greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Groundwater Quality State of the Environment monitoring programme

Annual data report, 2015/16

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Contents

1. Introduction

This report summarises the results from Greater Wellington Regional Council's (GWRC) Groundwater Quality State of the Environment (GQSoE) monitoring programme for the period 1 July 2015 to 30 June 2016 inclusive. The GQSoE programme incorporates quarterly monitoring of water quality in 71 wells across the Wellington Region.

Reports containing detailed analyses of long-term trends are produced approximately every five years (see Jones & Baker 2005, Tidswell et al 2012).

2. Overview of programme SoE monitoring programme

Groundwater quality has been routinely monitored in the western half of the Wellington Region (Kapiti Coast and Hutt Valley) since 1994 and in the Wairarapa since 1997. Up until 2003, this monitoring was effectively conducted under two separate programmes, with some differences in the suite of water quality variables and analytical methods. From late 2003, management practices were aligned to provide consistency in sampling methods, sampling frequency (increased from six-monthly to quarterly), analysis and reporting. At this time, a number of changes were also made to the location of monitoring sites, the range of variables monitored and the methods of analysis to improve the representativeness and quality of the information collected (see Jones & Baker 2005 and Tidswell et al 2012) for more details.

2.1 Monitoring objectives

The aims of GWRC's GQSoE monitoring programme are to:

1. Provide information on the baseline quality of groundwater;

2. Describe the current state of the region's groundwater resources at a regional scale;

3. Assist in the detection of spatial and temporal changes in groundwater quality;

4. Recommend the suitability of groundwater for designated uses; and

5. Provide a mechanism to determine the effectiveness of regional policies and plans.

2.2 Monitoring network

The existing GQSoE monitoring network consists of 71 wells (Figure 2.1, Appendix 1). During the 2015/16 year, several wells could not be sampled at all, and others were only sampled two or three times. Brief explanations as to why wells could not be sampled are listed below:

- S26/0756 was modified by the owner after the September 2014 monitoring round and no longer has a sampling tap on the headworks.

- S27/0283 could only be sampled three out of four times as there was insufficient artesian pressure in the December 2015 event.

- BQ33/0032 was drilled in September 2015 to replace S27/0614 which had collapsed. Sampling commenced at this well in December 2015.

- T26/0538 could not be sampled the March and June 2016 rounds as it did not yield enough water to purge (i.e. dried up on purging).

- S25/5256 is on land purchased by NZTA for the Peka Peka to Otaki Expressway. Power was turned off to the site and it is therefore unable to be pumped.

- R27/1137 was not able to be accessed in December 2015
- R25/5164 has been disconnected by the owner and has not been sampled since December 2015. This is a bore spear (steel tube driven into the sand), and is unlikely to be able to be used in the future.
- R27/1265, located on the Petone foreshore was unable to be sampled in March 2016 due to lack of artesian pressure.

Faecal indicator bacteria are only tested for in the wells used for potable water supply which total 44 of the 71 GQSoE sites.

The GQSoE monitoring wells are spread across four of the five Whaitua catchments (GWRC identified water management areas). The distribution of sites is primarily based on historical groundwater use and resource availability so they are not evenly distributed. The number of sites located in each Whaitua is:

- Ruamahanga – 48
- Kapiti Coast – 14
- Wellington and Hutt Valley – 8
- Wairarapa Coast - 1
- Porirua - 0

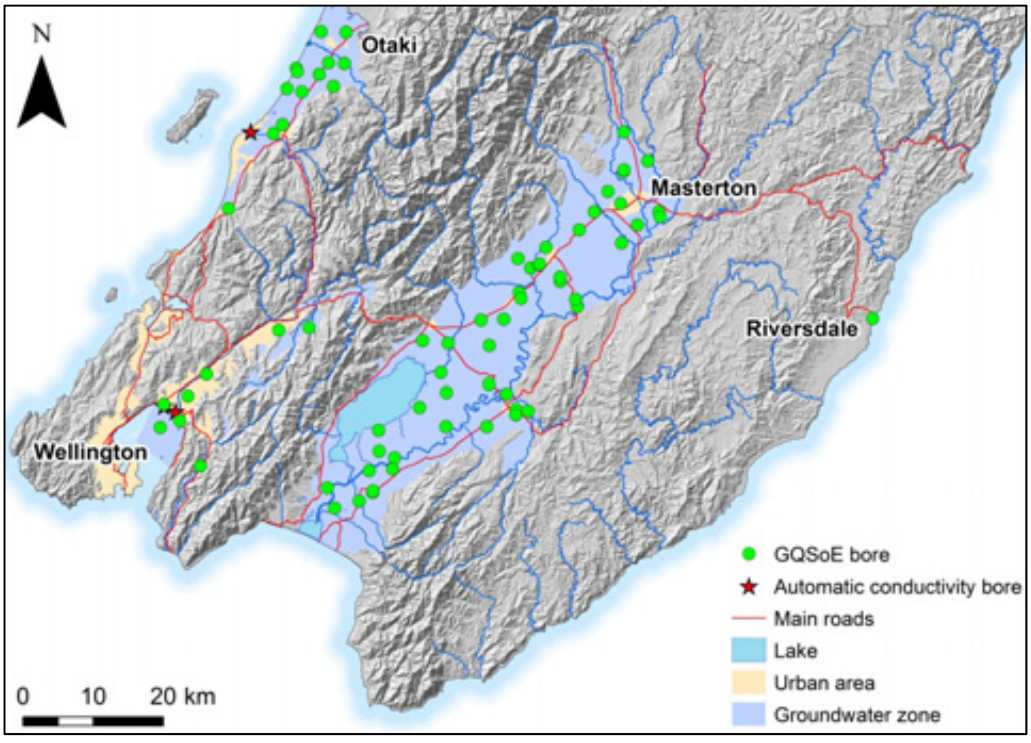

Figure 2.1: Location of groundwater quality monitoring sites in the Wellington Region. Automated saline intrusion (conductivity) groundwater monitoring sites are also shown (red stars).

2.3 Monitoring variables

The GQSoE network is sampled quarterly for a wide range of physio-chemical and microbiological variables. Groundwater samples are collected by trained GWRC staff using nationally accepted protocols (Ministry for the Environment 2006).

Groundwater quality is assessed by measuring 31 different variables including pH, conductivity, turbidity, faecal indicator bacteria, total organic carbon, dissolved nutrients and major ions. A full list of the variables measured and the analytical methods used are provided in Appendix 2.

3. Physico-chemical and microbiological water quality

3.1 Approach to analysis

This report presents the results of the four rounds of sampling that were conducted during the 2015/16 monitoring year. Results are discussed by whaitua.

For the 2015/16 sampling year, two key indicators of groundwater contamination (typically arising from landuse intensification and/or on-site wastewater disposal systems) have been evaluated: nitrate-nitrogen (nitrate) and *Escherichia coli (E. coli)* bacteria.

Details of the analytical methods used by the laboratory are provided in Appendix 2. Summary statistics were calculated using Microsoft Excel Professional Plus 2010 and NIWA Time Trends v3.3. Full data summaries are provided in Appendix 3. Data with values less than the laboratory's analytical detection limit were assigned a value of half their respective detection limit. Raw data is provided in Appendix 4.

3.2 Results

3.2.1 Nitrate

(a) 2015/16 Summary

Median nitrate concentrations across the region were low (<3 mg/L[1]) in most of the 69 wells monitored during 2015/16 (Figure 3.1). When assessed by whaitua, the following is noted:

- In the Ruamahanga Whaitua, 10 of the 47 sites (21%) had elevated (3-7 mg/L) concentrations of nitrate, and three of 47 (6%) had median nitrate concentrations in the relatively high range (7-11.3 mg/L);
- In the Kapiti Whaitua, four of the 12 sites (33%) had elevated (3-7 mg/L) concentrations of nitrate, and one of 12 (8%) had median nitrate concentrations in the relatively high range (7-11.3 mg/L);
- In the Hutt Valley Whaitua, all nine sites had median nitrate concentrations below 3 mg/L (low), and
- The single well in the Wairarapa Coast Whaitua (at Riversdale) had a median nitrate concentration of 1 mg/L.

No wells had maximum nitrate concentrations above the Ministry of Health Drinking-water Standards (DWSNZ) 2008 maximum acceptable value (MAV) concentration of 11.3 mg/L.

[1] Groundwater nitrate nitrogen (nitrate) concentrations were also evaluated in terms of likely human influence since groundwater in New Zealand rarely has nitrate concentration above 1 mg/L naturally (Close et al. 2001). A threshold of 3 mg/L was adopted as a means of defining nitrate contamination from anthropogenic sources (Close et al. 2001). This threshold has been used by Greater Wellington in precious reporting (Tidswell et al 2012) and follows the findings of a US study of nitrates (Madison & Brunett 1985) that concluded concentrations of nitrate in groundwater above 3 mg/L were due to human influence. Reference to "elevated" nitrate concentrations indicates the concentrations are above 3 mg/L; an additional 'highly elevated' threshold was arbitrarily set at >7 mg/L, approximately mid-way between the elevated threshold and DWSNZ MAV of 11.3 mg/L.

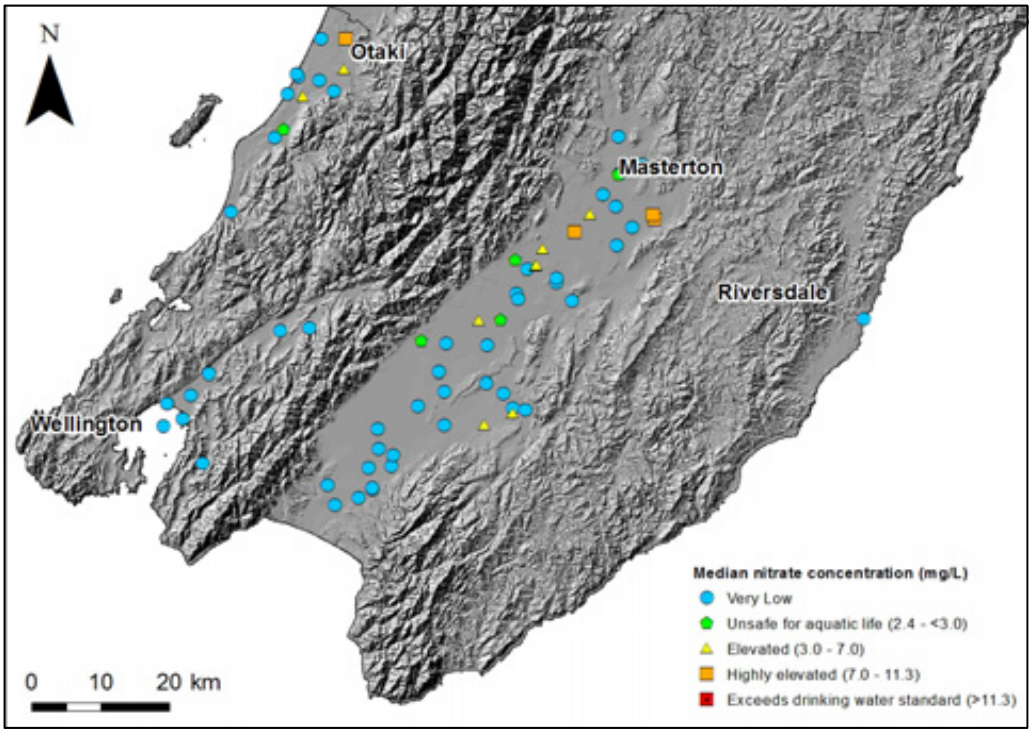

Figure 3.1: 2015/16 median nitrate concentrations in GQSoE monitoring wells

Overall, elevated nitrate was found in wells where previous sampling has historically detected elevated nitrate concentrations. The land use in these areas is typically agricultural (Wairarapa) and (often historically) horticulture (Kapiti Coast).

Elevated nitrate concentrations across the region are typically associated with unconfined, shallow and oxic (oxygen rich) groundwater. In total, 11 of the 13 wells (84%) with elevated nitrate are shallower than 30 meters.

(b) Effect on surface water

Groundwater discharges from shallow aquifers into a number of surface water bodies throughout the region and therefore there is the potential that groundwater high in nitrate could contribute to the decline of surface water quality. The ANZECC (2000) guidelines are commonly used to assess physico-chemical aspects of surface water quality in rivers and streams.

Median nitrate concentrations were above the ANZECC (2000) trigger value for lowland ecosystems (≤ 0.444 mg/L) in 37 of the 69 (53%) wells. These were distributed across the Whaitua as follows:

- 25 (of 47) were in the Ruamahanga;
- 6 (of 12) were in Kapiti;
- 5 (of 9) were in the Hutt, and
- 1 was at Riversdale

Of the above, 18 (26 %) recorded median concentrations above the Hickey (2013) threshold for aquatic toxicity (≤ 2.4 mg/L)[2].

Of the 18 sites exceeding the threshold for aquatic toxicity in 2015/16 (≤ 2.4 mg/L), two were Category A (direct connection to surface water), 13 Category B (moderate degree of connectivity to surface water) and three were Category C (not directly connected to surface water).

The two Category A locations were S26/0117 in the Mangatarere groundwater management zone near Carterton, and S25/5125 located in the Otaki groundwater management zone alongside the Otaki River. S26/0117 is in a rural lifestyle area, but also downgradient of dairying land. S25/5125 is located in the middle of a horticultural (pip/stone fruit) area.

3.2.2 *E. coli*

The DWSNZ uses *E. coli* as an indicator[3] of faecal contamination in drinking water. For drinking water supplies, *E. coli* counts should be <1 cfu/100mL.

E. coli was not detected (i.e. <1 cfu/100mL) in 39 of the 44 (88%) bores monitored.

E. coli was detected (ie, ≥1 cfu/100mL) on one or more occasions in five of the 44 bores tested (Figure 3.2):

- The highest *E. coli* count was 140 cfu/100mL in bore R25/5164 at Te Horo Beach. Te Horo Beach settlement is reliant on onsite wastewater treatment systems for effluent disposal. Previous studies involving dye tracer tests have confirmed that groundwater at Te Horo Beach is able to move from wastewater treatment systems into nearby bores relatively quickly (Hughes 1998). It is possible that the microbial contamination in bore R25/5164 is due to the bore's proximity to a nearby septic tank system. This bore is not used as a potable drinking water supply.

- The second highest *E. coli* count was 140 cfu/100mL in bore R27/6416 located at te Wainuiomata Golf Club. This shallow and large diameter well has had a history of high *E. coli* counts

The remaining three sites (S26/0223, T26/0430 and R25/5165) had *E. coli* counts ranging from 2 to 19 cfu/100mL. These are all shallow wells that have had positive *E. coli* counts on at least one occasion over the sites monitoring history.

[2] This (median) value replaces the former threshold of 1.7 mg/L (Hickey & Martin 2009) and is a recommended replacement value for the ANZECC (2000) toxicity threshold value of 7.2 mg/L.

[3] It is impracticable to monitor water supplies for all potential human pathogens, so surrogates are used to indicate possible contamination from such things as human and animal excrement, these being the most frequent causes of health-significant microbial contamination in drinking water supplies.

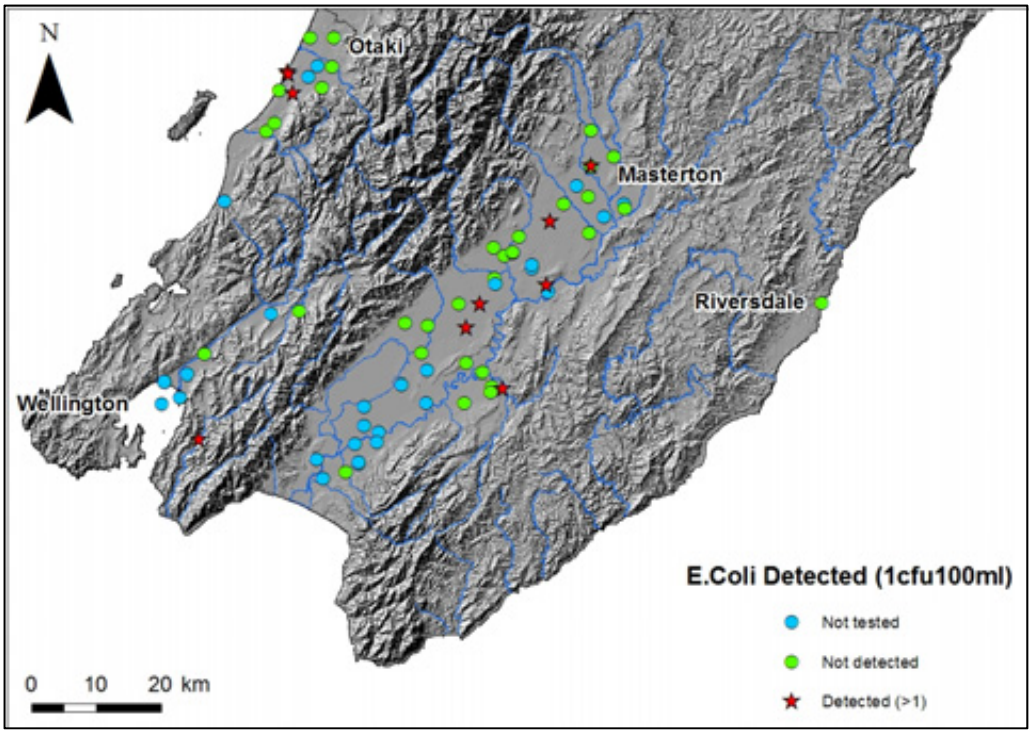

Figure 3.2: Detection of E. coli bacteria in GQSoE monitoring bores in 2015/16

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Appendix 1: GQSoE monitoring sites

Site number	Site name	X coordinates	Y coordinates	Groundwater zone	Category
Kapiti Coast					
R25/5100	O'Malley	1774552.15	5479451.35	Te Horo	Category B
R25/5135	Windsor Park	1779152.45	5481483.39	Te Horo	Category C
R25/5164	Card	1775873.28	5482367.50	Te Horo	Category B
R25/5165	Salter	1776019.28	5481886.47	Te Horo	Category B
R25/5190	Williams	1776678.23	5478988.27	Te Horo	Category B
R25/5233	Otaki Porirua Trust	1779397.56	5487564.84	Otaki	Category A
R26/6503	Queen Elizabeth Park	1766253.09	5462295.15	Raumati	Category B
R26/6587	Liddle	1772633.83	5473057.09	Waikanae	Category A
R26/6624	Boffa	1773932.93	5474297.10	Waikanae	Category B
S25/5125	Betty Partnership	1782733.73	5483013.44	Otaki	Category A
S25/5200	Common Property	1781182.52	5479785.21	Te Horo	Category C
S25/5256	Penray	1780490.58	5483153.49	Te Horo	Category C
S25/5322	Edhouse	1782982.85	5487485.83	Otaki	Category C
Hutt, Mangaroa and Wainuiomata Valley					
R27/0320	IBM 1	1756996.50	5434507.51	Hutt Valley	Category B
R27/1137	South Pacific Tyres	1773406.32	5444956.34	Hutt Valley	Category A
R27/1171	Somes Island	1756493.07	5431226.71	Hutt Valley	Category B
R27/1180	Mahoe/Willoughby St	1760435.48	5435698.05	Hutt Valley	Category B
R27/1182	Seaview Wools	1759274.04	5432161.32	Hutt Valley	Category B
R27/1183	Television New Zealand	1763083.77	5438690.64	Hutt Valley	Category A
R27/1265	IBM 2	1756997.50	5434515.51	Hutt Valley	Category B
R27/6418	Wainuiomata Golf Club	1762217.86	5425695.18	Wainuiomata	Unknown
R27/6833	Mangaroa School	1777716.35	5445323.81	Mangaroa	Unknown
Wairarapa Valley					
S26/0117	Butcher, G	1811483.15	5456780.11	Mangatarere	Category A
S26/0223	Nicholson	1816203.19	5459284.79	Taratahi	Category B
S26/0299	Graham	1818354.91	5461869.91	Taratahi	Category B
S26/0439	Rogers	1807492.42	5455180.48	Mangatarere	Category B
S26/0457	Palmer Berry Fruits	1807656.62	5450330.89	Waiohine	Category A
S26/0467	Fitzgerald	1809272.40	5453850.06	Mangatarere	Category A
S26/0568	Denbee	1813486.57	5451921.15	Parkvale	Category B
S26/0576	Mcnamara	1813461.67	5452534.23	Parkvale	Category B
S26/0705	Carterton District Council South	1810471.61	5454278.93	Mangatarere	Category B
S26/0756	Stevenson	1815919.19	5448296.24	Middle Ruamahanga	Category A
S26/0762	Schaef	1815702.37	5449348.42	Middle Ruamahanga	Category A
S26/0824	Carterton District Council North	1810546.63	5454380.93	Mangatarere	Category B
S26/0846	Druzianic	1807902.50	5449491.76	Waiohine	Category A
S27/0009	Dondertman	1793895.42	5443481.45	Tauherenikau	Category B
S27/0070	South Featherston School	1797507.54	5443110.86	Tauherenikau	Category B
S27/0136	Sugrue	1802217.44	5446389.36	Tauherenikau	Category B
S27/0156	O'Neale	1803402.88	5442775.85	Tauherenikau	Category B
S27/0202	Croad	1805460.73	5446519.85	Tauherenikau	Category B
S27/0268	Barton	1793452.70	5434055.07	Lake	Category B
S27/0283	Osborne	1797276.24	5436168.48	Tauherenikau	Category B
S27/0299	Johnson	1796503.73	5438935.77	Tauherenikau	Category A
S27/0344	George	1803347.81	5437340.43	Lower Ruamahanga	Category A
S27/0389	Dimattina	1807205.35	5433792.40	Martinborough	Category C
S27/0396	SWDC Martinborough	1805858.70	5435961.84	Lower Ruamahanga	Category A
S27/0433	Mapuna Atea	1787692.45	5427838.97	Lake	Category B
S27/0435	Wairio	1787608.01	5430805.03	Lake	Category B
S27/0442	Robinson Transport	1789891.27	5426883.54	Lake	Category B
S27/0495	Bosch	1797227.31	5431330.26	Lower Ruamahanga	Category A
S27/0522	Duggan	1803031.58	5431324.10	Martinborough	Category C
S27/0571	Martinborough Golf Club	1807158.18	5433014.36	Martinborough	Category C
S27/0585	McCreary	1780320.53	5422598.32	Onoke	Category C
S27/0588	SWDC Piriona	1784844.06	5420713.48	Onoke	Category A
S27/0594	Warren	1781350.93	5419721.16	Onoke	Category C
S27/0602	Weatherstone	1789625.95	5425301.57	Lake	Category B

Site number	Site name	X coordinates	Y coordinates	Groundwater zone	Category
S27/0607	Finlayson	1786288.91	5425037.20	Lake	Category B
S27/0614	Sorenson South	1786778.28	5421924.10	Unknown	Unknown
S27/0615	Sorenson North	1786805.33	5422158.09	Unknown	Unknown
S27/0681	Te Kairanga Wines	1808952.42	5433542.02	Huangarua	Category A
T26/0003	Lenton	1822559.22	5473236.52	Upper Ruamahanga	Category B
T26/0087	Biss	1820295.66	5464750.15	Waingawa	Category C
T26/0099	Butcher, M	1822518.46	5467619.40	Upper Ruamahanga	Category B
T26/0206	Thornton	1822581.50	5467829.43	Upper Ruamahanga	Category B
T26/0259	Opaki Water Supply Association	1825997.33	5469120.23	Upper Ruamahanga	Category A
T26/0332	Taratahi Agricultural Training Centre	1822230.80	5457401.54	Fernhill-Tiffen	Category C
T26/0413	Seymour	1824485.62	5459978.64	Waingawa	Category B
T26/0430	Trout Hatchery	1822130.71	5463027.57	Waingawa	Category B
T26/0489	Duffy	1827571.49	5461854.50	Te Ore Ore	Category B
T26/0538	Percy	1827738.41	5461169.34	Te Ore Ore	Category B
Riversdale					
T27/0063	Acacia Ave	1858025.04	5446630.37	Riversdale	Unknown
Saline intrusion monitoring					
R26/6956	Waikanae Estuary Deep	1769406.76	5473310.22	Waikanae	Category A
R27/0122	McEwan Park Shallow	1758681.27	5433523.34	Hutt Valley	Category B
R27/7153	McEwan Park Deep	1758681.27	5433523.34	Hutt Valley	Category B
R27/7154	Tamatoa Deep	1757019.47	5434294.51	Hutt Valley	Category B
R27/7215	Tamatoa Shallow	1757021.47	5434298.51	Hutt Valley	Category B

Appendix 2: Monitoring variables and analytical methods

Groundwater samples are collected quarterly by trained GWRC staff using nationally accepted protocols (Ministry for the Environment 2006). This involves purging the bore for a predetermined amount of time to remove any standing water and monitoring the pumped water continuously until field measurements (eg conductivity) stabilise. Field measurements (temperature, conductivity, pH and dissolved oxygen) are taken using field meters which are calibrated on the day of sampling.

Water samples are stored on ice upon collection and transported to an external laboratory within 24 hours of sampling. RJ Hill Laboratories in Hamilton analysed the samples for the variables listed in Table A2.1

The rationale for variables monitored is detailed in Table A2.1 and analytical methods are summarised in Table A2.2.

Table A2.1. Rationale for inclusion in GQSoE sampling regime

Test type	Variable	Rationale for inclusion
Bacteria	Faecal coliforms *E. coli*	Faecal coliforms *and E. coli* can indicate pollution due to faecal matter and the presence of potentially harmful pathogens in groundwater. Ministry for the Environment uses *E. coli* as an indicator of ground water quality.
Major ions	Dissolved sodium Dissolved potassium Dissolved calcium Dissolved magnesium Chloride Sulphate Total alkalinity	Concentrations of major ions can give an indication of the chemical composition of the water, the origins of groundwater, water residence time in the aquifer and extent of rock/water interaction. Concentrations of major ions can also be indicative of groundwater contamination from industrial, agricultural and domestic sources.
Nutrients	Total ammoniacal nitrogen Nitrite-nitrate nitrogen (NNN) Nitrate nitrogen Nitrite nitrogen Dissolved reactive phosphorus	Dissolved concentrations of nutrients can indicate impact from anthropogenic activity such as intensive land use. Nitrate nitrogen represents the oxidised form of nitrogen. Elevated concentrations of nitrate nitrogen can have an adverse effect on human health and can be harmful to biota. Total ammoniacal nitrogen usually exists under oxygen-poor conditions and represents the reduced form of nitrogen. Therefore, can be used as an indicator of contamination in the absence of nitrate nitrogen. The ANZECC guidelines (2000) state trigger values for the direct toxicity to biota.

Table A2.1 cont. Rationale for inclusion in GQSoE sampling regime

Chemical tests	Variable	Rationale for inclusion in sampling regime
Metals	Dissolved iron Dissolved manganese Dissolved lead Dissolved zinc	Trace metals are usually present in groundwater at low concentrations. Elevated concentrations of trace metals can suggest contamination of groundwater. Elevated concentrations of dissolved of lead and manganese can have an adverse effect on human health.
Trace elements	Bromide Fluoride Dissolved boron	Bromide naturally occurs in water but can suggest contamination from wastewater and agricultural run off. Elevated concentrations of dissolved of boron can have an adverse effect on human health and the DWSNZ (2005) MAV for fluoride is set to protect against potential dental fluorosis.
Other	pH	Water with a low pH can have a high plumbosolvency. Measured in the field to identify when the bore is purged and sample can be collected.
	Electrical conductivity	Electrical conductivity can provide a measure of total dissolved solids. Measured in the field to identify when the bore is purged and sample can be collected.
	Dissolved oxygen	Dissolved oxygen can indicate whether groundwater is under reduced or oxidised conditions. Measured in the field to identify when the bore is purged and sample can be collected.
	Dissolved reactive silica	Can help interpret the extent of rock/water interaction
	Total organic carbon (TOC)	Can indicate the presence of organic matter (either from wastewater or natural sources) in groundwater.
Calculations	Total dissolved solids (TDS)	Can indicate the extent of rock/water interaction.
	Free carbon dioxide (CO_2)	Can indicate the extent of rock/water interaction.
	Bicarbonate (H_2CO_3)	Can indicate the extent of rock/water interaction.
	Total hardness	Can indicate the extent of rock/water interaction.
	Total anions	Sum of all anions
	Total cations	Sum of all cations
	% Difference in ion balance	Difference between the sum of all anions and the sum of all cations. Can be used as a measure of analytical accuracy of water quality data. Value should be 0% but generally a difference of <5% is considered acceptable.

NB: Groundwater samples are also tested for arsenic, chromium, cadmium, nickel and copper but on a not routine basis. Conductivity and pH are tested both in the field and by Hills Laboratory. Dissolved oxygen is only tested for in the field.

Table A2.2. Analytical methods

Variable	Method Used	Detection Limit
Temperature	Field meter – WTW350i and YSI Professional Plus Meters	0.01 ˚C
Dissolved oxygen	Field meter – WTW350i and YSI Professional Plus Meters	0.01 mg/L
Electrical conductivity	Field meter – WTW350i and YSI Professional Plus Meters	0.1 µS/cm
pH	Field meter – WTW350i and YSI Professional Plus Meters	0.01 units
pH (lab)	pH meter APHA 4500-H+ B 22st ed. 2012.	0.1 pH units
Total alkalinity	Titration to pH 4.5 (M-alkalinity), Radiometer autotitrator. APHA 2320 B (Modified for alk <20) 22st ed. 2012.	1 mg/L as $CaCO_3$
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22st ed. 2012.	1 mg/L at 25°C
Free carbon dioxide	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22st ed. 2012.	1.0 mg/L at 25°C
Total hardness	Calculation from calcium and magnesium. APHA 2340 B 22st ed. 2012.	1.0 mg/L $CaCO_3$
Electrical conductivity (lab)	Conductivity meter, 25°C APHA 2510 B 22st ed. 2012.	0.1 mS/m, 1 µS/cm
Total dissolved solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 – 105°C used rather than 180 ± 2°C) 22st ed. 2012.	10 mg/L
Dissolved boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.005 mg/L
Dissolved calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.05 mg/L
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.02 mg/L
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.0001 mg/L
Dissolved magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.02 mg/L
Dissolved manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.0005 mg/L
Dissolved potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.05 mg/L
Dissolved sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.02 mg/L
Dissolved zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 22st ed. 2012.	0.001 mg/L
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B 22st ed. 2012.	0.05 mg/L
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500-Cl- E (modified from continuous-flow analysis) 22st ed. 2012.	0.5 mg/L
Fluoride	Ion selective electrode APHA 4500-F- C 22st ed. 2012.	0.05 mg/L
Total ammoniacal nitrogen	Filtered sample. Phenol/hypochlorite colorimetry. Discrete Analyser. (NH_4-N = NH_4+-N + NH_3-N) APHA 4500-NH_3 F (modified from manual analysis) 22st ed. 2012.	0.01 mg/L
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3 - I (modified) 22st ed. 2012.	0.002 mg/L
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.001 mg/L
Nitrate-N + Nitrite-N (NNN)	Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO_3 - I (modified) 22st ed. 2012.	0.002 mg/L
Dissolved reactive phosphorus	Filtered sample. Molybdenum blue colorimetry. Discrete Analyser. APHA 4500-P E (modified from manual analysis) 22st ed. 2012.	0.004 mg/L
Reactive silica	Filtered sample. Heteropoly blue colorimetry. Discrete Analyser. APHA 4500-SiO2 F (modified from flow injection analysis) 22st ed. 2012.	0.1 mg/L as SiO_2
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22st ed. 2012.	0.5 mg/L
Total organic carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) 22st ed. 2012.	0.05 mg/L
Total anions	Calculation: sum of anions as mEquiv/L [Includes Alk, Cl, NO_xN, F, DRP & SO_4]. APHA 1030 E 22nd ed. 2012.	0.07 mEquiv/L
Total cations	Calculation: sum of cations as mEquiv/L [Includes pH (H^+), Ca, Mg, Na, K, Fe, Mn, Zn & NH_4N]. APHA 1030 E 22nd ed. 2012.	0.06 mEquiv/L
% Difference in Ion Balance	Calculation from Sum of Anions and Cations. Please note: The result reported for the '% Difference in Ion Balance' is an absolute difference between the 'Sum of Anions' and 'Sum of Cations' based on the formula	0.1 %

Variable	Method Used	Detection Limit
	taken from APHA. This does not indicate whether the 'Sum of Anions' or the 'Sum of Cations' produced a higher value. APHA APHA 1030 E 22nd ed. 2012.	
Faecal coliforms	Membrane filtration, count on mFC agar. Incubated at 44.5°C for 22 hours, confirmation. Analysed at Hill laboratories – Microbiology: 1 Clow Place, Hamilton. Method 9222 D 22st ed. 2012.	1 cfu/100 mL
E. coli	Membrane filtration, count on mFC agar. Incubated at 44.5°C for 22 hours, MUG confirmation. Analysed at Hill laboratories – Microbiology: 1 Clow Place, Hamilton. Method 9222 G 22st ed. 2012.	1 cfu/100 mL

Appendix 3: Tabulated Statistical Data

Site	Easting	Northing	E.coli detected	No. of E.coli samples	Median NO3-N	No. of NO3-N samples
BQ33/0032	1786750	5421805	Not tested	3	0.001	3
R25/5100	1774552	5479451	N	4	0.001	4
R25/5135	1779152	5481483	Not tested	4	0.001	4
R25/5164	1775873	5482367	Y	2	0.385	2
R25/5165	1776019	5481886	Y	4	0.0255	4
R25/5190	1776678	5478988	N	4	3.8	4
R25/5233	1779398	5487565	N	4	2.25	4
R26/6503	1766253	5462295	Not tested	4	0.045	4
R26/6587	1772634	5473057	N	4	0.89	4
R26/6624	1773933	5474297	N	4	2.8	4
R27/0320	1756996	5434508	Not tested	5	0.001	5
R27/1137	1773406	5444956	N	3	1.72	3
R27/1171	1756493	5431227	Not tested	5	0.021	5
R27/1180	1760435	5435698	Not tested	5	1	5
R27/1182	1759274	5432161	Not tested	4	0.675	4
R27/1183	1763084	5438691	N	4	0.29	4
R27/1265	1756998	5434516	Not tested	4	0.101	4
R27/6418	1762218	5425695	Y	4	1.565	4
R27/6833	1777716	5445324	N	4	0.855	4
S25/5125	1782734	5483013	N	4	3.35	4
S25/5200	1781183	5479785	N	4	0.001	4
S25/5322	1782983	5487486	N	4	9.35	4
S26/0117	1811483	5456780	N	4	3.1	4
S26/0223	1816203	5459285	Y	4	9.95	4
S26/0299	1818355	5461870	N	4	3.7	4
S26/0439	1807492	5455180	N	4	2.8	4
S26/0457	1807657	5450331	N	4	0.505	4
S26/0467	1809272	5453850	N	4	2.2	4
S26/0568	1813487	5451921	Not tested	4	0.01	4
S26/0576	1813462	5452534	Not tested	4	0.031	4
S26/0705	1810472	5454279	N	4	4.35	4
S26/0762	1815702	5449348	N	4	0.0155	4
S26/0824	1810547	5454381	N	4	4.85	4
S26/0846	1807902	5449492	Not tested	4	0.83	4

S27/0009	1793895	5443481	N	4	2.8	4
S27/0070	1797508	5443111	N	4	0.325	4
S27/0136	1802217	5446389	N	4	4.4	4
S27/0156	1803403	5442776	N	4	0.0085	4
S27/0202	1805461	5446520	N	4	2.7	4
S27/0268	1793453	5434055	Not tested	4	0.003	4
S27/0283	1797276	5436168	Not tested	3	0.001	3
S27/0299	1796504	5438936	N	4	0.355	4
S27/0344	1803348	5437340	N	4	0.034	4
S27/0389	1807205	5433792	N	4	0.202	4
S27/0396	1805859	5435962	N	4	0.2145	4
S27/0433	1787692	5427839	Not tested	4	0.001	4
S27/0435	1787608	5430805	Not tested	4	0.001	4
S27/0442	1789891	5426884	Not tested	4	0.0115	4
S27/0495	1797227	5431330	Not tested	4	0.0025	4
S27/0522	1803032	5431324	N	4	3.5	4
S27/0571	1807158	5433014	N	4	5.35	4
S27/0585	1780321	5422598	Not tested	4	0.001	4
S27/0588	1784844	5420713	N	4	0.001	4
S27/0594	1781351	5419721	Not tested	4	0.0085	4
S27/0602	1789626	5425302	Not tested	4	0.0055	4
S27/0607	1786289	5425037	Not tested	4	0.018	4
S27/0615	1786805	5422158	Not tested	4	0.0015	4
S27/0681	1808952	5433542	N	4	0.505	4
T26/0003	1822559	5473237	N	4	1.28	4
T26/0087	1820296	5464750	Not tested	4	0.965	4
T26/0099	1822518	5467619	N	4	2.75	4
T26/0206	1822582	5467829	N	4	2.05	4
T26/0259	1825997	5469120	N	4	0.87	4
T26/0332	1822231	5457402	N	4	0.605	4
T26/0413	1824486	5459979	Not tested	4	0.001	4
T26/0430	1822131	5463028	Y	4	1.375	4
T26/0489	1827571	5461855	Not tested	4	10.4	4
T26/0538	1827738	5461169	N	2	9.6	2
T27/0063	1858025	5446630	N	4	1.015	4

Appendix 4: Raw Data

Site Name	Date	Time	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
BQ33/0032	9/12/2015	12:05:00		<0.00200000
BQ33/0032	3/03/2016	13:25:00		<0.00200000
BQ33/0032	14/06/2016	13:29:00		<0.00200000
R25/5100	1/09/2015	10:15:00	<1.00	<0.00200000
R25/5100	25/11/2015	9:52:00	<1.00	<0.00200000
R25/5100	23/02/2016	9:45:00	<1.00	<0.00200000
R25/5100	8/06/2016	12:10:00	<1.00	<0.00200000
R25/5135	31/08/2015	12:23:00		<0.00200000
R25/5135	24/11/2015	12:05:00		<0.0200000
R25/5135	22/02/2016	11:10:00		<0.00200000
R25/5135	7/06/2016	12:04:00		<0.00200000
R25/5164	31/08/2015	13:47:00	13	0.3
R25/5164	24/11/2015	12:40:00	140	0.47
R25/5164	23/02/2016	0:00:00		
R25/5164	7/06/2016	0:00:00		
R25/5165	31/08/2015	13:16:00	<1.00	0.16
R25/5165	24/11/2015	13:15:00	<1.00	0.034
R25/5165	22/02/2016	12:18:00	2	0.017
R25/5165	7/06/2016	13:42:00	<1.00	<0.00200000
R25/5190	1/09/2015	9:20:00	<1.00	3.7
R25/5190	25/11/2015	9:31:00	<1.00	3.9
R25/5190	23/02/2016	10:40:00	<1.00	4
R25/5190	8/06/2016	11:11:00	<1.00	3
R25/5233	31/08/2015	10:45:00	<1.00	5.9
R25/5233	24/11/2015	9:20:00	<1.00	2.2
R25/5233	22/02/2016	8:42:00	<1.00	2.3
R25/5233	7/06/2016	9:57:00	<1.00	1.8
R26/6503	1/09/2015	13:00:00		0.055
R26/6503	25/11/2015	12:56:00		0.062
R26/6503	23/02/2016	13:22:00		0.035
R26/6503	7/06/2016	15:12:00		0.035
R26/6587	3/07/2015	0:00:00		
R26/6587	1/09/2015	12:03:00	<1.00	1.25
R26/6587	25/11/2015	12:05:00	<1.00	0.86
R26/6587	23/02/2016	11:28:00	<1.00	0.4

R26/6587	8/06/2016	13:47:00	<1.00	0.92
R26/6624	1/09/2015	11:07:00	<1.00	2.4
R26/6624	25/11/2015	11:17:00	<1.00	2.9
R26/6624	23/02/2016	12:13:00	<1.00	2.7
R26/6624	8/06/2016	13:08:00	<1.00	2.9
R27/0320	7/07/2015	9:25:00		0.002
R27/0320	23/09/2015	13:57:00		<0.00200000
R27/0320	26/11/2015	14:00:00		<0.00200000
R27/0320	14/04/2016	11:00:00		<0.00200000
R27/0320	9/06/2016	8:33:00		<0.00200000
R27/1137	22/10/2015	10:37:00	<1.00	2.1
R27/1137	25/02/2016	7:31:00		1.2
R27/1137	10/06/2016	9:35:00	<1.00	1.72
R27/1171	7/07/2015	10:35:00		0.021
R27/1171	1/10/2015	9:35:00		0.186
R27/1171	15/12/2015	11:34:00		0.045
R27/1171	25/02/2016	11:41:00		0.018
R27/1171	28/06/2016	12:36:00		<0.00200000
R27/1180	4/07/2015	12:16:00		1
R27/1180	23/09/2015	12:25:00		1.06
R27/1180	26/11/2015	8:38:00		0.97
R27/1180	24/02/2016	12:07:00		1
R27/1180	9/06/2016	12:28:00		1.09
R27/1182	23/09/2015	14:35:00		0.71
R27/1182	26/11/2015	12:55:00		<0.0200000
R27/1182	24/02/2016	8:46:00		0.68
R27/1182	9/06/2016	9:34:00		0.67
R27/1183	23/09/2015	11:45:00	<1.00	0.28
R27/1183	26/11/2015	9:30:00	<1.00	0.25
R27/1183	24/02/2016	11:22:00	<1.00	0.3
R27/1183	9/06/2016	13:32:00	<1.00	0.34
R27/1265	7/07/2015	9:03:00		0.116
R27/1265	23/09/2015	13:30:00		0.1
R27/1265	26/11/2015	13:43:00		0.102
R27/1265	9/06/2016	8:12:00		0.093
R27/6418	23/09/2015	15:45:00	100	2.7
R27/6418	26/11/2015	10:45:00	<1.00	1.4
R27/6418	24/02/2016	10:20:00	1	0.98

R27/6418	9/06/2016	11:28:00	1	1.73
R27/6833	23/09/2015	10:20:00	<1.00	1.5
R27/6833	8/12/2015	7:45:00	<1.00	0.61
R27/6833	24/02/2016	13:18:00	<1.00	0.67
R27/6833	9/06/2016	14:39:00	<1.00	1.04
S25/5125	31/08/2015	11:34:00	<1.00	4.2
S25/5125	24/11/2015	11:00:00	<1.00	2.9
S25/5125	22/02/2016	10:20:00	<1.00	1.24
S25/5125	7/06/2016	12:55:00	<1.00	3.8
S25/5200	31/08/2015	14:22:00	<1.00	<0.00200000
S25/5200	24/11/2015	14:02:00	<1.00	<0.00200000
S25/5200	22/02/2016	13:25:00	<1.00	<0.00200000
S25/5200	8/06/2016	9:45:00	<1.00	<0.00200000
S25/5256	31/08/2015	0:00:00		
S25/5256	24/11/2015	0:00:00		
S25/5322	31/08/2015	9:55:00	<1.00	9.2
S25/5322	24/11/2015	10:00:00	<1.00	9.3
S25/5322	22/02/2016	9:30:00	<1.00	9.9
S25/5322	7/06/2016	10:53:00	<1.00	9.4
S26/0117	11/09/2015	13:55:00	<1.00	3.3
S26/0117	2/12/2015	14:27:00	<1.00	3.5
S26/0117	1/03/2016	13:31:00	<1.00	2.4
S26/0117	21/06/2016	13:36:00	<1.00	2.9
S26/0223	9/09/2015	14:36:00	<1.00	9.9
S26/0223	1/12/2015	9:24:00	<1.00	12
S26/0223	9/03/2016	14:03:00	3	10
S26/0223	15/06/2016	12:50:00	19	4.3
S26/0299	16/09/2015	14:06:00	<1.00	3.4
S26/0299	30/11/2015	13:50:00	<1.00	4.2
S26/0299	4/03/2016	14:07:00	<1.00	4
S26/0299	17/06/2016	14:38:00	<1.00	2.5
S26/0439	11/09/2015	13:10:00	<1.00	2.8
S26/0439	2/12/2015	11:46:00	<1.00	2.9
S26/0439	10/03/2016	11:33:00	<1.00	2.8
S26/0439	21/06/2016	12:12:00	<1.00	2.8
S26/0457	17/09/2015	14:29:00	<1.00	0.95
S26/0457	11/12/2015	7:35:00	<1.00	0.41
S26/0457	7/03/2016	13:38:00	<1.00	0.25

S26/0457	23/06/2016	12:18:00	<1.00	0.6
S26/0467	11/09/2015	12:17:00	<1.00	2.4
S26/0467	2/12/2015	10:45:00	<1.00	3.8
S26/0467	1/03/2016	11:59:00	<1.00	2
S26/0467	21/06/2016	12:58:00	<1.00	1.36
S26/0568	11/09/2015	11:27:00		<0.0200000
S26/0568	2/12/2015	8:37:00		<0.0200000
S26/0568	1/03/2016	8:58:00		0.01
S26/0568	21/06/2016	15:06:00		<0.00200000
S26/0576	11/09/2015	10:40:00		<0.00200000
S26/0576	2/12/2015	7:50:00		0.1
S26/0576	1/03/2016	8:03:00		0.061
S26/0576	23/06/2016	13:02:00		<0.00200000
S26/0705	7/10/2015	9:15:00	<1.00	4.4
S26/0705	11/12/2015	9:50:00	<1.00	4.4
S26/0705	2/03/2016	9:30:00	<1.00	4.3
S26/0705	22/06/2016	9:42:00	<1.00	2.7
S26/0756	11/09/2015	0:00:00		
S26/0756	2/12/2015	0:00:00		
S26/0762	11/09/2015	9:47:00	<1.00	0.182
S26/0762	2/12/2015	9:25:00	<1.00	0.03
S26/0762	1/03/2016	10:00:00	<1.00	<0.00200000
S26/0762	21/06/2016	9:27:00	<1.00	<0.00200000
S26/0824	10/09/2015	9:50:00	<1.00	4.7
S26/0824	3/12/2015	8:15:00	<1.00	4.9
S26/0824	2/03/2016	8:50:00	<1.00	4.9
S26/0824	22/06/2016	9:13:00	<1.00	4.8
S26/0846	9/09/2015	13:30:00		0.83
S26/0846	1/12/2015	13:09:00		1.07
S26/0846	9/03/2016	12:39:00		0.83
S26/0846	13/06/2016	13:28:00		0.72
S27/0009	17/09/2015	9:56:00	<1.00	2.9
S27/0009	8/12/2015	11:57:00	<1.00	3.4
S27/0009	7/03/2016	9:46:00	<1.00	2.7
S27/0009	20/06/2016	10:50:00	<1.00	2.7
S27/0070	17/09/2015	10:44:00	<1.00	0.48
S27/0070	8/12/2015	12:50:00	<1.00	0.17
S27/0070	7/03/2016	10:58:00	<1.00	0.164

S27/0070	20/06/2016	11:35:00	<1.00	0.98
S27/0136	17/09/2015	13:50:00	<1.00	5.6
S27/0136	8/12/2015	14:07:00	<1.00	8.6
S27/0136	8/03/2016	13:23:00	<1.00	3.2
S27/0136	15/06/2016	11:51:00	<1.00	2.6
S27/0156	17/09/2015	11:40:00	<1.00	0.009
S27/0156	2/12/2015	13:18:00	<1.00	0.089
S27/0156	7/03/2016	12:39:00	<1.00	0.008
S27/0156	20/06/2016	12:40:00	<1.00	0.007
S27/0202	9/09/2015	11:35:00	<1.00	2.9
S27/0202	1/12/2015	11:33:00	<1.00	2.9
S27/0202	9/03/2016	11:03:00	<1.00	2.5
S27/0202	13/06/2016	12:46:00	<1.00	2.3
S27/0268	14/09/2015	8:52:00		<0.0200000
S27/0268	9/12/2015	7:18:00		<0.00200000
S27/0268	3/03/2016	8:35:00		<0.00200000
S27/0268	14/06/2016	9:08:00		0.005
S27/0283	15/09/2015	13:40:00		<0.00200000
S27/0283	10/12/2015	0:00:00		
S27/0283	8/03/2016	7:29:00		<0.00200000
S27/0283	23/06/2016	9:02:00		<0.200000
S27/0299	10/09/2015	15:40:00	<1.00	0.8
S27/0299	3/12/2015	14:15:00	<1.00	0.39
S27/0299	14/04/2016	14:28:00	<1.00	0.32
S27/0299	22/06/2016	15:33:00	<1.00	0.3
S27/0344	10/09/2015	10:41:00	<1.00	0.24
S27/0344	3/12/2015	9:54:00	<1.00	0.046
S27/0344	15/04/2016	10:11:00	<1.00	<0.00200000
S27/0344	22/06/2016	10:51:00	<1.00	0.022
S27/0389	15/09/2015	11:32:00	<1.00	0.094
S27/0389	10/12/2015	8:59:00	<1.00	0.31
S27/0389	8/03/2016	9:34:00	<1.00	0.46
S27/0389	16/06/2016	12:04:00	<1.00	0.008
S27/0396	15/09/2015	12:15:00	<1.00	5.8
S27/0396	10/12/2015	7:50:00	<1.00	0.24
S27/0396	8/03/2016	8:47:00	<1.00	0.133
S27/0396	16/06/2016	13:45:00	<1.00	0.189
S27/0433	14/09/2015	11:18:00		<0.0200000

S27/0433	9/12/2015	9:46:00		<0.00200000
S27/0433	3/03/2016	11:33:00		<0.00200000
S27/0433	14/06/2016	11:07:00		<0.00200000
S27/0435	14/09/2015	10:30:00		0.003
S27/0435	9/12/2015	8:57:00		<0.00200000
S27/0435	3/03/2016	10:22:00		<0.00200000
S27/0435	15/06/2016	9:39:00		<0.00200000
S27/0442	14/09/2015	11:52:00		0.014
S27/0442	9/12/2015	10:32:00		<0.00200000
S27/0442	3/03/2016	12:17:00		0.009
S27/0442	14/06/2016	11:52:00		0.024
S27/0495	14/09/2015	9:34:00		0.004
S27/0495	9/12/2015	8:00:00		<0.00200000
S27/0495	3/03/2016	9:12:00		0.108
S27/0495	14/06/2016	10:08:00		<0.00200000
S27/0522	14/09/2015	14:15:00	<1.00	3.4
S27/0522	9/12/2015	13:45:00	<1.00	3.3
S27/0522	8/03/2016	11:55:00	<1.00	3.6
S27/0522	16/06/2016	15:01:00	<1.00	3.7
S27/0571	15/09/2015	10:03:00	<1.00	0.49
S27/0571	10/12/2015	11:02:00	<1.00	5.3
S27/0571	8/03/2016	10:25:00	<1.00	5.4
S27/0571	16/06/2016	11:24:00	<1.00	5.7
S27/0585	17/09/2015	8:45:00		0.002
S27/0585	8/12/2015	10:18:00		<0.00200000
S27/0585	7/03/2016	8:21:00		<0.00200000
S27/0585	20/06/2016	9:38:00		<0.00200000
S27/0588	10/09/2015	13:11:00	<1.00	<0.00200000
S27/0588	3/12/2015	12:00:00	<1.00	<0.00200000
S27/0588	2/03/2016	11:11:00	<1.00	<0.00200000
S27/0588	22/06/2016	12:01:00	<1.00	<0.00200000
S27/0594	10/09/2015	13:50:00		0.007
S27/0594	3/12/2015	12:35:00		0.03
S27/0594	15/04/2016	14:02:00		<0.00200000
S27/0594	22/06/2016	12:50:00		<0.0200000
S27/0602	14/09/2015	12:30:00		0.019
S27/0602	9/12/2015	11:16:00		<0.00200000
S27/0602	3/03/2016	13:58:00		0.01

S27/0602	14/06/2016	12:46:00		<0.00200000
S27/0607	10/09/2015	12:10:00		0.006
S27/0607	3/12/2015	11:10:00		0.03
S27/0607	2/03/2016	13:08:00		<0.00200000
S27/0607	22/06/2016	14:10:00		<0.200000
S27/0615	14/09/2015	13:18:00		<0.0200000
S27/0615	9/12/2015	12:38:00		<0.00200000
S27/0615	3/03/2016	12:57:00		0.002
S27/0615	14/06/2016	14:07:00		<0.00200000
S27/0681	15/09/2015	8:50:00	<1.00	0.78
S27/0681	10/12/2015	9:50:00	<1.00	0.74
S27/0681	15/04/2016	12:01:00	<1.00	0.115
S27/0681	23/06/2016	11:06:00	<1.00	0.27
T26/0003	16/09/2015	10:40:00	<1.00	5.1
T26/0003	30/11/2015	9:13:00	<1.00	1.37
T26/0003	4/03/2016	9:41:00	<1.00	0.26
T26/0003	17/06/2016	11:03:00	<1.00	1.19
T26/0087	16/09/2015	13:19:00		2.3
T26/0087	30/11/2015	11:52:00		1.14
T26/0087	4/03/2016	12:42:00		0.122
T26/0087	17/06/2016	13:46:00		0.79
T26/0099	16/09/2015	12:33:00	<1.00	2.7
T26/0099	30/11/2015	10:59:00	<1.00	2.9
T26/0099	4/03/2016	11:22:00	<1.00	2.8
T26/0099	17/06/2016	12:53:00	<1.00	2.3
T26/0206	16/09/2015	11:42:00	<1.00	2.1
T26/0206	30/11/2015	10:04:00	<1.00	2.6
T26/0206	4/03/2016	10:36:00	<1.00	1.75
T26/0206	17/06/2016	12:00:00	<1.00	2
T26/0259	24/09/2015	10:05:00	<1.00	2.2
T26/0259	30/11/2015	8:33:00	<1.00	0.98
T26/0259	4/03/2016	7:15:00	<1.00	0.39
T26/0259	17/06/2016	8:53:00	<1.00	0.76
T26/0332	9/09/2015	8:34:00	<1.00	0.71
T26/0332	1/12/2015	8:27:00	<1.00	0.81
T26/0332	15/04/2016	8:41:00	<1.00	0.32
T26/0332	13/06/2016	8:59:00	<1.00	0.5
T26/0413	16/09/2015	9:45:00		0.008

T26/0413	30/11/2015	7:44:00		<0.00200000
T26/0413	4/03/2016	8:43:00		<0.00200000
T26/0413	17/06/2016	10:08:00		<0.00200000
T26/0430	10/09/2015	8:59:00	<1.00	2.2
T26/0430	30/11/2015	12:49:00	<1.00	1.81
T26/0430	4/03/2016	13:14:00	9	0.61
T26/0430	13/06/2016	14:16:00	1	0.94
T26/0489	10/09/2015	8:20:00		11.1
T26/0489	3/12/2015	7:14:00		10.4
T26/0489	2/03/2016	7:42:00		9.4
T26/0489	23/06/2016	14:27:00		10.4
T26/0538	9/09/2015	15:25:00	<1.00	8.7
T26/0538	1/12/2015	7:18:00	<1.00	10.5
T26/0538	13/06/2016	0:00:00		
T27/0063	16/09/2015	8:13:00	<1.00	1
T27/0063	10/12/2015	13:17:00	<1.00	1.06
T27/0063	29/02/2016	8:23:00	<1.00	0.92
T27/0063	20/06/2016	15:00:00	<1.00	1.03