Groundwater Quality State of the Environment monitoring programme

Annual data report, 2017/18

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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 2017 to 30 June 2018 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). A trend report has been produced recently for nitrate levels (see Baker 2017).

2. Overview of groundwater quality 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. In 2016/17 five bores on private land were unable to be sampled due to loss of access, sampling point and/or decommissioning of the bore (see Tidswell 2018). A groundwater quality state of environment network review is in progress, where these five bores will either be replaced or officially removed from the GQSoE network.

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, of which 66 are currently monitored (Figure 2.1 and Appendix 1). In 2016/17 five bores on private land were unable to be sampled due to loss of access, sampling point and/or decommissioning of the bore (see Tidswell 2018). None the five bores were sampled during the 2017/18 monitoring period. During the 2017/18 monitoring period, eight wells were only sampled two or three times. Brief explanations as to why wells could not be sampled are included below:

- R25/5165 was unable to be sampled in March 2018 due to the bore being dry.
- R26/6503 was unable to be sampled in September 2017 due to the irrigation pump being repaired.

- R26/6587 was unable to be sampled in December 2017 and June 2018 due to the sample point being disconnected and bore undergoing maintenance.

- R27/1180 was unable to be sampled due to the public supply bore not being used due to the presence of *E-coli*. This resulted in the bore being unable to be purged to collect a groundwater sample.

- S27/0433 and S27/0435 were unable to be sampled due to temporary restricted access.

- S27/0615 was unable to be sampled in June 2018 due to pump malfunction prohibiting the collection of a sample from the sampling point.

- T26/0087 was unable to be sampled in June 2018 due to the pump having been removed from the bore.

Faecal indicator bacteria (*Escherichia coli (E.coli)* is only tested for in the wells used for potable water supplies or in shallow groundwater wells, which total 43 of the 67 GQSoE sites currently monitored.

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 wells located in each Whaitua are:

- Ruamahanga – 45

- Kapiti Coast – 11

- Wellington and Hutt Valley – 9

- Wairarapa Coast - 1

- Porirua - 0

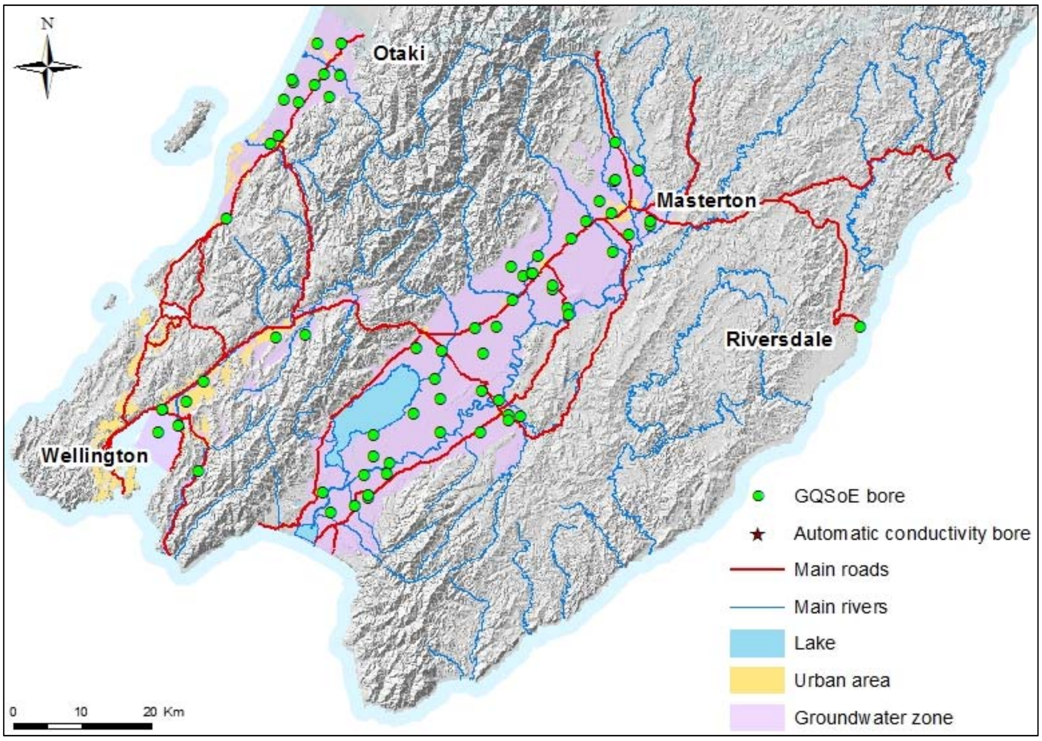

Figure 2.1: Location of groundwater quality monitoring sites in the Wellington Region. Automated saline intrusion (conductivity) groundwater monitoring sites are also shown (red stars).

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 30 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 2017/18 monitoring year. Results are discussed by whaitua.

For the 2017/18 sampling year, two key indicators of groundwater contamination (typically arising from land use intensification and/or on-site wastewater disposal systems) have been evaluated: nitrate-nitrogen (nitrate) and *E. coli* bacteria.

Details of the analytical methods used by the laboratory are provided in Appendix 2. Summary statistics were calculated using the programming language R. 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) 2017/18 Summary

Median nitrate concentrations across the region were low (<3 mg/L[1]) in most of the 66 wells monitored during 2016/17 (Figure 3.1). When assessed by whaitua, the following is noted:

- In the Ruamahanga Whaitua, eight of the 45 wells (17.8%) had elevated (3-7 mg/L) concentrations of nitrate, while a further two wells of 45 monitored (8.9%) had median nitrate concentrations in the highly elevated range (7-11.3 mg/L);
- In the Kapiti Whaitua, two of the 11 wells (18.2%) had elevated (3-7 mg/L) concentrations of nitrate while a further individual well of the 11 monitored (4.5%) had median nitrate concentrations in the highly elevated 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 0.71 mg/L.

[1] Groundwater nitrate nitrogen (nitrate) concentrations are evaluated in terms of likely human influence. Although, groundwater in New Zealand rarely has nitrate concentration above 1 mg/L naturally, a threshold of 3 mg/L has been adopted as a means of defining nitrate contamination from anthropogenic sources (Close et al. 2001). This threshold has been used by Greater Wellington in previous 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.

Maximum nitrate concentrations in well T26/0538 at Te Ore Ore were above the Ministry of Health Drinking-water Standards (DWSNZ) 2008 maximum acceptable value (MAV) concentration of 11.3 mg/L in December 2017 (13.2 mg/L).

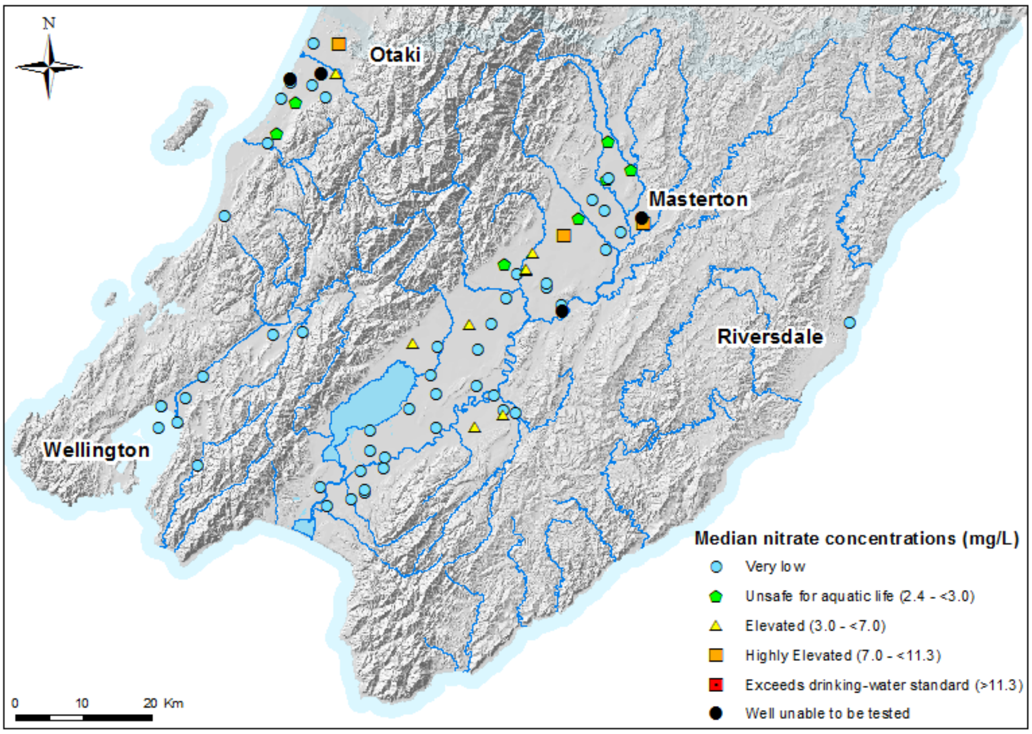

Figure 3.1: Median nitrate-nitrogen (nitrate) concentrations in GQSoE wells monitored quarterly during 2017/18

Overall, elevated nitrate was found in wells where previous GQSoE 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 oxygen rich groundwater. All 11 wells which recorded elevated concentrations of nitrate were from wells shallower than 35 meters.

(b) Effect on surface water

Groundwater discharges from aquifers into a number of surface water bodies throughout the region and there is the potential that groundwater high in nitrate could contribute to the decline of surface water quality. The 2000 Australia New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 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 33 of the 66 (50%) wells monitored during 2017/18 (see Figure 3.2). These wells were distributed across the Whaitua as follows:

- 21 (of 45) were in the Ruamahanga;
- 6 (of 11) were in Kapiti;
- 5 (of 9) were in the Hutt, and
- 1 was at Riversdale

In addition to exceeding the ANZECC (2000) trigger value, median nitrate concentrations in 18 of the 33 wells (54.6%) were also above the Hickey (2013) threshold for aquatic toxicity (≤ 2.4 mg/L)[2].

Of the 18 sites exceeding the threshold for aquatic toxicity in 2016/17 (≤ 2.4 mg/L), three were Category A aquifers (direct connection to surface water), 12 Category B aquifers (moderate degree of connectivity to surface water) and three were Category C aquifers (not directly connected to surface water) (see Figure 3.2).

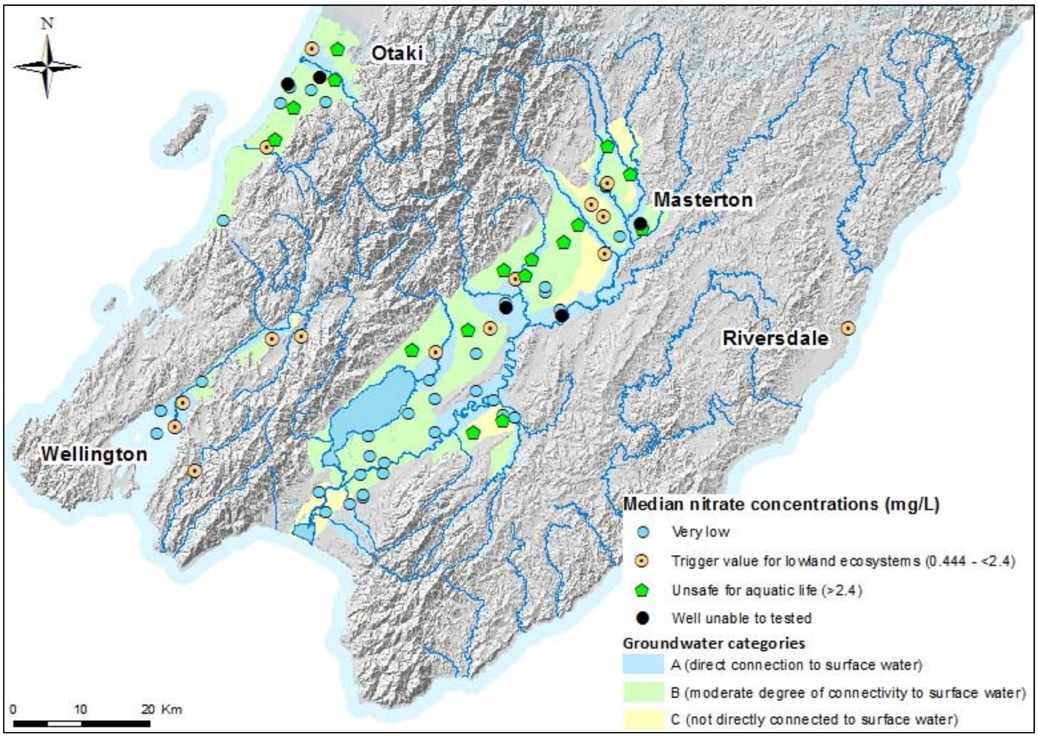

Figure 3.2: Median nitrate-nitrogen (nitrate) concentrations in GQSoE wells monitored quarterly during 2017/18 and groundwater categories showing degree of groundwater connectivity to surface water

The wells located in Category A aquifers were S25/5125 located in the Otaki groundwater management zone alongside the Otaki River, S26/0117 and S26/0467 in the Mangatarere groundwater management zone near Carterton alongside the Mangatarere River, and T26/0259 located in the Upper Ruamahanga groundwater management zone alongside the Upper Ruamahanga

[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.

River. S26/0117 and T26/0259 are in rural lifestyle areas, but also downgradient of dairying land, while S26/0467 is located in the middle of a dairy farming area in the Wairarapa. S25/5125 is located in the middle of a horticultural (pip/stone fruit) area on the Kapiti Coast.

3.2.2 *E. coli*

The DWSNZ (2008) uses *E. coli* as an indicator[3] of faecal contamination in drinking water. For drinking water supplies, *E. coli* counts should be below the MAV of <1 cfu/100mL. As set out in Section 2.2, 43 GQSoE wells were tested for *E. coli*.

- *E. coli* was not detected (i.e. < 1 cfu/100mL) in 31 of the 43 (72.1%) wells tested.

- *E. coli* was detected (ie, ≥ 1 cfu/100mL) on one or more occasions in 12 of the 43 (30.2%) wells tested (Figure 3.3):

The highest *E. coli* counts (200 and 340 cfu/100mL) were recorded in well S26/0467 located in the Mangatarere groundwater management zone near Carterton. This well is shallow in depth and draws water from the unconfined gravel aquifer for domestic supply. Historically, this well has shown *E. coli* counts above the DWSNZ (2008) MAV only a couple of times; however *E. coli* above the MAV has been consistently found in this well since September 2017. This may be due to the water table being shallow (2.24 m below ground level in June 2018) and therefore *E. coli* contamination may be a result of the surrounding landuse or it could be more localised and a result of discharge from a nearby septic tank(s).

The second highest *E. coli* count (100 cfu/100mL) was recorded in well R27/6418, located in Wainouimata. This well is shallow in depth and has a large diameter. Historically, this well has periodically shown *E. coli* counts above the DWSNZ (2008) MAV. Whilst this well is covered with a lid made of sheet metal, this is not considered to be a secure well head. Therefore, the well is likely contaminated directly through the unsecure well head and/or as a result of surrounding landuse due to the bore drawing water from the shallow, unconfined gravel aquifer. This well is used for potable supply in addition to irrigation.

The remaining 10 wells had *E. coli* counts ranging from 1 to 32 cfu/100mL. All wells that had positive *E. coli* counts during the 2017/18 monitoring period had tested positive for bacteriological contamination historically and are located in unconfined aquifers in either Category A (direct connection to surface water) and Category B (moderate degree of connectivity to surface water) groundwater (Figure 3.3).

[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.

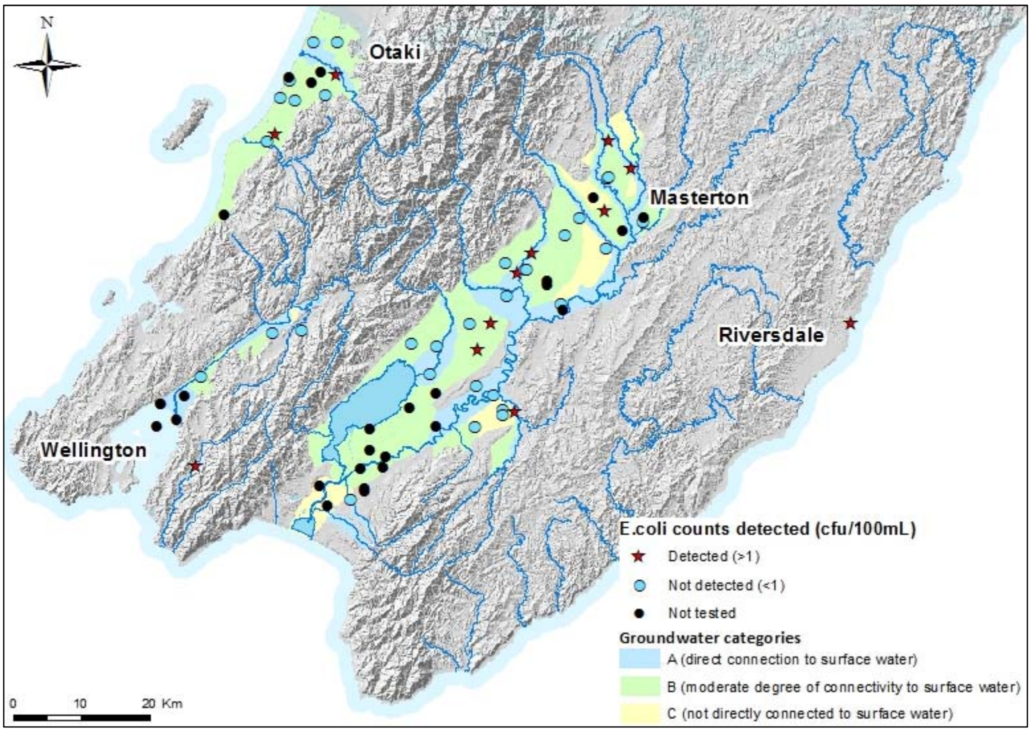

Figure 3.3: Detection of *E. coli* bacteria in GQSoE wells monitored quarterly over 2017/18

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- Tim Baker for providing data quality assurance.

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
BQ33/0032	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

*wells not sampled from 2016 – 2018 due to loss of access, sampling point and/or the bore was decommissioned

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 well for a predetermined amount of time to remove any standing water and monitoring the pumped water continuously until field measurements (e.g. conductivity) stabilise. Field measurements (temperature, conductivity, pH, dissolved oxygen and ORP) 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 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 well 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 well 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 well 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 –YSI Professional Plus Meters	0.01 ˚C
Dissolved oxygen	Field meter –YSI Professional Plus Meters	0.01 mg/L
Electrical conductivity	Field meter –YSI Professional Plus Meters	0.1 µS/cm
pH	Field meter –YSI Professional Plus Meters	0.01 units
ORP	Field meter –YSI Professional Plus Meters	
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
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 taken from APHA. This does not indicate whether the 'Sum of Anions' or the	0.1 %

Variable	Method Used	Detection Limit
	'Sum of Cations' produced a higher value. APHA APHA 1030 E 22^{nd} 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 22^{st} 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 22^{st} 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		0.01	4
R25/5100	1774552	5479451	N	4	0.0055	4
R25/5135	1779152	5481483	not tested		0.001	4
R25/5165	1776019	5481886	N	3	0.2	3
R25/5190	1776678	5478988	N	4	2.75588	4
R25/5233	1779398	5487565	N	4	2.006495	4
R26/6503	1766253	5462295	not tested		0.016	3
R26/6587	1772634	5473057	N	2	0.957488	2
R26/6624	1773933	5474297	Y	4	2.75	4
R27/0320	1756996	5434508	not tested		0.003896	4
R27/1137	1773406	5444956	N	4	1.582785	4
R27/1171	1756493	5431227	not tested		0.0034	4
R27/1180	1760435	5435698	not tested		0.98	3
R27/1182	1759274	5432161	not tested		0.71812	4
R27/1183	1763084	5438691	N	4	0.280046	4
R27/1265	1756998	5434516	not tested		0.111036	4
R27/6418	1762218	5425695	Y	4	1.29062	4
R27/6833	1777716	5445324	N	4	0.829334	4
S25/5125	1782734	5483013	Y	4	3.13371	4
S25/5200	1781183	5479785	N	4	0.001	4
S25/5322	1782983	5487486	N	4	9.393685	4
S26/0117	1811483	5456780	Y	4	3.32894	4
S26/0223	1816203	5459285	N	4	9.070235	4
S26/0299	1818355	5461870	N	4	2.60148	4
S26/0439	1807492	5455180	N	4	2.787985	4
S26/0457	1807657	5450331	N	4	0.428637	4
S26/0467	1809272	5453850	Y	4	2.08154	4
S26/0568	1813487	5451921	not tested		0.01	4
S26/0576	1813462	5452534	not tested		0.00207	4
S26/0705	1810472	5454279	N	4	4.2693	4
S26/0762	1815702	5449348	N	4	0.01	4
S26/0824	1810547	5454381	N	4	4.923905	4
S27/0009	1793895	5443481	N	4	3.261405	4
S27/0070	1797508	5443111	N	4	0.596727	4
S27/0136	1802217	5446389	N	4	4.70943	4
S27/0156	1803403	5442776	Y	4	0.014091	4

Site	Easting	Northing	*E.coli* detected	No. of *E.coli* samples	Median NO3-N	No. of NO3-N samples
S27/0202	1805461	5446520	Y	3	2.07791	3
S27/0268	1793453	5434055	not tested		0.002	4
S27/0283	1797276	5436168	not tested		0.01	4
S27/0299	1796504	5438936	N	3	0.323118	3
S27/0344	1803348	5437340	N	2	0.001	2
S27/0389	1807205	5433792	N	4	0.0265	4
S27/0396	1805859	5435962	N	4	0.432704	4
S27/0433	1787692	5427839	not tested		0.003	3
S27/0435	1787608	5430805	not tested		0.004	3
S27/0442	1789891	5426884	not tested		0.001604	4
S27/0495	1797227	5431330	not tested		0.0065	4
S27/0522	1803032	5431324	N	4	3.15046	4
S27/0571	1807158	5433014	N	4	5.2	4
S27/0585	1780321	5422598	not tested		0.001	4
S27/0588	1784844	5420713	N	4	0.0025	4
S27/0594	1781351	5419721	not tested		0.002066	4
S27/0602	1789626	5425302	not tested		0.0055	4
S27/0607	1786289	5425037	not tested		0.004123	4
S27/0615	1786805	5422158	not tested		0.003	3
S27/0681	1808952	5433542	Y	3	0.389792	3
T26/0003	1822559	5473237	Y	4	2.91198	4
T26/0087	1820296	5464750	not tested		1.19452	3
T26/0099	1822518	5467619	N	4	2.7765	4
T26/0206	1822582	5467829	N	4	2.027475	4
T26/0259	1825997	5469120	Y	4	2.75453	4
T26/0332	1822231	5457402	N	4	0.940336	4
T26/0413	1824486	5459979	not tested		0.001	4
T26/0430	1822131	5463028	Y	4	1.77317	4
T26/0538	1827738	5461169	N	4	10.11227	4
T27/0063	1858025	5446630	Y	4	0.710518	4

Appendix 4: Raw data

Site Name	Easting	Northing	Date	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
BQ33/0032	1786750	5421805	07-Sep-2017	-	0.02
BQ33/0032	1786750	5421805	05-Dec-2017	-	0.18
BQ33/0032	1786750	5421805	13-Mar-2018	-	0.02
BQ33/0032	1786750	5421805	21-Jun-2018	-	0.02
R25/5100	1774552	5479451	18-Sep-2017	1	0.002
R25/5100	1774552	5479451	09-Jan-2018	1	0.002
R25/5100	1774552	5479451	05-Mar-2018	1	0.02
R25/5100	1774552	5479451	05-Jun-2018	1	0.02
R25/5135	1779152	5481483	19-Sep-2017	-	0.02
R25/5135	1779152	5481483	09-Jan-2018	-	0.002
R25/5135	1779152	5481483	05-Mar-2018	-	0.002
R25/5135	1779152	5481483	06-Jun-2018	-	0.002
R25/5165	1776019	5481886	18-Sep-2017	1	0.2
R25/5165	1776019	5481886	09-Jan-2018	1	0.2
R25/5165	1776019	5481886	05-Jun-2018	1	0.223083
R25/5190	1776678	5478988	18-Sep-2017	1	3.9
R25/5190	1776678	5478988	09-Jan-2018	1	2.6
R25/5190	1776678	5478988	05-Mar-2018	1	2.91176
R25/5190	1776678	5478988	22-Jun-2018	1	1.83
R25/5233	1779398	5487565	18-Sep-2017	1	1.97
R25/5233	1779398	5487565	10-Jan-2018	1	2.1
R25/5233	1779398	5487565	08-Mar-2018	1	2.04299
R25/5233	1779398	5487565	06-Jun-2018	1	1.77129
R26/6503	1766253	5462295	10-Jan-2018	-	0.016
R26/6503	1766253	5462295	04-Apr-2018	-	0.0140997
R26/6503	1766253	5462295	06-Jun-2018	-	0.0180123
R26/6587	1772634	5473057	18-Sep-2017	1	1.13
R26/6587	1772634	5473057	08-Mar-2018	1	0.784975
R26/6624	1773933	5474297	19-Sep-2017	1	2.8
R26/6624	1773933	5474297	10-Jan-2018	1	2.7
R26/6624	1773933	5474297	08-Mar-2018	1	2.61089
R26/6624	1773933	5474297	06-Jun-2018	1	2.82638
R27/0320	1756996	5434508	20-Sep-2017	-	0.009
R27/0320	1756996	5434508	07-Dec-2017	-	0.002
R27/0320	1756996	5434508	07-Mar-2018	-	0.002
R27/0320	1756996	5434508	07-Jun-2018	-	0.0067926
R27/1137	1773406	5444956	20-Sep-2017	1	2.1

Site Name	Easting	Northing	Date	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
R27/1137	1773406	5444956	11-Jan-2018	1	1.46
R27/1137	1773406	5444956	06-Mar-2018	1	1.57603
R27/1137	1773406	5444956	08-Jun-2018	1	1.58954
R27/1171	1756493	5431227	28-Sep-2017	-	0.002
R27/1171	1756493	5431227	12-Jan-2018	-	0.002
R27/1171	1756493	5431227	06-Mar-2018	-	0.0047992
R27/1171	1756493	5431227	08-Jun-2018	-	0.0134541
R27/1180	1760435	5435698	04-Dec-2017	-	0.98
R27/1180	1760435	5435698	07-Mar-2018	-	0.996366
R27/1180	1760435	5435698	08-Jun-2018	-	0.919211
R27/1182	1759274	5432161	20-Sep-2017	-	0.73
R27/1182	1759274	5432161	11-Jan-2018	-	0.71
R27/1182	1759274	5432161	07-Mar-2018	-	0.72624
R27/1182	1759274	5432161	07-Jun-2018	-	0.70082
R27/1183	1763084	5438691	21-Sep-2017	1	0.3
R27/1183	1763084	5438691	30-Nov-2017	1	0.22
R27/1183	1763084	5438691	07-Mar-2018	1	0.267419
R27/1183	1763084	5438691	07-Jun-2018	1	0.292672
R27/1265	1756998	5434516	20-Sep-2017	-	0.13
R27/1265	1756998	5434516	07-Dec-2017	-	0.078
R27/1265	1756998	5434516	07-Mar-2018	-	0.108218
R27/1265	1756998	5434516	07-Jun-2018	-	0.113853
R27/6418	1762218	5425695	20-Sep-2017	1	1.48
R27/6418	1762218	5425695	11-Jan-2018	1	1.04
R27/6418	1762218	5425695	07-Mar-2018	1	1.10124
R27/6418	1762218	5425695	07-Jun-2018	100	1.69763
R27/6833	1777716	5445324	20-Sep-2017	1	0.85
R27/6833	1777716	5445324	11-Jan-2018	1	1.92
R27/6833	1777716	5445324	07-Mar-2018	1	0.519806
R27/6833	1777716	5445324	08-Jun-2018	1	0.808668
S25/5125	1782734	5483013	19-Sep-2017	5	3.7
S25/5125	1782734	5483013	10-Jan-2018	1	1.16
S25/5125	1782734	5483013	08-Mar-2018	6	2.56742
S25/5125	1782734	5483013	06-Jun-2018	1	4.00549
S25/5200	1781183	5479785	18-Sep-2017	1	0.002
S25/5200	1781183	5479785	09-Jan-2018	1	0.002
S25/5200	1781183	5479785	05-Mar-2018	1	0.002
S25/5200	1781183	5479785	05-Jun-2018	1	0.002
S25/5322	1782983	5487486	19-Sep-2017	1	8.9

Site Name	Easting	Northing	Date	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
S25/5322	1782983	5487486	10-Jan-2018	1	9.6
S25/5322	1782983	5487486	08-Mar-2018	1	9.2855
S25/5322	1782983	5487486	06-Jun-2018	1	9.50187
S26/0117	1811483	5456780	04-Sep-2017	1	4.1
S26/0117	1811483	5456780	04-Dec-2017	1	3.5
S26/0117	1811483	5456780	12-Mar-2018	3	2.9694
S26/0117	1811483	5456780	14-Jun-2018	1	3.15788
S26/0223	1816203	5459285	11-Sep-2017	1	8.7
S26/0223	1816203	5459285	12-Dec-2017	1	11.4
S26/0223	1816203	5459285	21-Mar-2018	1	9.44047
S26/0223	1816203	5459285	20-Jun-2018	1	8.19664
S26/0299	1818355	5461870	13-Sep-2017	1	2.6
S26/0299	1818355	5461870	07-Dec-2017	1	2.5
S26/0299	1818355	5461870	21-Mar-2018	1	2.60296
S26/0299	1818355	5461870	13-Jun-2018	1	3.35833
S26/0439	1807492	5455180	04-Sep-2017	1	2.7
S26/0439	1807492	5455180	04-Dec-2017	1	2.7
S26/0439	1807492	5455180	12-Mar-2018	1	2.89415
S26/0439	1807492	5455180	20-Jun-2018	1	2.87597
S26/0457	1807657	5450331	04-Oct-2017	1	0.82
S26/0457	1807657	5450331	08-Dec-2017	1	0.35
S26/0457	1807657	5450331	19-Mar-2018	1	0.369247
S26/0457	1807657	5450331	14-Jun-2018	1	0.488027
S26/0467	1809272	5453850	04-Sep-2017	200	2.6
S26/0467	1809272	5453850	04-Dec-2017	29	2.6
S26/0467	1809272	5453850	12-Mar-2018	340	1.49965
S26/0467	1809272	5453850	20-Jun-2018	12	1.56308
S26/0568	1813487	5451921	14-Sep-2017	-	0.002
S26/0568	1813487	5451921	04-Dec-2017	-	0.02
S26/0568	1813487	5451921	12-Mar-2018	-	0.02
S26/0568	1813487	5451921	20-Jun-2018	-	0.02
S26/0576	1813462	5452534	04-Sep-2017	-	0.002
S26/0576	1813462	5452534	04-Dec-2017	-	0.038
S26/0576	1813462	5452534	12-Mar-2018	-	0.002
S26/0576	1813462	5452534	20-Jun-2018	-	0.00314043
S26/0705	1810472	5454279	06-Sep-2017	1	4.3
S26/0705	1810472	5454279	14-Dec-2017	1	3.7
S26/0705	1810472	5454279	15-Mar-2018	1	4.3136
S26/0705	1810472	5454279	15-Jun-2018	1	4.2386

Site Name	Easting	Northing	Date	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
S26/0762	1815702	5449348	04-Sep-2017	1	0.02
S26/0762	1815702	5449348	04-Dec-2017	1	0.02
S26/0762	1815702	5449348	12-Mar-2018	1	0.02
S26/0762	1815702	5449348	20-Jun-2018	1	0.002
S26/0824	1810547	5454381	06-Sep-2017	1	5
S26/0824	1810547	5454381	06-Dec-2017	1	5.4
S26/0824	1810547	5454381	22-Mar-2018	1	4.84781
S26/0824	1810547	5454381	15-Jun-2018	1	4.7584
S27/0009	1793895	5443481	12-Sep-2017	1	3.6
S27/0009	1793895	5443481	08-Dec-2017	1	3.9
S27/0009	1793895	5443481	19-Mar-2018	1	2.92281
S27/0009	1793895	5443481	18-Jun-2018	1	2.81608
S27/0070	1797508	5443111	12-Sep-2017	1	0.84
S27/0070	1797508	5443111	08-Dec-2017	1	0.192
S27/0070	1797508	5443111	19-Mar-2018	1	0.522442
S27/0070	1797508	5443111	14-Jun-2018	1	0.671012
S27/0136	1802217	5446389	12-Sep-2017	1	4.8
S27/0136	1802217	5446389	14-Dec-2017	1	6.1
S27/0136	1802217	5446389	19-Mar-2018	1	4.56529
S27/0136	1802217	5446389	14-Jun-2018	1	4.61886
S27/0156	1803403	5442776	12-Sep-2017	9	0.006
S27/0156	1803403	5442776	08-Dec-2017	1	0.075
S27/0156	1803403	5442776	19-Mar-2018	1	0.0122076
S27/0156	1803403	5442776	18-Jun-2018	1	0.0159747
S27/0202	1805461	5446520	12-Dec-2017	3	1.51
S27/0202	1805461	5446520	21-Mar-2018	2	2.07791
S27/0202	1805461	5446520	14-Jun-2018	1	2.39708
S27/0268	1793453	5434055	07-Sep-2017	-	0.003
S27/0268	1793453	5434055	05-Dec-2017	-	0.002
S27/0268	1793453	5434055	13-Mar-2018	-	0.2
S27/0268	1793453	5434055	21-Jun-2018	-	0.002
S27/0283	1797276	5436168	08-Sep-2017	-	0.02
S27/0283	1797276	5436168	13-Dec-2017	-	0.02
S27/0283	1797276	5436168	20-Mar-2018	-	0.02
S27/0283	1797276	5436168	22-Jun-2018	-	0.002
S27/0299	1796504	5438936	06-Sep-2017	1	0.32
S27/0299	1796504	5438936	06-Dec-2017	1	0.36
S27/0299	1796504	5438936	15-Mar-2018	1	0.323118
S27/0344	1803348	5437340	06-Sep-2017	-	

Site Name	Easting	Northing	Date	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
S27/0344	1803348	5437340	06-Dec-2017	1	0.002
S27/0344	1803348	5437340	15-Mar-2018	1	0.002
S27/0389	1807205	5433792	14-Sep-2017	1	0.32
S27/0389	1807205	5433792	13-Dec-2017	1	0.052
S27/0389	1807205	5433792	20-Mar-2018	1	0.002
S27/0389	1807205	5433792	12-Jun-2018	32	0.002
S27/0396	1805859	5435962	08-Sep-2017	1	1.51
S27/0396	1805859	5435962	13-Dec-2017	1	0.39
S27/0396	1805859	5435962	20-Mar-2018	1	0.287452
S27/0396	1805859	5435962	22-Jun-2018	1	0.475407
S27/0433	1787692	5427839	07-Sep-2017	-	0.003
S27/0433	1787692	5427839	05-Dec-2017	-	0.002
S27/0433	1787692	5427839	13-Mar-2018	-	0.0555124
S27/0435	1787608	5430805	07-Sep-2017	-	0.004
S27/0435	1787608	5430805	05-Dec-2017	-	0.002
S27/0435	1787608	5430805	13-Mar-2018	-	0.02
S27/0442	1789891	5426884	07-Sep-2017	-	0.002
S27/0442	1789891	5426884	05-Dec-2017	-	0.002
S27/0442	1789891	5426884	13-Mar-2018	-	0.0038657
S27/0442	1789891	5426884	21-Jun-2018	-	0.002207
S27/0495	1797227	5431330	07-Sep-2017	-	0.003
S27/0495	1797227	5431330	05-Dec-2017	-	0.002
S27/0495	1797227	5431330	13-Mar-2018	-	0.02
S27/0495	1797227	5431330	21-Jun-2018	-	0.02
S27/0522	1803032	5431324	08-Sep-2017	1	3.1
S27/0522	1803032	5431324	13-Dec-2017	1	3.3
S27/0522	1803032	5431324	20-Mar-2018	1	3.18566
S27/0522	1803032	5431324	15-Jun-2018	1	3.11526
S27/0571	1807158	5433014	08-Sep-2017	1	5.3
S27/0571	1807158	5433014	13-Dec-2017	1	5.1
S27/0571	1807158	5433014	20-Mar-2018	1	5.04483
S27/0571	1807158	5433014	12-Jun-2018	1	5.53029
S27/0585	1780321	5422598	12-Sep-2017	-	0.002
S27/0585	1780321	5422598	08-Dec-2017	-	0.02
S27/0585	1780321	5422598	19-Mar-2018	-	0.002
S27/0585	1780321	5422598	18-Jun-2018	-	0.002
S27/0588	1784844	5420713	06-Sep-2017	1	0.004
S27/0588	1784844	5420713	14-Dec-2017	1	0.002
S27/0588	1784844	5420713	15-Mar-2018	1	0.02

Site Name	Easting	Northing	Date	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
S27/0588	1784844	5420713	12-Jun-2018	1	0.002
S27/0594	1781351	5419721	06-Sep-2017	-	0.002
S27/0594	1781351	5419721	06-Dec-2017	-	0.002
S27/0594	1781351	5419721	15-Mar-2018	-	0.02
S27/0594	1781351	5419721	19-Jun-2018	-	0.00313175
S27/0602	1789626	5425302	14-Sep-2017	-	0.002
S27/0602	1789626	5425302	05-Dec-2017	-	0.002
S27/0602	1789626	5425302	13-Mar-2018	-	0.0243549
S27/0602	1789626	5425302	21-Jun-2018	-	0.02
S27/0607	1786289	5425037	06-Sep-2017	-	0.004
S27/0607	1786289	5425037	06-Dec-2017	-	0.002
S27/0607	1786289	5425037	15-Mar-2018	-	0.02
S27/0607	1786289	5425037	19-Jun-2018	-	0.00424675
S27/0615	1786805	5422158	07-Sep-2017	-	0.003
S27/0615	1786805	5422158	05-Dec-2017	-	0.002
S27/0615	1786805	5422158	13-Mar-2018	-	0.0566544
S27/0681	1808952	5433542	08-Sep-2017	3	0.83
S27/0681	1808952	5433542	20-Mar-2018	1	0.254245
S27/0681	1808952	5433542	12-Jun-2018	1	0.389792
T26/0003	1822559	5473237	13-Sep-2017	1	4.3
T26/0003	1822559	5473237	07-Dec-2017	1	1
T26/0003	1822559	5473237	16-Mar-2018	1	1.52396
T26/0003	1822559	5473237	13-Jun-2018	8	4.65071
T26/0087	1820296	5464750	07-Dec-2017	-	0.96
T26/0087	1820296	5464750	16-Mar-2018	-	1.19452
T26/0087	1820296	5464750	13-Jun-2018	-	1.67515
T26/0099	1822518	5467619	13-Sep-2017	1	2.8
T26/0099	1822518	5467619	07-Dec-2017	1	2.9
T26/0099	1822518	5467619	16-Mar-2018	1	2.72658
T26/0099	1822518	5467619	13-Jun-2018	1	2.753
T26/0206	1822582	5467829	13-Sep-2017	1	2.1
T26/0206	1822582	5467829	07-Dec-2017	1	1.81
T26/0206	1822582	5467829	16-Mar-2018	1	1.9747
T26/0206	1822582	5467829	13-Jun-2018	1	2.08025
T26/0259	1825997	5469120	13-Sep-2017	1	5.8
T26/0259	1825997	5469120	07-Dec-2017	1	0.64
T26/0259	1825997	5469120	16-Mar-2018	1	1.20414
T26/0259	1825997	5469120	13-Jun-2018	1	4.30492
T26/0332	1822231	5457402	06-Sep-2017	1	1.44

Site Name	Easting	Northing	Date	E-Coli (cfu/100ml)	Nitrate Nitrogen (g/m3-N)
T26/0332	1822231	5457402	06-Dec-2017	1	1.24
T26/0332	1822231	5457402	15-Mar-2018	1	0.640671
T26/0332	1822231	5457402	19-Jun-2018	1	0.406746
T26/0413	1824486	5459979	13-Sep-2017	-	0.002
T26/0413	1824486	5459979	07-Dec-2017	-	0.002
T26/0413	1824486	5459979	16-Mar-2018	-	0.002
T26/0413	1824486	5459979	15-Jun-2018	-	0.002
T26/0430	1822131	5463028	11-Sep-2017	1	2.8
T26/0430	1822131	5463028	12-Dec-2017	2	1.59
T26/0430	1822131	5463028	21-Mar-2018	1	1.40663
T26/0430	1822131	5463028	11-Jun-2018	2	1.95634
T26/0538	1827738	5461169	11-Sep-2017	1	10.8
T26/0538	1827738	5461169	12-Dec-2017	1	13.2
T26/0538	1827738	5461169	21-Mar-2018	1	8.32156
T26/0538	1827738	5461169	18-Jun-2018	1	9.42453
T27/0063	1858025	5446630	11-Sep-2017	1	0.79
T27/0063	1858025	5446630	12-Dec-2017	1	0.57
T27/0063	1858025	5446630	21-Mar-2018	1	0.804113
T27/0063	1858025	5446630	11-Jun-2018	1	0.631035