16L	2951	23.0	0.15	212	—	3.60	334	—
			sample		collected					
sation Criteria (3 readings ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

observations: eg. Nearby activities, weather

fair light winds - warm temperatures

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

vations during Sampling:-
lours, sheens, turbidity, water colour

Light tannin stain.
Low odour

Samples Taken	Number	Duplicate: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

ORING WELL VOLUMES:-

er of well casing:		mm	
er of hole drilled:		mm	
me of casing only	0.000000	m3 (kL)	0.00 L per metre
me of drill-hole	0.000000	m3 (kL)	0.00 L per metre
me of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
Bore Volume = 0.3*(3) + (1)	0.000000	m3 (kL)	0.0 L /m
ming 30% porosity in sand/gravel pack)			

echnician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	4(6) Personal inforr
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	16-9-19

Desal 3	WELL DETAILS			SAMPLING EQUIPMENT	
	Well depth:	50	(m)	Sampling device: Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm		Water meter:	YSI# Pro ✓
	Casing type:	PVC		Turbidity Meter:	TM#
	Initial water level:	3306	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
10.10	2L	2L	3840	24.9	0.13	211	—	4.71	-175.2	—
10.14	2L	4L	3645	24.9	0.13	212	—	4.73	-182.2	—
10.18	2L	6L	3650	24.9	0.13	213	—	4.71	-183	—
10.22	2L	8L	3650	24.9	0.14	215	—	4.74	-181	—
10.26	2L	10L	3650	24.9	0.13	217	—	4.75	-174	—
10.30	2L	12L	3650	25.0	0.13	218	—	4.73	-174.4	—
10.34	2L	14L	3650	24.9	0.14	223	—	4.74	-172.6	—
10.38	2L	16L	3650	25.0	0.15	222	—	4.74	-171.8	—
			sample collected							
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

fine light winds

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? (Yes)

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

light tannin stain
low odour.

Samples Taken	Number	Duplicate: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

MONITORING WELL VOLUMES:-

Diameter of well casing:	mm	
Diameter of hole drilled:	mm	
) Volume of casing only	0.000000 m3 (kL)	0.00 L per metre
) Volume of drill-hole	0.000000 m3 (kL)	0.00 L per metre
) Volume of annulus around casing	0.000000 m3 (kL)	0.00 L per metre
) Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000 m3 (kL)	0.0 L /m

Field Technician #1

Field Technician #2

DESAL **Groundwater Monitoring Standing Water Level Measurement**

NB Measurement to be taken in mm from top of bore casing

Date	Time	Operator	Desal 1	Desal 2	Desal 3
7-9-2016	1300	[redacted]	2210	2440	2985
27.9.2016	10:00		2275	2500	2792
18.10.2016	11.45		2324	2575	2845
15.11.2016	2.50pm		2440	2672	3142
14.12.2016.	0910am		2405	2650	2995
19.1.2017	0745		2461	2698	3072
27.2.2017	0230		2627	2860	3402
8.3.2017	0930		2650	2883	3642
18/4/2017	3 30pm		2051	2278	2953
19/5/2017	11:30am		2135	2372	2960
21-6-2017	9.30		2170	2470	2980
20-7-2017	15.40		2290	2510	2998
23-8-2017	8.10A.M		2317	2627	3017
27-9-2017	9.10 AM		2425	2718	3120
26/10/2017	3pm		1825	2120	2554
20/11/2017	12pm		2120	2344	2892
14-12-17	8.30		1883	2085	2862
21.1.18	1:10pm		2065	2280	2950
27.2.18	8.30A.M	4p4(6) Personal informa	1522	1728	2745
22.3.18	9.00 A.M		1602	1830	2846
27-4-18	3.30pm		1834	2023	2875
23-5-18	8.15		1912	2123	2896
4-6-18	9.00 a.m		1930	2150	2912
6-7-18	9.10 a.m.		2030	2023	2083
03-8-18	11.10a.m		2210	2441	3001
19-9-18	9.00 am		2296	2498	3058
8-10-18	8.42 AM		2350	2578	3072
29-11-18	13:06pm		2370	2660	3175
18-12-18	9.00A.M		2765	2692	3016
31-1-19	16:00pm		2475	2810	3390
28-2-19	10:40 Am		2587	2980	3535
25-3-19	9.00 AM		2530	2882	3375
16-4-19	8.10 A.M		2547	2889	3401
27-5-19	12.30p.m		2234	2552	3012
24-6-19	9.00Am		2380	2681	3100
31-7-2019	7.20 A.M		2478	2786	3181
16.8.19	8.30 Am		2582	2832	3227
16.9.19	8.45 Am		2627	2949	3306

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	
Project:	Groundwater bore installation and sampling	Sampled by:	[redacted]
Location:	Agnes Water, Qld	Date:	16-12-19

Desal 1

WELL DETAILS		
Well depth:	6.5	(m)
Well diameter:	50 mm	
Casing type:	PVC	
Initial water level:	2784	(m)

SAMPLING EQUIPMENT	
Sampling device: Peristaltic (low flow)	GEO#
Water meter:	YSI# ✓ Pro
Turbidity Meter:	TM#
Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
9.00	2L	2L	2796	25.0	0.62	271	—	3.86	188	—
9.04	2L	4L	2794	25.1	0.23	273	—	3.88	215	—
9.08	2L	6L	2795	25.2	0.83	252	—	3.87	232	—
9.12	2L	8L	2795	25.2	0.52	281	—	3.86	241	—
9.16	2L	10L	2795	25.2	0.67	286	—	3.86	248	—
9.20	2L	12L	2795	25.2	0.87	279	—	3.86	248	—
9.24	2L	14L	2795	25.2	0.88	280	—	3.88	248	—
9.28	2L	16L	2795	25.2	0.88	278	—	3.87	248	—
				sample collected						
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

NE winds Hot.

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

Low odour
Brown stained.

Samples Taken	Number	Duplicate QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.0 L /m

Field Technician #1

Field Technician #2

ENCAP
lin Point
undwater Sampling Record

GREENCAP

nt:	Trility	Job No:	
ect:	Groundwater bore installation and sampling	Sampled by:	[redacted]
tion:	Agnes Water, Qld	Date:	16-12-19

Desal 2

WELL DETAILS		SAMPLING EQUIPMENT	
Well depth:	6.0 (m)	Sampling device: Peristaltic (low flow)	GEO# ✓
Well diameter:	50mm	Water meter:	YSI# ✓ Pro
Casing type:	PVC	Turbidity Meter:	TM#
Initial water level:	3140 (m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
9.40	2L	2L	3145	23.9	0.98	197	—	3.84	250	—
9.44	2L	4L	3145	23.9	1.02	197	—	3.84	250	—
9.48	2L	6L	3146	23.9	1.08	197	—	3.86	256	—
9.52	2L	8L	3146	23.9	0.91	195	—	3.84	281	—
9.56	2L	10L	3146	23.9	0.93	196	—	3.78	289	—
10.00	2L	12L	3146	23.9	0.97	192	—	3.71	292	—
10.04	2L	14L	3146	23.9	0.98	194	—	3.71	292	—
				sample collected						
tion Criteria (3 readings nges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

bservations: eg. Nearby activities, weather

NE winds, Hot

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

tions during Sampling:-
rs, sheens, turbidity, water colour

~~NE winds~~
Hot
Low to moderate odour.
low brown stain.

Samples Taken	Number	Duplicate: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

ING WELL VOLUMES:-
f well casing: mm
f hole drilled: mm
of casing only 0.000000 m3 (kL) 0.00 L per metre
of drill-hole 0.000000 m3 (kL) 0.00 L per metre
of annulus around casing 0.000000 m3 (kL) 0.00 L per metre
re Volume = 0.3*(3) + (1) 0.000000 m3 (kL) 0.0 L/m
g 30% porosity in sand/gravel pack)

nician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	
Project:	Groundwater bore installation and sampling	Sampled by:	4(6) Personal infor
Location:	Agnes Water, Qld	Date:	16-12-19

	WELL DETAILS		SAMPLING EQUIPMENT	
Desal 3	Well depth:	5.0 (m)	Sampling device: Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm	Water meter:	YSI# ✓ PRO
	Casing type:	PVC	Turbidity Meter:	TM#
	Initial water level:	3892 (m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
10.15	2	2L	2810	26.6	1.24	207	—	4.67	-123	—
10.19	2	4L	2817	26.7	1.28	208	—	4.67	-143	—
10.23	2	6L	2820	26.6	1.48	209	—	4.67	-151	—
10.27	2	8L	2820	26.6	1.50	215	.	4.71	-154	—
10.31	2	10L	2820	26.6	1.51	208	—	4.73	-155	—
10.35	2	12L	2821	26.6	1.51	209	—	4.72	-155	
			Sample collected.							
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

fine NE winds, Hot.

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

Tannin stain, odourous

Samples Taken	Number	Duplicate: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

ONITORING WELL VOLUMES:-

ameter of well casing:	mm		
ameter of hole drilled:	mm		
Volume of casing only	0.000000 m3 (kL)	0.00 L per metre	
Volume of drill-hole	0.000000 m3 (kL)	0.00 L per metre	
Volume of annulus around casing	0.000000 m3 (kL)	0.00 L per metre	
Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000 m3 (kL)	0.0 L /m	

eld Technician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	4p4(6) Personal informat
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	15-4-2020

DESAL 1

WELL DETAILS			SAMPLING EQUIPMENT	
Well depth:	6.5	(m)	Sampling device: Peristaltic (low flow)	GEO# ✓
Well diameter:	50 mm		Water meter:	YSI# ✓ PRO +
Casing type:	PVC		Turbidity Meter:	TM#
Initial water level:	2.243	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
11.27	2	2	2.252	26.0	0.12	338.8		3.88	233.1	
11.31	2	4	2.252	26.2	0.11	324.5		3.90	219.3	
11.35	2	6	2.252	26.2	0.15	311.6		3.95	208.4	
11.39	2	8	2.252	26.3	0.22	303.6		3.97	199.4	
11.43	2	10	2.252	26.3	0.27	302.0		3.98	193.1	
11.47	2	12	2.252	26.3	0.29	301.0		3.98	186.7	
11.51	2	14	2.252	26.3	0.30	300.2		3.99	182.1	
11.55	2	16	2.252	26.3	0.31	299.6		3.99	178.9	
11.59	2	18	2.252	26.3	0.32	297.1		4.00	174.9	
12.03	2	20	2.252	26.3	0.32	298.7		3.99	172.4	
			SAMPLES TAKEN							
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, SLIGHT SOUTHERLY BREEZE

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

COLOUR BUT NOT TURBID.

Samples Taken	Number	Duplicte: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3*(3) + (1)	0.000000	m3 (kL)	**0.0 L /m**

(assuming 30% porosity in sand/gravel pack)

Field Technician #1 **Field Technician #2**

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	sch4p4(6) Personal information
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	15-4-2020

	WELL DETAILS			SAMPLING EQUIPMENT		
DESAL 2	Well depth:	6.0	(m)	Sampling device: Peristaltic (low flow)	GEO#	✓
	Well diameter:	50mm		Water meter:	YSI#	✓ PRO+
	Casing type:	PVC		Turbidity Meter:	TM#	
	Initial water level:	2.523	(m)	Interphase probe:	IP#	

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
10-10	2	2	2.530	24.7	0.24	292.2		4.16	135.0	
10-14	2	4	2.530	24.7	0.16	286.0		4.03	163.3	
10-18	2	6	2.532	24.8	0.16	304.0		3.99	186.2	
10-22	2	8	2.532	24.8	0.19	311.0		3.91	190.0	
10-26	2	10	2.532	24.8	0.22	314.2		3.89	191.8	
10-30	2	12	2.532	24.8	0.26	314.0		3.87	189.6	
10-34	2	14	2.532	24.8	0.28	313.3		3.90	186.8	
10-38	2	16	2.532	24.8	0.29	311.7		3.91	186.2	
10-42	2	18	2.532	24.8	0.31	313.6		3.94	185.3	
10-46	2	20	2.532	24.8	0.31	313.6		3.92	180.6	
			SAMPLES		TAKEN					
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, SLIGHT SOUTHERLY BREEZE

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

TURBID

Samples Taken	Number	Duplicte: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3*(3) + (1)	0.000000	m3 (kL)	0.0 L /m
(assuming 30% porosity in sand/gravel pack)			

Field Technician #1

Field Technician #2

GREENCAP

Client:	Trility	Job No:	
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	

	WELL DETAILS		SAMPLING EQUIPMENT	
DESAL 3	Well depth:	5.0 (m)	Sampling device: Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm	Water meter:	YSI# ✓ PRO+
	Casing type:	PVC	Turbidity Meter:	TM#
	Initial water level:	2.960 (m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
0830	2	2	3.264	27.6	0.12	198.7		4.86	-109.8	
0834	2	4	3.323	27.7	0.22	199.1		4.83	-139.7	
0838	2	6	3.328	27.6	0.36	200.6		4.81	-155.7	
0842	2	8	3.342	27.7	0.39	204.6		4.83	-159.7	
0846	2	10	3.350	27.7	0.41	205.4		4.82	-167.2	
0850	2	12	3.360	27.7	0.42	207.9		4.82	-171.9	
0854	2	14	3.370	27.6	0.42	209.1		4.82	-173.2	
0858	2	16	3.376	27.6	0.42	211.1		4.82	-175.8	
0902	2	18	3.382	27.6	0.42	211.1		4.83	-177.8	
0906	2	20	3.386	27.7	0.43	212.3		4.82	-177.9	
0910	2	22	3.392	27.6	0.43	218.5		4.82	-177.7	
0914	2	24	3.396	27.6	0.44	219.0		4.82	-177.7	
			SAMPLES TAKEN							
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, SLIGHT SOUTHERLY BREEZE

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

DIRTY, TANNIN COLOURED, ODOUROUS

Samples Taken	Number	Duplicte: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				

(* DESIGNATES SAMPLES FILTERED IN FIELD)

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3*(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.0 L /m

Field Technician #1 **Field Technician #2**

GREENCAP
Bladin Point
Groundwater Sampling Record

Client:	Trility	Job No:	ch4p4(6) Personal informatio
Project:	Groundwater bore Installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	21-4-2020

STP 1

WELL DETAILS		SAMPLING EQUIPMENT	
Well depth:	15.36 (m)	Sampling device. Peristaltic (low flow)	GEO# ✓
Well diameter:	50mm	Water meter	YSI# ✓ PRO+
Casing type:	PVC	Turbidity Meter	TM#
Initial water level:	2.248 (m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
0936	2	2	2.375	24.2	0.39	3801		6.66	2.2	
0940	2	4	2.395	24.2	0.54	3764		6.64	2.8	
0944	2	6	2.428	24.2	0.65	3738		6.70	-6.7	
0948	2	8	2.448	24.1	0.66	3727		6.70	-9.9	
0952	2	10	2.468	24.1	0.68	3680		6.70	-13.2	
0956	2	12	2.484	24.2	0.70	3716		6.71	-15.4	
1000	2	14	2.495	24.1	0.71	3720		6.72	-19.1	
1004	2	16	2.505	24.1	0.72	3716		6.72	-17.4	
1008	2	18	2.512	24.1	0.72	3729		6.71	-16.7	
				SAMPLES TAKEN						
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, NO WIND, SUNNY

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

CLEAR, NO ODOUR

Samples Taken	Number	Duplicte: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-			
Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.00 L per metre

Field Technician #1 **Field Technician #2**

GREENCAP
Bladin Point
Groundwater Sampling Record

Client:	Trility	Job No:	ch4p4(6) Personal informatio
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	21-4-2020

	WELL DETAILS			SAMPLING EQUIPMENT	
STP 2	Well depth:	13.14	(m)	Sampling device. Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm		Water meter	YSI# ✓ PRO +
	Casing type:	PVC		Turbidity Meter	TM#
	Initial water level:	4.142	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
1051	2	2	4.512	24.1	0.62	11903		6.55	92.5	
1055	2	4	4.560	24.0	1.02	11786		6.54	89.7	
1059	2	6	4.565	24.0	1.07	11749		6.54	85.6	
1105	2	8	4.565	24.0	1.09	11656		6.53	86.3	
1109	2	10	4.565	24.0	1.10	11778		6.53	86.3	
1114	2	12	4.565	24.0	1.12	11640		6.53	85.9	
1118	2	14	4.565	24.0	1.13	11732		6.53	85.5	
			SAMPLES TAKEN							
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, NO WIND, SUNNY

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

CLEAR, NO ODOUR

Samples Taken	Number	Duplicte: QA__	Triplicate: QA__	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved Inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1)	0.000000	m3 (kL)	0.00 L per metre
(assuming 30% porosity in sand/gravel pack)			

Field Technician #1 **Field Technician #2**

TRILITY

DESAL Groundwater Monitoring Standing Water Level Measurement

NB Measurement to be taken in mm from top of bore casing

Date	Time	Operator	Desal 1	Desal 2	Desal 3
1-9-2016	1300	[redacted]	2210	2440	2985
27-9-2016	10:00		2275	2500	2992
18-10-2016	11.45		2324	2575	2845
15-11-2016	2.50pm		2440	2672	3142
14.12.2016.	0910am		2405	2650	2995
19.1.2017	0745		2461	2698	3072
27-2-2017	0230		2627	2860	3402
8-3-2017	0930		2650	2889	3642
18/4/2017	3:30pm		2051	2278	2953
1/5/2017	11:30am		2135	2372	2860
21-6-2017	9.30		2170	2470	2980
20-7-2017	15.40		2240	2510	2998
23-8-2017	8.10A.M		2317	2627	3017
27-9-2017	9.10 AM		2425	2718	3120
26/10/2017	3pm		1825	2120	2554
20/11/2017	12pm		2120	2344	2892
14-12-17	8.30		1882	2085	2862
21.1.18	1:10pm		2065	2280	2950
27.2.18	8.30A.M		1522	1728	2745
22.3.18	9.00 A.M		1602	1830	2846
27-4-18	3.30pm		1834	2023	2875
23-5-18	8:15		1912	2123	2896
4-6-18	9.00 a.m		1930	2150	2912
6-7-18	9.10 a.m.	4p4(6) Personal informa	2030	2023	2083
23-8-18	11.10 a.m		2210	2441	3001
19-9-18	9.00 AM		2296	2498	3058
8-10-18	8.42 AM		2350	2572	3072
29-11-18	13:06pm		2370	2660	3175
18-12-18	9.00 A.M		2265	2692	3016
31-1-19	16:00pm		2475	2810	3390
28-2-19	10:40 Am		2587	2980	3535
25-3-19	9.00 AM		2530	2882	3375
16-4-19	8.10 A.M		2547	2889	3401
27-5-19	12.30pm		2234	2552	3012
24-6-19	9.00 AM		2380	2681	3110
31-7-2019	7.20 A.M		2478	2786	3181
16-8-19	5.30 AM		2582	2832	3227
16.9.19	8.45 Am		2627	2949	3306
21-10-19	11:20 Am		2547	2851	3090
27.11.19	14:15 P.M.		2760	3065	3082
16-12-19	9.00 AM		2784	3140	3592
29-1-20	15:00 pm		2943	3244	3652
26-2-20	12:30 pm		2104	2445	2779
15-4-20	0830		2243	2523	2960
29-5-20	0830		2430	2695	3072
22-6-20	0950		2443	2735	3080

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GREENCAP
Bladin Point
Groundwater Sampling Record

Client:	Trility	Job No:	
Project:	Groundwater bore Installation and sampling	Sampled by:	[redacted]
Location:	Agnes Water, Qld	Date:	24-6-2020

STP 1	WELL DETAILS		SAMPLING EQUIPMENT	
	Well depth:	15.36 (m)	Sampling device. Peristaltic (low flow)	GEO# /
	Well diameter:	50mm	Water meter	YSI# PRO +
	Casing type:	PVC	Turbidity Meter	TM#
	Initial water level:	2.225	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
1033	2	2	2335	23.6	3.22	3894		6.67	13.8	
1037	2	4	2368	23.6	2.82	3872		6.67	7.5	
1041	2	6	2394	23.7	2.38	3774		6.67	4.4	
1045	2	8	2414	23.7	2.11	3860		6.67	2.8	
1049	2	10	2431	23.7	1.59	3861		6.67	1.1	
10.53	2	12	2448	23.7	1.32	3864		6.67	0	
1057	2	14	2462	23.7	1.22	3866		6.67	-0.1	
1101	2	16	2473	23.7	1.07	3855		6.67	0.2	
1105	2	18	2484	23.7	0.96	3878		6.67	0.4	
1109	2	20	2492	23.7	0.93	3863		6.67	0.5	
1113	2	22	2450	23.7	0.85	3884		6.67	1.0	
				Sample taken						
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

CLEAR, FINE, STILL

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

No odour, slightly turbid, clear colour.

Samples Taken	Number	Duplicte: QA_	Triplicate: QA_	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)			-	
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000	m3 (kL)	0.00 L per metre

Field Technician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

Client:	Trility	Job No:	h4p4(6) Personal informati
Project:	Groundwater bore Installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	24-6-2020

STP 2

WELL DETAILS			SAMPLING EQUIPMENT		
Well depth:	13.14	(m)	Sampling device: Peristaltic (low flow)	GEO#	/
Well diameter:	50mm		Water meter	YSI#	PRO +
Casing type:	PVC		Turbidity Meter	TM#	
Initial water level:	4173	(m)	Interphase probe:	IP#	

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
0834	2	2	4510	23.5	0.79	12102		6.52	91.2	
0838	2	4	4600	23.6	0.99	12067		6.52	69.6	
0843	2	6	4680	23.6	0.89	12029		6.51	71.2	
0847	2	8	4628	23.6	0.74	12063		6.51	78.8	
0851	2	10	4635	23.6	0.66	12033		6.51	79.9	
0855	2	12	4640	23.6	0.63	12025		6.50	79.6	
0859	2	14	4645	23.6	0.56	12032		6.50	79.1	
0903	2	16	4648	23.7	0.56	12031		6.50	77.6	
0908	2	18	4650	23.8	0.53	11931		6.50	77.6	
0912	2	18	4650	23.7	0.50	12020		6.50	79.0	
0916	2	20	4653	23.8	0.49	12069		6.50	80.0	
				Samples taken						
Stabilisation Criteria (3 readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10 mV	N/A

Field observations: eg. Nearby activities, weather

CLEAR, FINE, STILL

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

Clear, slightly turbid, no odour

Samples Taken	Number	Duplicate QA	Triplicate QA	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved Inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved Inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:	mm	
Diameter of hole drilled:	mm	
(1) Volume of casing only	0.000000 m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000 m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000 m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1)	0.000000 m3 (kL)	0.00 L per metre

(assuming 30% porosity in sand/gravel pack)

Field Technician #1 **Field Technician #2**

GREENCAP
Bladin Point
Groundwater Sampling Record

Client:	Trility	Job No:	sch4p4(6) Personal information
Project:	Groundwater bore Installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	24-6-2020

97/1	WELL DETAILS		SAMPLING EQUIPMENT	
	Well depth:	1.500 (m)	Sampling device. Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm	Water meter	YSI# PRO +
	Casing type:	PVC	Turbidity Meter	TM#
	Initial water level:	0.680 (m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature °C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
0945	2	2	0.690	19.6	2.65	851		5.52	185.6	
0949	2	4	0.694	19.6	2.98	827		5.52	147.1	
0953	2	6	0.693	19.6	2.79	816		5.53	147.7	
0957	2	8	0.695	19.6	2.62	804		5.58	147.8	
1000	2	10	0.695	19.6	2.55	797		5.55	148.2	
1004	2	12	0.695	19.6	2.55	790		5.55	148.5	
10.08	2	14	0.695	19.5	2.46	781		5.56	148.1	
			Samples	taken						
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

FINE, CLEAR, STILL.

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

no odours, turbid

Samples Taken	Number	Duplicte: QA_	Triplicate: QA_	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)			-	
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:	mm	
Diameter of hole drilled:	mm	
(1) Volume of casing only	0.000000 m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000 m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000 m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1) (assuming 30% porosity in sand/gravel pack)	0.000000 m3 (kL)	0.00 L per metre

Field Technician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

Client:	Trility	Job No:	h4p4(6) Personal informati
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	23-6-2020

	WELL DETAILS			SAMPLING EQUIPMENT	
97/2	Well depth:	1.70	(m)	Sampling device: Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm		Water meter	YSI#
	Casing type:	PVC		Turbidity Meter	TM#
	Initial water level:	1370	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
1040	1	1	DRY							
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

Pumped dry after 1 liter & did not recover.

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

Samples Taken	Number	Duplicte: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved Inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved Inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1)	0.000000	m3 (kL)	0.00 L per metre
(assuming 30% porosity in sand/gravel pack)			

Field Technician #1

Field Technician #2

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	ch4p4(6) Personal information
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	23-6-2020

97/3	WELL DETAILS			SAMPLING EQUIPMENT	
	Well depth:	1.69	(m)	Sampling device: Peristaltic (low flow)	GEO# ✓
	Well diameter:	50mm		Water meter	YSI#
	Casing type:	PVC		Turbidity Meter	TM#
	Initial water level:	1.160	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
1056	1.8	1.8	DRY							
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

Pumped dry at 1.8L & did not recover.

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

Samples Taken	Number	Duplicte: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved inorganics (1L)				
Preserved inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:		mm	
Diameter of hole drilled:		mm	
(1) Volume of casing only	0.000000	m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000	m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000	m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1)	0.000000	m3 (kL)	0.00 L per metre
(assuming 30% porosity in sand/gravel pack)			

Field Technician #1 **Field Technician #2**

GREENCAP
Bladin Point
Groundwater Sampling Record

GREENCAP

Client:	Trility	Job No:	[redacted]
Project:	Groundwater bore installation and sampling	Sampled by:	
Location:	Agnes Water, Qld	Date:	23-6-2020

97/4

WELL DETAILS			SAMPLING EQUIPMENT	
Well depth:	1.57	(m)	Sampling device: Peristaltic (low flow)	GEO# ✓
Well diameter:	50mm		Water meter	YSI#
Casing type:	PVC		Turbidity Meter	TM#
Initial water level:	0.960	(m)	Interphase probe:	IP#

Time	Amount purged (L)	Cumulative purged (L)	Water Level (m)	Temperature C	DO % sat	Sp. Conductivity µS/cm	Salinity PSU	pH Units	ORP mV	Turbidity NTU
1120	2	2	1.300							
1123	1	3	DRY							
Stabilisation Criteria (3readings within ranges)		N/A	Drawdown <10cm	± 10%	± 10%	± 5%	± 10%	± 0.1	± 10mv	N/A

Field observations: eg. Nearby activities, weather

Pumped dry at 3L & did not recover.

Has water quality meter and turbidity meter been calibrated in accordance with operating manual and recorded? Yes
Decontamination procedures followed? Yes

Observations during Sampling:-
eg. Odours, sheens, turbidity, water colour

Samples Taken	Number	Duplicte: QA	Triplicate: QA	Order
Metals Plastic*				
Plastic unpreserved Inorganics (1L)				
Preserved Inorganics (250mL)				
Glass vials (40mL)				
Glass amber unpreserved (500mL)				
Plastic nutrients 60mL green/white				
Plastic unpreserved Inorganics (500mL)				
Plastic nutrients 60mL light green				
Glass amber unpreserved (100mL)				
Plastic unpreserved Inorganics (250mL)				
(* DESIGNATES SAMPLES FILTERED IN FIELD)				

MONITORING WELL VOLUMES:-

Diameter of well casing:	mm	
Diameter of hole drilled:	mm	
(1) Volume of casing only	0.000000 m3 (kL)	0.00 L per metre
(2) Volume of drill-hole	0.000000 m3 (kL)	0.00 L per metre
(3) Volume of annulus around casing	0.000000 m3 (kL)	0.00 L per metre
(4) Total Bore Volume = 0.3(3) + (1)	0.000000 m3 (kL)	0.00 L per metre

(assuming 30% porosity in sand/gravel pack)

Field Technician #1

Field Technician #2