CENTRAL PLAINS

WATER

# Central Plains Water Limited

# Annual Ground and Surface Water Monitoring Report

# 2017/2018

**Central Plains Water Limited**

| | Name | Position on Project | Signature | Date |
|---|---|---|---|---|
| **Prepared by:** | **Glenn Rutter** | **Environmental Scientist** | | **12-11-2018** |

**Ground and Surface Water Expert Review Panel Members for the 2017-18 Period**

John Sunckell (Chairman), John Bright, Peter Callander, Kyle Nelson, Ned Norton & Matthew Smith

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# 1. Purpose

The purpose of this report is to present all monitoring data collected by Central Plains Water Limited (CPWL) between 1 July 2017 and 30 June 2018, and to provide an interpretation of background conditions and impacts arising from consented activities. This report is prepared to comply with condition 25(a) of Schedule 2: Administrative Conditions of Resource Consent CRC165680. The condition requires that:

> *The consent holder shall prepare a report describing the results of the environmental monitoring outlined in the Ground and Surface Water Plan, for the period from 1 July to the following 30 June for each year.*

CPWL are required to measure a suite of parameters for river and stream water quality; lake water quality; and groundwater quality and quantity and report the results in this Ground and Surface Water Monitoring Report for the Period 1 July to the following 30 June each year. This report is required to include all the monitoring data and an interpretation of background conditions and impacts arising from the consented activities.

CPWL have developed a Ground and Surface Water Monitoring Plan (GSWP) (as required by Condition 18 of CRC165680), which is in two parts:

- Part I: includes an outline of CPWLs monitoring programme; and
- Part II: specifies (amongst other matters) trigger levels for monitored parameters.

The results from the monitoring programme are included in this report and are compared to applicable trigger levels.

## 2. Executive Summary

Alpine sourced CPWL irrigation water has been supplied to the Stage 1 area for three seasons and to the Sheffield Scheme area for one season. CPWL did not supply irrigation water to the Stage 2 area during 2017/18.

The effects of this irrigation water on surface water and groundwater flows, levels and quality are being monitored at multiple locations within, and downstream of, the CPWL supply area.

A range of environmental trigger values are, or will be in future, used by CPWL to draw attention to changes in the state of water flows, levels and quality in the Selwyn Waihora catchment that *may* be attributed to the operation of the CPWL scheme.

A large complex low pressure system brought heavy rain and gales to Canterbury during 20-22 July 2017. Following this event, some surface water bodies that hadn't been observed to be flowing often, or at all, since September 2015, started to carry water.

For the first monitoring period since CPWL began supplying water some groundwater levels in the Lowland monitoring network of bores reached their respective trigger levels. The trigger levels were exceeded in July or August 2017 but by November groundwater levels had receded back below the respective trigger levels. We will however, have to wait for further years of alpine water use and the associated reduction in groundwater abstraction, in order to be able to determine if groundwater levels are rising and flows in the lowland streams are recovering due to the influence of the Scheme.

In many instances where stream and lake water quality triggers were exceeded the results were found to be consistent with those from previous years (prior to the CPWL Scheme operating) so any elevated levels cannot be attributed to the operation of the CPWL Scheme.

Two surface water quality sites that have been monitored for 14 and 25 years respectively showed new maximum annual median and annual 95$^{th}$ Percentile Nitrate-N concentrations. The individual monthly monitoring results for 2017-18 that contributed to the new maximums showed a trend of decreasing Nitrate-N levels following on from the July rain event. A drop off in Nitrate-N from a July 2017 peak was not evident however, at all of the CPWL, monitoring sites that displayed new maximum annual median and annual 95$^{th}$ Percentile Nitrate-N concentrations in 2017-18. Therefore external environmental conditions such as past and/or recently intensified irrigated landuse (i.e., non-climatic factors), cannot be disregarded as contributing to the new maximum concentrations measured at some of the sites It is too early to be conclusive about the cause of elevated Nitrate-N and time will tell whether the new elevated concentrations will be sustained.

*E. coli* was detected in one Sheffield and five Stage 1 monitoring bores during 2017-18. On only a single occasion for both Stage 1 and Sheffield did a water sample return a level of *E. coli* greater than 2 MPN/100 ml). Subsequent retesting confirmed either, a 2MPN/100ml level, or absence of, *E. coli*. *E. coli* was detected in a significantly higher number of Stage 2 bore water samples compared to Stage 1 bore samples.

Nitrate-N levels measured in the Sheffield monitoring bores were found to be within ranges previously encountered before the Scheme commenced operating with one bore consistently exhibiting a Nitrate-N concentration at the lower end of the pre operating range.

New peak Nitrate-N concentrations were reached in 75% of Stage 1 bores and 80% of Stage 2 bores during 2017-18. Higher readings are not unexpected from bores screened across the water table located in an area that received above average rainfall following three years of below average rainfall. Further monitoring and time will tell whether the newly elevated concentrations are sustained during more normal seasonal weather conditions.

In general, the monitoring results obtained during the last three years of partial scheme operation are not sufficient to enable any definitive statements explaining the impact of the Scheme on water quality. This is particularly the case when CPWL monitoring results are compared against existing elevated, or increasing contaminant level trends, caused by historic land uses and practices whose effects are time-lagged. A wetter than average year following on from three drier than average years further complicates identification of any emerging trends from CPWL monitoring results. Additional years of water quality monitoring will be necessary, together with on-going assessment of CPWL facilitated, and other, land use change patterns in the catchment, to determine whether any significant change to existing elevated Nitrate-N concentrations or increasing trends, can be attributable to CPWL, previous land use changes and/or to improving practices through time.

With CPWL irrigation expected to commence Stage 2 later in 2018, further monitoring of the effects of the scheme will take place and future Ground and Surface Water Monitoring Reports will be able to present this information.

CPWL did not receive any complaints during 2017-18 concerning adverse environmental effects of the Scheme on groundwater or surface water, including more specifically, impacts on land drainage, or on-site wastewater systems.

# 3. Background

The CPWL Irrigation Scheme (the Scheme) is located in the Selwyn Waihora Zone, within the Selwyn District (Figure 1).

The Scheme is being developed in a staged manner. Once completed the Scheme will provide water to up to 47,600ha situated between the Rakaia and Waimakariri Rivers, the Foothills and State Highway 1.

The 23,000ha Stage 1 section of the Scheme was constructed during early 2014 – mid 2015, with first irrigation water supplied on 1 September 2015. The 4600ha Sheffield Scheme first supplied irrigation water on 25 November 2017. At the end of the 2017-18 monitoring period, the 20,000ha Stage 2 was under construction with first irrigation planned for September 2018 (see Figure 2).

The limit/target for nitrogen losses in Selwyn Waihora is 5,044.4 tonnes/year by 2037 (Table 11(i) of the Canterbury Land and Water Regional Plan (CLWRP)). A total of 358 tonnes/year (7% of the total) has been allocated to CPWL to allow for the conversion of dryland into irrigated land. This allocation is in addition to the assessed dryland nitrogen baseline of 621 tonnes (giving a total of 979 tonnes, as specified in Table 11(j) of the CLWRP).

The regulatory environment planning framework has changed since CPWL's original Take and Use Water permit was granted in 2010.

The Selwyn Waihora Zone Implementation Plan (ZIP, and ZIP Addendum) was developed by the Selwyn Waihora Zone Committee as a result of a two-year collaborative process, which commenced in December 2011. The ZIP identified a number of priority outcomes sought for the Zone which is considered to be over-allocated in terms of consented groundwater takes and nitrogen contamination in groundwater.

Variation 1 to the Land and Water Plan was therefore developed based on the recommendations in the Selwyn Waihora ZIP.

The original Central Plains Water Trust (CPWT) consent decision recognised the trade-off between benefits associated with increased baseflows in the lowland streams resulting from operation of the Scheme with the potential negative effects on land drainage and wastewater infrastructure in the lowland Central Plains area due to groundwater mounding.

While Variation 1 to the Land and Water Regional Plan (LWRP) has provided explicit recognition of the positive benefits associated with increased baseflows in lowland streams, it does not provide equivalent guidance in terms of thresholds for adverse effects on land drainage and wastewater infrastructure. It remained the task of CPWL to operate in accordance with the consent conditions to ensure appropriate management of environmental effects resulting from operation of the Scheme.

For a detailed summary of the background to CPWL and the Schemes' water use and nitrogen discharge consents please refer to Appendix 6.2: Central Plains Water Limited Annual Compliance Report 2015/2016 Irrigation Season; Section 4.

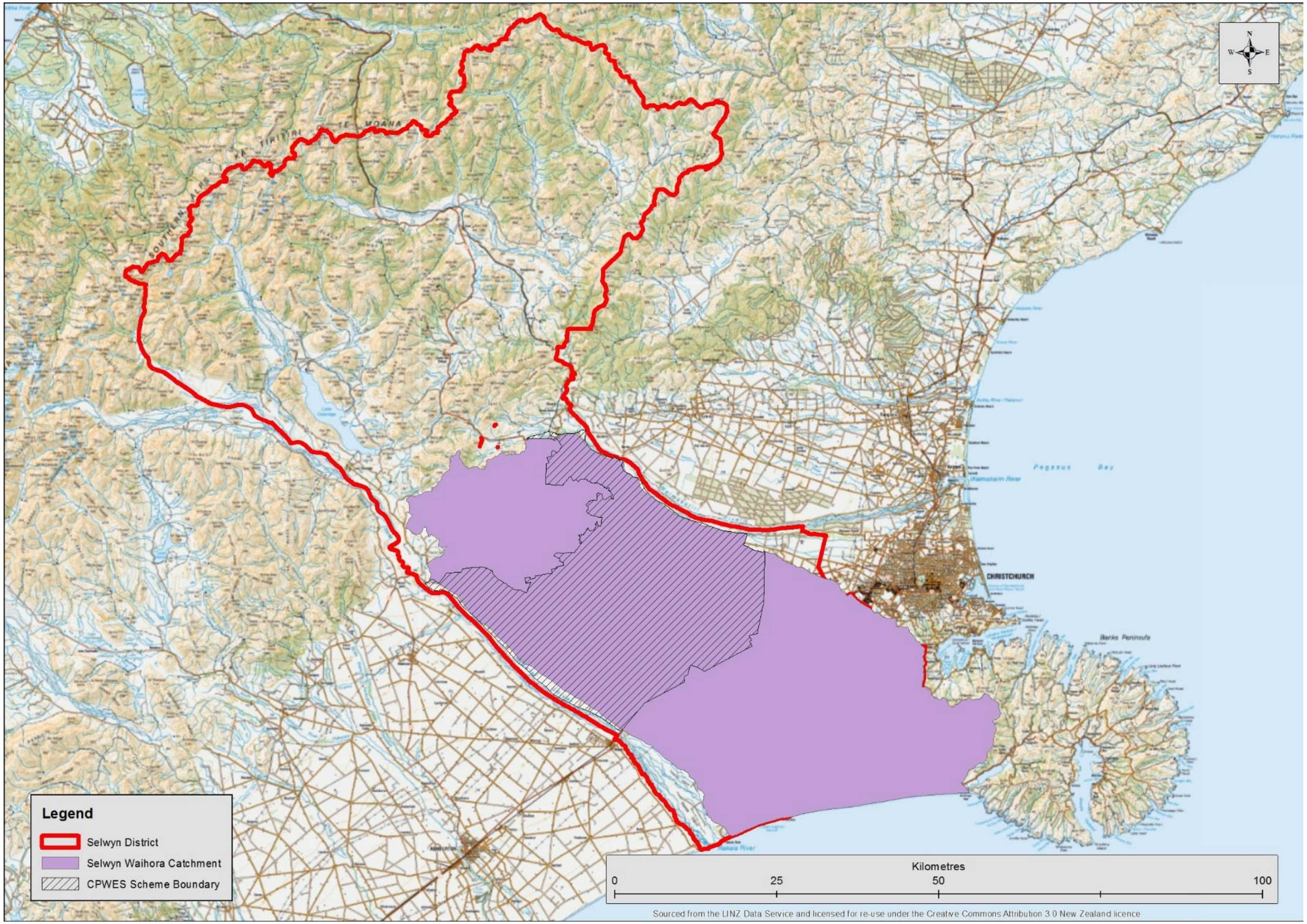



**Figure 1**. CPWL Scheme with the Selwyn Waihora Catchment

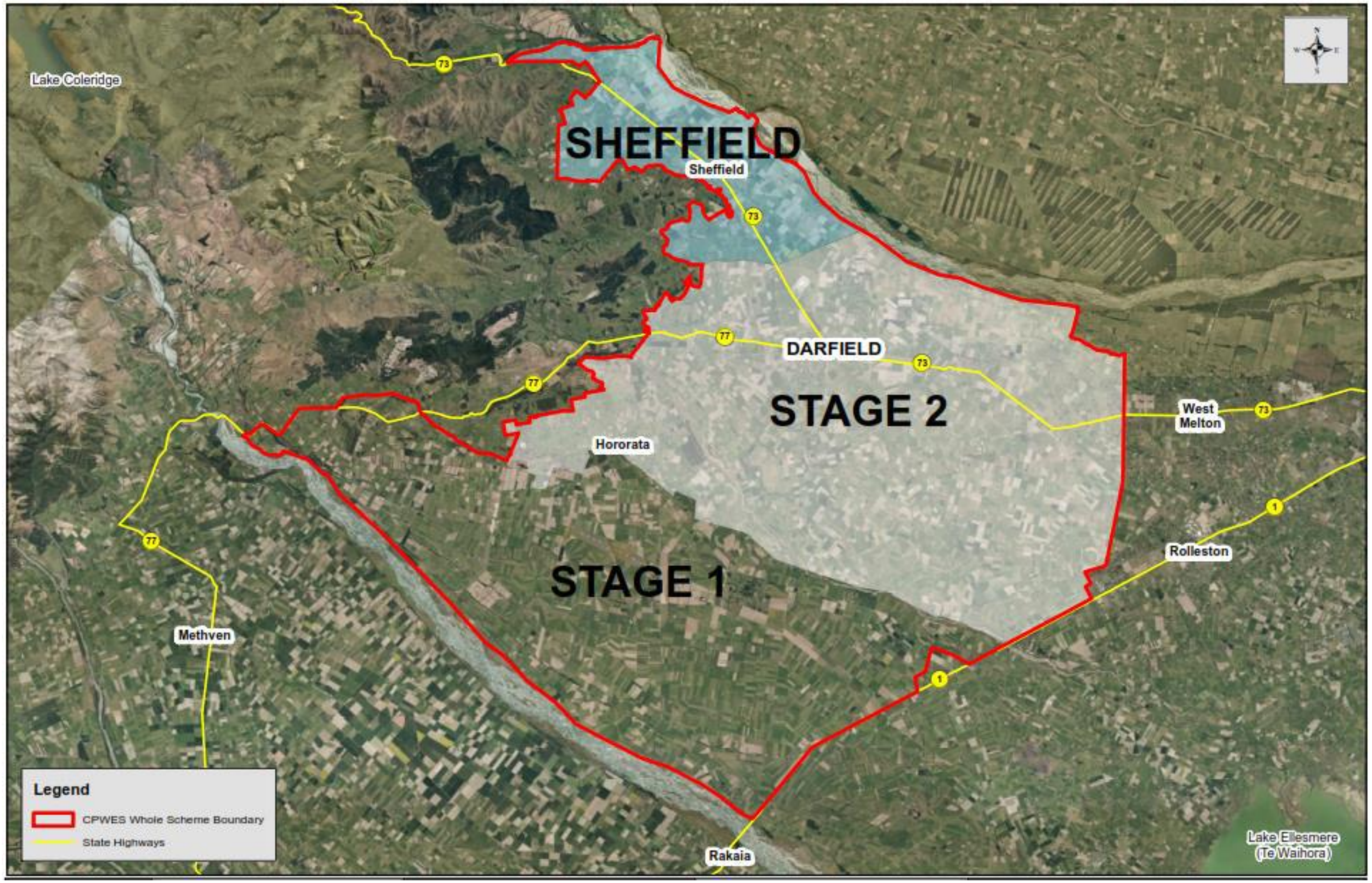



**Figure 2**. Scheme Overview showing Operational and Planned Stages

**Water Use**

During the 2017-18 irrigation season, Stage 1 farms introduced 79,620,983m$^3$ of alpine water into the catchment (2016-17 = 66,395,044m$^3$, 2015-16 = 91,092,984m$^3$), while 7,033,481m$^3$ was delivered to Sheffield farms. This can be compared to approximately 170,000,000m$^3$ and 33,000,000m$^3$ of rainfall that fell on S1 and Sheffield CPWL Irrigated land respectively over the same time period and 263,000,000m$^3$ and 46,000,000m$^3$ of rainfall over the 12 months from July 2017 – June 2018.

Irrigators who solely use CPWL water used an average of 2,486m$^3$/Ha. Irrigators who used a combination of groundwater and CPWL water used an average of 4,518m$^3$/Ha, comprising an average of 1428m$^3$/Ha of groundwater and 3090m$^3$/Ha of CPWL water.

Stage 1 CPWL shareholders abstracted 18,354,898m$^3$ of groundwater during 2017-18 (2016-17 = 15,228,020m$^3$, 2015-16 = 20,825,642m$^3$) of groundwater. 875,916m$^3$ of groundwater was abstracted by Sheffield CPWL Shareholders during the 2017-18 Irrigation season.

Figure 3 shows the source of water for Stage 1 Shareholder properties during the irrigation season. From the 2015-16 to 2017-18 Irrigation season the Stage 1 Irrigated land area has remained constant so differences in volumes of water used reflect differences in seasonal application rates.

Despite 2017-18 being overall much wetter than 2016-17, significantly less rain was recorded at NIWA's Hororata weather station (4702) between the 1 March to 18 April 2018 period (129mm) compared to the same period in 2017 (239mm). This extended the 2017-18 season by 12 days compared to the previous season.

Appendix 6.2: CPWL Annual Compliance Report 2017/2018 Irrigation Season (Section 6(b) for further details on the use of CPWL Scheme water for irrigation.

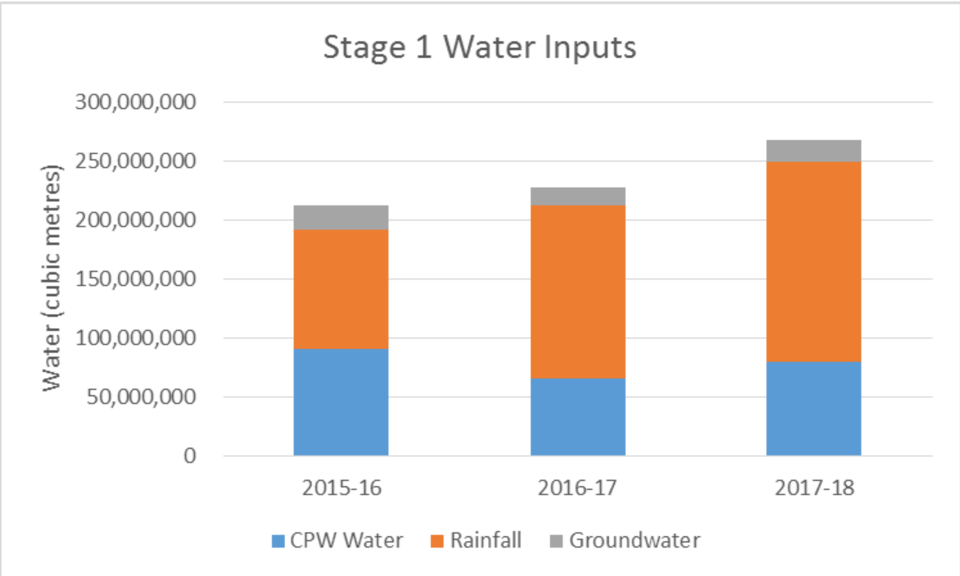



**Figure 3**. Stage 1 Water Inputs for the 2017-18 Irrigation Season

## 3.1. Scope of Water Monitoring Programme

**River and Stream Water Quality**

CPWL is required to monitor on a monthly basis surface water quality at 29 river and stream sites (see Figure 4). Full details of CPWL's surface water monitoring programme is contained in Part 1 of CPWL's Ground and Surface Water Monitoring Plan (available at http://www.cpwl.co.nz/environmental-management/ground-surface-water-monitoring-programme).

CRC165680 authorises CPWL to rely on data collected on Te Waihora/Lake Ellesmere, lowland streams, other rivers/streams or drains and the stockwater network by the Canterbury Regional Council or any other entity in lieu of establishing new monitoring sites. Instances where CPWL rely on data from ECan will be noted in this report.

Parameters to be analysed are: *Escherichia coli* (*E. coli)*, Turbidity, Nitrate + Nitrate-Nitrogen, Total Nitrogen, Total Ammoniacal Nitrogen, Dissolved Reactive Phosphorus, Total Phosphorus, Electrical Conductivity, Dissolved Oxygen, pH and temperature. CPWL has water quality triggers in place for Nitrate-Nitrogen (Annual Medians and Annual 95$^{th}$ Percentiles).

Commencement of the Surface Water Monitoring programme began alongside operation of Stage 1 of the Scheme in September 2015.

**Lake Water Quality**

This report contains water quality data from ECan's monitoring of Te Waihora from July 2017 to June 2018. Water samples are analysed for a wide range of parameters but only those required by the Ground and Surface Water Plan (as per those listed under 'River and Stream Water Quality' above and Trophic Level Index ($TLI_3$) and Chlorophyll *a*) are included in this report. Figure 4 shows the five locations sampled by ECan. CPWL has water quality triggers in place for Trophic Level Index ($TLI_3$), Total Phosphorus, Total Nitrogen and Chlorophyll *a*.

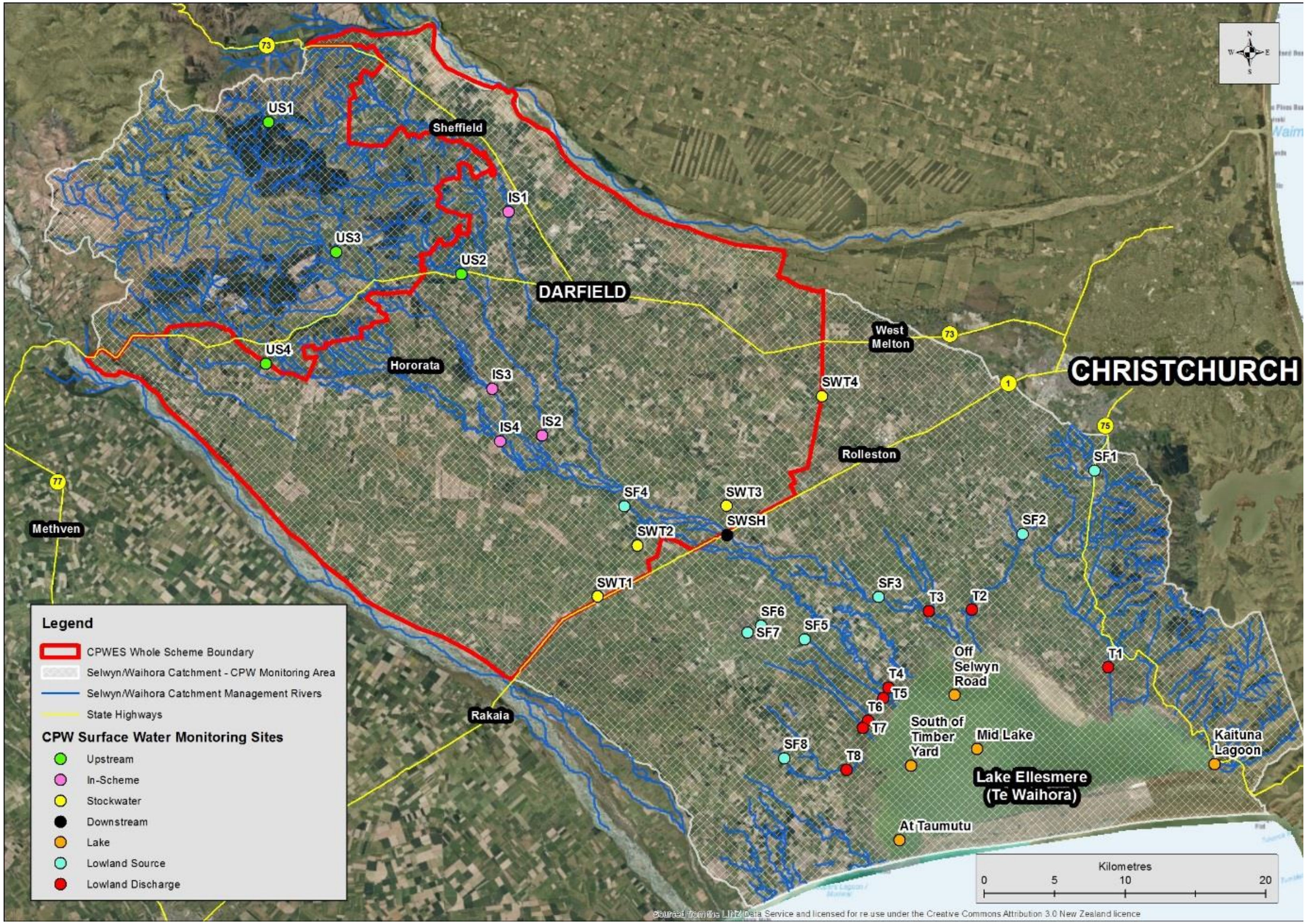



**Figure 4**. Surface Water Monitoring Sites

**Ground Water Quality and Levels**

Twenty monitoring bores have been installed by CPWL throughout the Scheme area (refer to Figure 5). Eight bores are located within Stage 1, ten in Stage 2 with two in the Sheffield area.

CRC165680 required two years of ground water monitoring data to be collected prior to the use of water. By 1 September 2015, CPWL had completed seven rounds of quarterly monitoring of our Stage 1 dedicated long-screen bores (Refer to Figure 6 for a comparison of a water supply bore to a dedicated long-screen monitoring bore). Long-screen monitoring bores are screened across the water table and this enables samples to be taken from close to the groundwater's static water level (SWL). This contrasts with typical Canterbury water supply bores that can have relatively short (~2m long) screens located close to the bottom of the bore. Water samples taken from typical Canterbury water supply bores may be abstracted from some distance below the SWL. This difference is important because some groundwater contaminants, in particular Nitrate-N, are typically most concentrated at the SWL and become decreasingly concentrated with depth, rather like cream in a bottle of milk. This means that samples taken from near to the SWL are more likely to accurately reflect Nitrate-N concentrations affected by land surface recharge than samples collected from a bore screened 20m below the SWL. This difference is illustrated in Figure 6.

In order to have two years of monitoring data before the commencement of Stage 1 irrigation, the Stage 1 dedicated monitoring bores were located adjacent to existing water supply bores that had been monitored for at least two years prior to CPWL's first irrigation season. The water supply and long-screen bores were monitored concurrently for two years to establish a relationship between the two forms of monitoring that may be useful when comparing future results to the historic record.

The dedicated long-screen monitoring bores were installed in the Stage 2 area of the Scheme in the first half of 2015. These bores will have been monitored for three and a half years prior to the commencement of Stage 2 irrigation in 2018. At the time of writing 13 monitoring rounds had been completed.

Full details of the Groundwater Monitoring Programme are contained in Part 1 of CPWL's Ground and Surface Water Monitoring Plan (available at http://www.cpwl.co.nz/environmental-management/ground-surface-water-monitoring-programme).

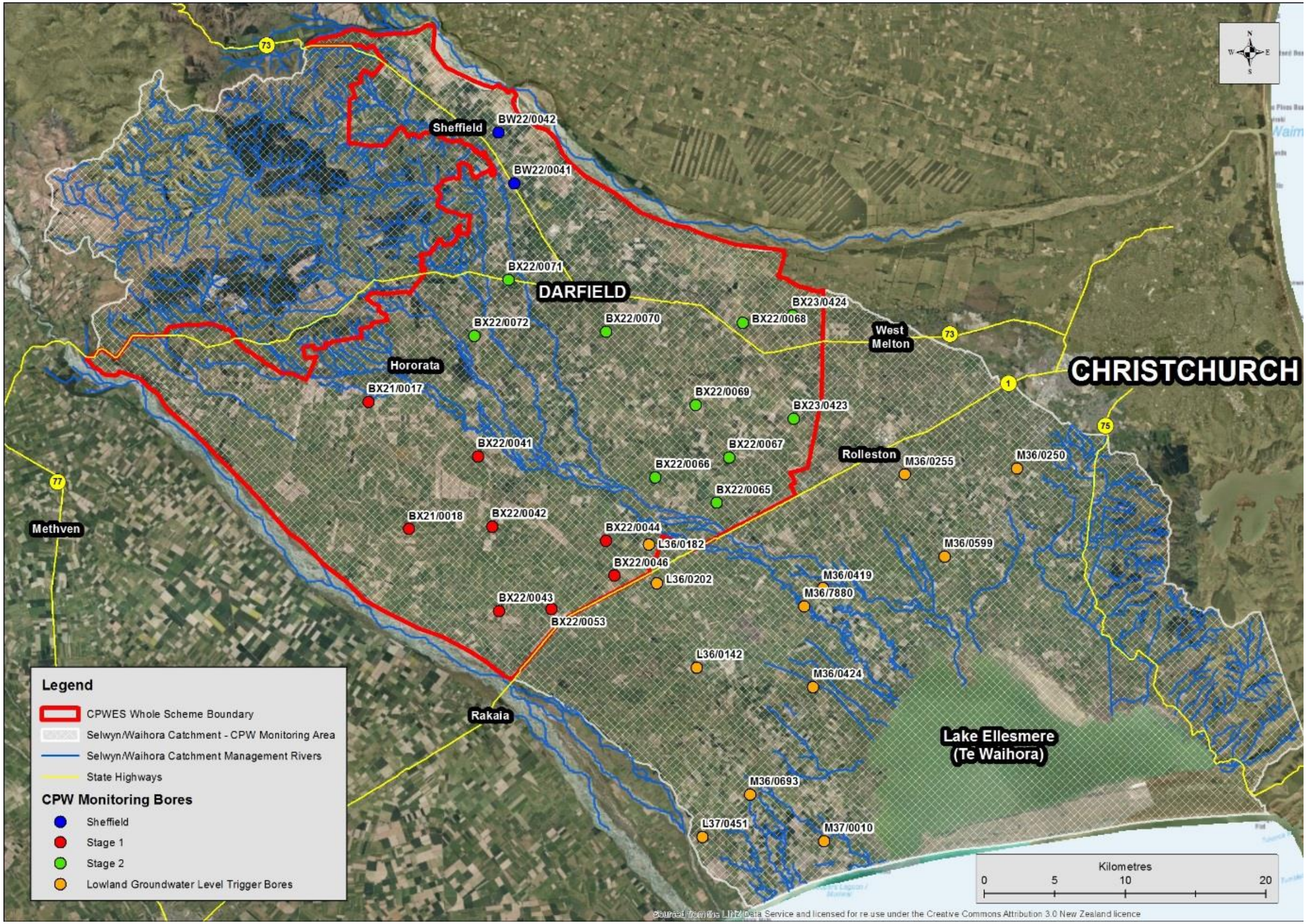



**Figure 5**. CPWL Groundwater Quality and Lowland Water Level Monitoring Sites

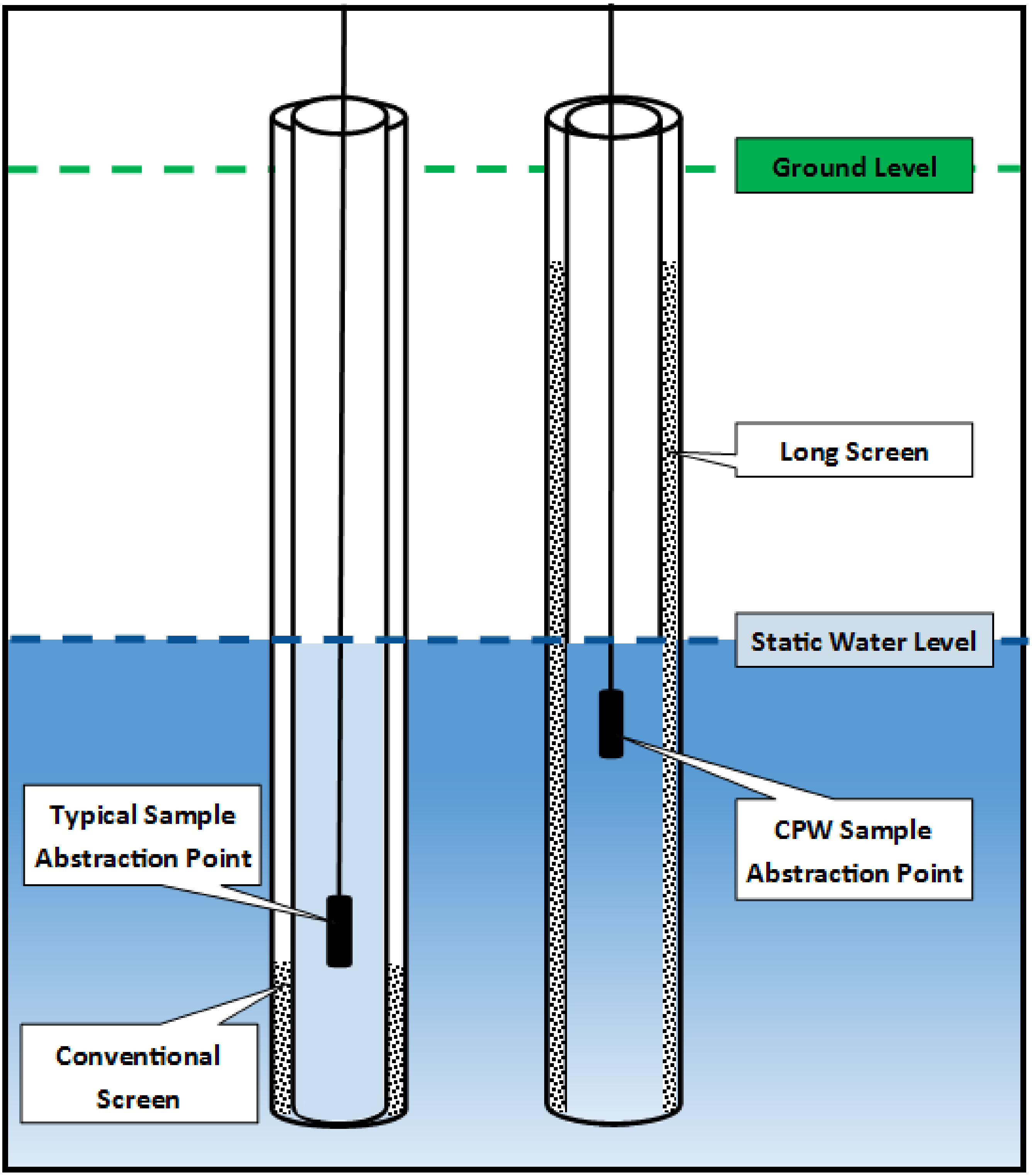



**Figure 6**. Comparison of a typical Canterbury Water Supply Bore to a dedicated CPWL long-screen Monitoring Bore

**Groundwater Level Trigger Levels**

CPWL does not carry out any specific groundwater monitoring in the Lowland Central Plains area but instead utilises data collected by Environment Canterbury (ECan). ECan operate an extensive groundwater level monitoring network in the Lowland Central Plains. GSWERP has established groundwater level trigger limits for a series of 12 bores within the ECan network (orange circles in Figure 5). The trigger limits will be used to provide advance warning of potential groundwater mounding. In order to provide sufficient warning of possible groundwater mounding the trigger limits are relatively conservative in that they have been set at a level which has been reached in the past. This may result in occasions where the triggers are reached following for example, high intensity rainfall events that lead to elevated groundwater levels, or for other reasons that are outside of CPWL's control.

**Groundwater Quality Trigger Levels**

With the exception of Nitrate-N in groundwater, CPWL's trigger levels are assessed against monthly or annual data.

Trigger levels for Nitrate-N in groundwater are based on five-year annual averages. This means a comparison of monitoring results to the groundwater Nitrate-N trigger from five years' of CPWL activities cannot be made until September 2020 for Stage 1, 2022 for Sheffield and 2023 for Stage 2. It will still be useful however, to evaluate the results obtained prior to 2020-23 to see if any developing trends can be identified.

Until a sufficient amount of data has been collected to report against five-year annual averages, CPWL will highlight in the results section instances where new maximum Nitrate-N concentrations are detected and where annual average Nitrate-N values exceed 7.65mg/L[1] for the Stage 1 and Sheffield area.

It is worth noting that there is a recognised lag effect in the transport of nitrogen in the groundwater system. Therefore elevated and/or increasing Nitrate-N readings may continue to be measured in deep groundwater, lowland streams and Te Waihora for a period of time, from pre-scheme land use, irrespective of improving farm practices that would be expected to result in lower discharges of nutrients into the environment. Consequently, in deep groundwater, lowland streams and Te Waihora it may take many years to detect changes in Nitrate-N concentrations resulting from changed land use under CPWL, if this occurs.

Prior to the commencement of CPWL irrigation, 42% of the water samples taken from Stage 1 long-screen bores had Nitrate-N concentrations greater than 7.65mg/L, for Sheffield bores the figure was 30%, while for Stage 2 the figure is running at 60%.

Groundwater samples are analysed for pH, Electrical Conductivity, Dissolved Oxygen, Temperature, Alkalinity, Bromide, Chloride, Dissolved Reactive Phosphorus, Nitrate-Nitrogen, Total Nitrogen, Sulphate and *E. coli.* The static groundwater level is also measured at the time of sampling. CPWL has water quality triggers in place for Nitrate Nitrogen and *E. coli*.

Appendix 6.1 contains all trigger limits and trigger response processes from Part II of the Ground and Surface Water Plan.

[1] 7.65mg/L is the trigger level for Nitrate-N based on a five-year annual average concentration.

## 3.2. 2017/2018 Seasonal Climatic Influence

**Rainfall**

The most significant weather event of the 2017-18 period was associated with the large, complex low pressure system that brought heavy rain and gales to Canterbury during 20-22 July. July 2017 was the first month that all CPWL surface water monitoring sites were found to be flowing since monitoring began in September 2015.

During the period 1 July 2017 to 30 June 2018, 1153mm of rainfall was recorded at NIWA's weather station 4702 located approximately 4km west of Hororata. This was the second highest 12-month total (1 July to 30 June) since records began in the 1981-82 period (refer to Figure 7).

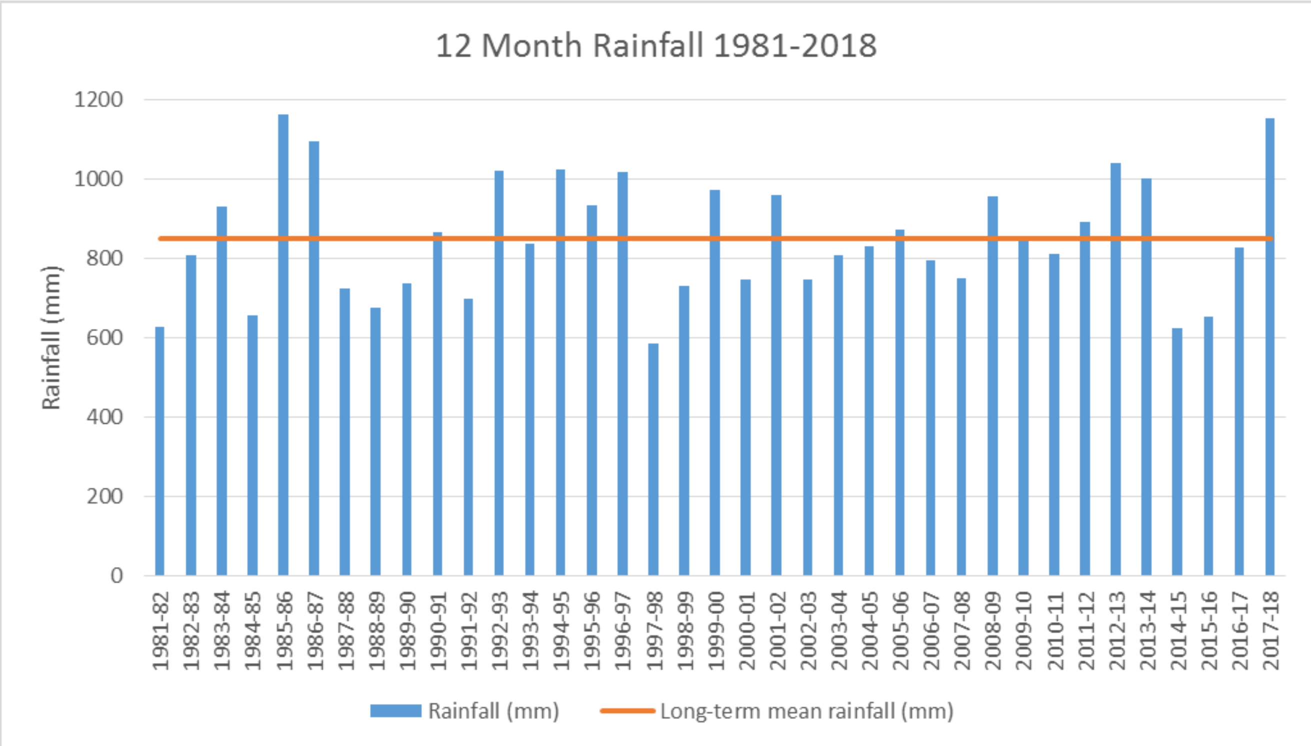



**Figure 7**. Rainfall record at NIWA's Weather Station 4702, Hororata
Source NIWA Clifo Database.

Rainfall and Soil Moisture Deficit data generated from NIWA's weather station (4702) for the 2016-17 and 2017-18 periods are shown in Figure 8 below. The soil at weather station 4072 site could be classified as being severely dry for 28 days, with zero days rated as extremely dry, during the 1 July 2017 to 30 June 2018 period. This compared with a classification of severely dry for 25 days and extremely dry for 17 days during the period 1 July 2016 to 30 June 2017.

CPWL's Stage 1 2017-18 irrigation season ended on 30 April. This was 12 days later than the 18 April conclusion to the 2016-17 irrigation season. Despite significantly more rain falling during 2017-18 compared to 2016-17 (1153mm vs 828mm), only 129mm of rain fell during 1 March to 18 April 2018 compared to 239mm during 1 March to 18 April 2017.

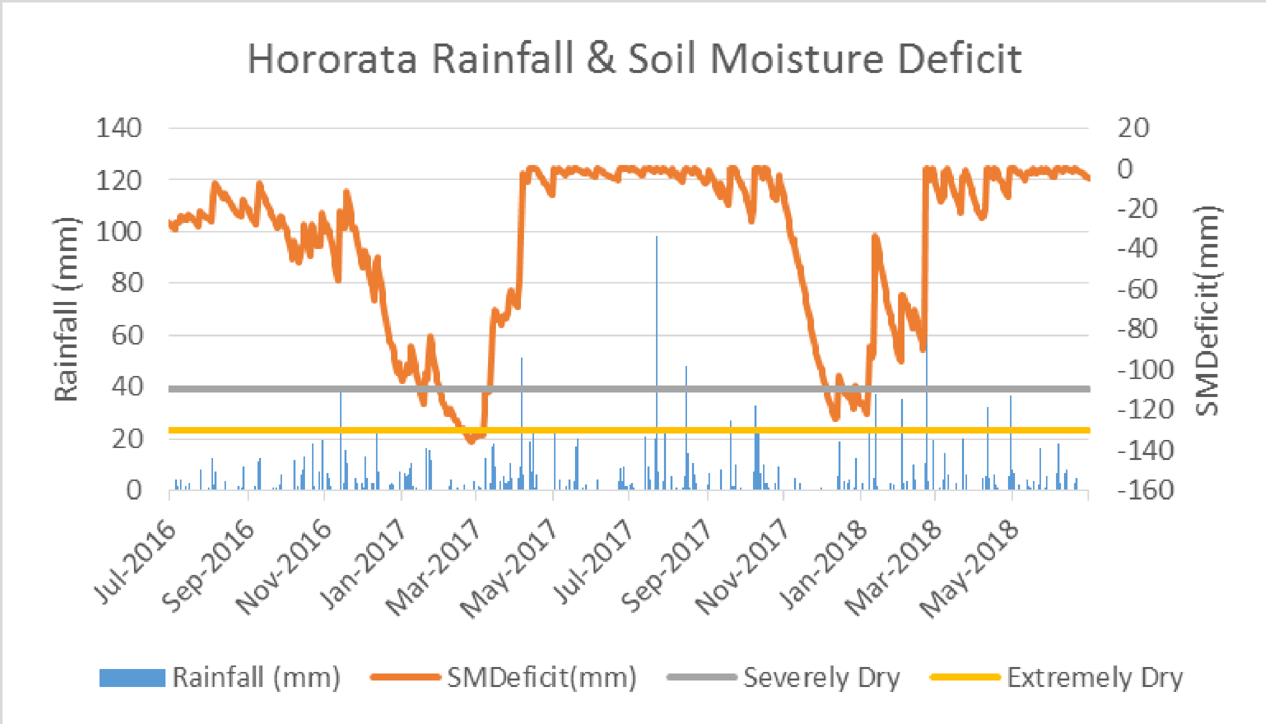



**Figure 8**. Rainfall and Soil Moisture Deficit Measured at NIWA's Monitoring Station in Hororata
Source NIWA Clifo Database.

# 4. Results & Interpretation

All monitoring data is listed, as required by CRC165680, appears in Appendices 6.3-6.6.

In August 2017 CPWL changed laboratory provider. Whereas previously a nil result for *E. coli* was reported on a 'none detected' basis the new Laboratory reports nil results as <1MPN/100ml. Eight groundwater samples were incorrectly analysed for *E. coli* by the new laboratory such that results could only be reported as <4 MPN/100ml rather than <1 MPN/100ml if applicable.

On three occasions (twice in February and once in March 2018) the new Laboratory failed to analyse surface water samples for *E. coli* within 24 hours. The laboratory have addressed their internal processes and there have not been any incidences since.

## 4.1. River and Stream Water Quality

CPWL has annual median, and annual 95$^{th}$ percentile, trigger limits for Nitrate-N. CPWL has surface water samples analysed for Nitrate + Nitrite-N. Like ECan and the majority of Regional Councils in New Zealand, CPWL monitors oxidised nitrogen as Nitrite-Nitrate-Nitrogen. Nitrite is not directly measured because of its transient nature and the very low concentrations that are present in Canterbury Rivers. When discussing surface (including lake) water quality monitoring results in this report, Nitrate-Nitrogen + Nitrite-Nitrogen will be referred to as Nitrate-N.

CPWL River and Stream quality trigger levels are shown in Table 1 and the monitoring results are shown in Table 2 (NB: values depicted in red indicate trigger level exceedances). The number of samples collected, as reported in Table 2, is a reflection of flows in those waterways; samples can only be collected if the waterway is flowing. For example, the Selwyn River at SH1 was flowing on nine out of 12 occasions throughout monitoring period.

A maximum of 306 samples could be collected by CPWL and ECan during the 2017-18 monitoring period from the 25 sites displayed in Table 2. During 2017-18 the total number of samples collected was 285 compared to only 207 out of a maximum of 308 samples for 2016-17.

**Table 1**. Surface Water Quality Triggers for Nitrate-N in mg/L

| River Type | CPWL Surface Water Monitoring | |
|---|---|---|
| | Annual Median | Annual 95$^{th}$ Percentile |
| Hill-fed Lower | 1.8 | 2.6 |
| Spring-fed Plains | 5.2 | 7.4 |

**Table 2**. Surface Water Quality Nitrate-N Annual Medians and 95th Percentiles

| Site | Site ID | 2017-2018 | | | Period of Highest Concentration | | Month of Peak Nitrate-N Conc-tration |
|---|---|---|---|---|---|---|---|
| | | Nitrate-N Annual Median (mg/L) | Nitrate-N Annual 95th percentile (mg/L) | No. of samples | Nitrate-N Annual Median (mg/L) | Nitrate-N Annual 95th percentile (mg/L) | |
| **Hill-Fed Lower Sites** | | | | | | | |
| Hawkins River In-scheme | IS1 | **2.69** | **3.11** | 12 | 2017-18 | 2017-18 | Feb-18 |
| Waianiwaniwa River In-scheme | IS2 | 1.80 | **3.05** | 6 | 2016-17 [B] | 2016-17 [B] | Aug-17 |
| Selwyn River In-scheme | IS3 | 0.66 | 0.85 | 9 | 2016-17 [C] | 2017-18 | Jan-18 |
| Hororata River In-scheme | IS4 | **2.05** | **3.21** | 12 | 2017-18 | 2017-18 | Sep-17 |
| Selwyn River @ SH1 | SWSH | 1.53 | 2.16 | 9 | 2015-16 [B] | 2015-16 [B] | Aug-17 |
| Hawkins River Upstream | US1 | 0.54 | 1.22 | 12 | 2017-18 | 2017-18 | Jul-17 |
| Waianiwaniwa River Upstream | US2 | **1.87** | **2.78** | 9 | 2017-18 | 2017-18 | Jan-18 |
| Selwyn River Upstream | US3 | 0.41 | 0.65 | 12 | 2017-18 | 2017-18 | Aug-17 |
| Hororata River Upstream | US4 | 1.09 | 1.34 | 12 | 2017-18 | 2016-17 | Aug-17 |
| **Spring-Fed Plains Sites** | | | | | | | |
| Halswell River Source | SF1 | 3.14 | 3.48 | 12 | 2015-16 | 2015-16 | May-18 |
| LII Stream Source | SF2 | 4.09 | 4.18 | 12 | 2015-16 | 2015-16 | Jan-18 |
| Selwyn River Spring Source | SF3 | 4.94 | 6.30 | 12 | 2015-16 | 2016-17 | Nov-17 |
| Irwell River Source | SF4 | 1.95 | 3.31 | 12 | 2015-16 [D] | 2016-17 | Jul-17 |
| Hanmer Road Drain Source | SF5 | 4.23 | **7.96** | 12 | 2016-17 [B] | 2017-18 | Jul-17 |
| Boggy Creek Source | SF6 | **8.10** | **12.89** | 12 | 2016-17 [E] | 2017-18 | Jul-17 |
| Doyleston Drain Source | SF7 | **8.10** | **14.49** | 12 | [F] | [F] | Jul-17 |
| Harts Creek Source | SF8 | **8.40** | **9.41** | 12 | 2015-16 [D] | 2017-18 | Jul-17 |
| Halswell River Downstream | T1 | 2.34 | 2.66 | 12 | 2015-16 | 2015-16 | May-18 |
| LII Stream Downstream | T2 | 3.10 | 3.55 | 12 | 2015-16 | 2015-16 | Apr-18 |
| Selwyn River Downstream | T3 | 5.05 | 6.65 | 12 | 2015-16 | 2016-17 | Nov-17 |
| Irwell River Downstream | T4 | 1.93 | 4.87 | 12 | 2017-18 | 2017-18 | Jul-17 |
| Hanmer Road Drain Downstream | T5 | 3.40 | 6.85 | 12 | 2017-18 | 2017-18 | Jul-17 |
| Boggy Creek Downstream | T6 | **8.18** | **10.74** | 15 [A] | 2017-18 | 2017-18 | Jul-17 |
| Doyleston Drain Downstream | T7 | **5.72** | **10.55** | 15 [A] | 2017-18 | 2017-18 | Aug-17 |
| Harts Creek Downstream | T8 | **7.55** | **7.89** | 12 | 2017-18 | 2017-18 | Nov-17 |

[A] Includes three rounds of ECan Monitoring data
[B] n=1
[C] n=3
[D] n=2
[E] n=5
[F] no data for 2015/16 and 2016/17

Both the annual median, and annual 95th percentile, trigger limits were exceeded at nine monitoring sites [2016-17 six sites], two sites solely exceeded the 95th percentile trigger [2016-17 one site] and no sites solely exceeded the annual median trigger level [2016-17 two sites]. Figure 9 spatially depicts which sites experienced trigger level exceedances.

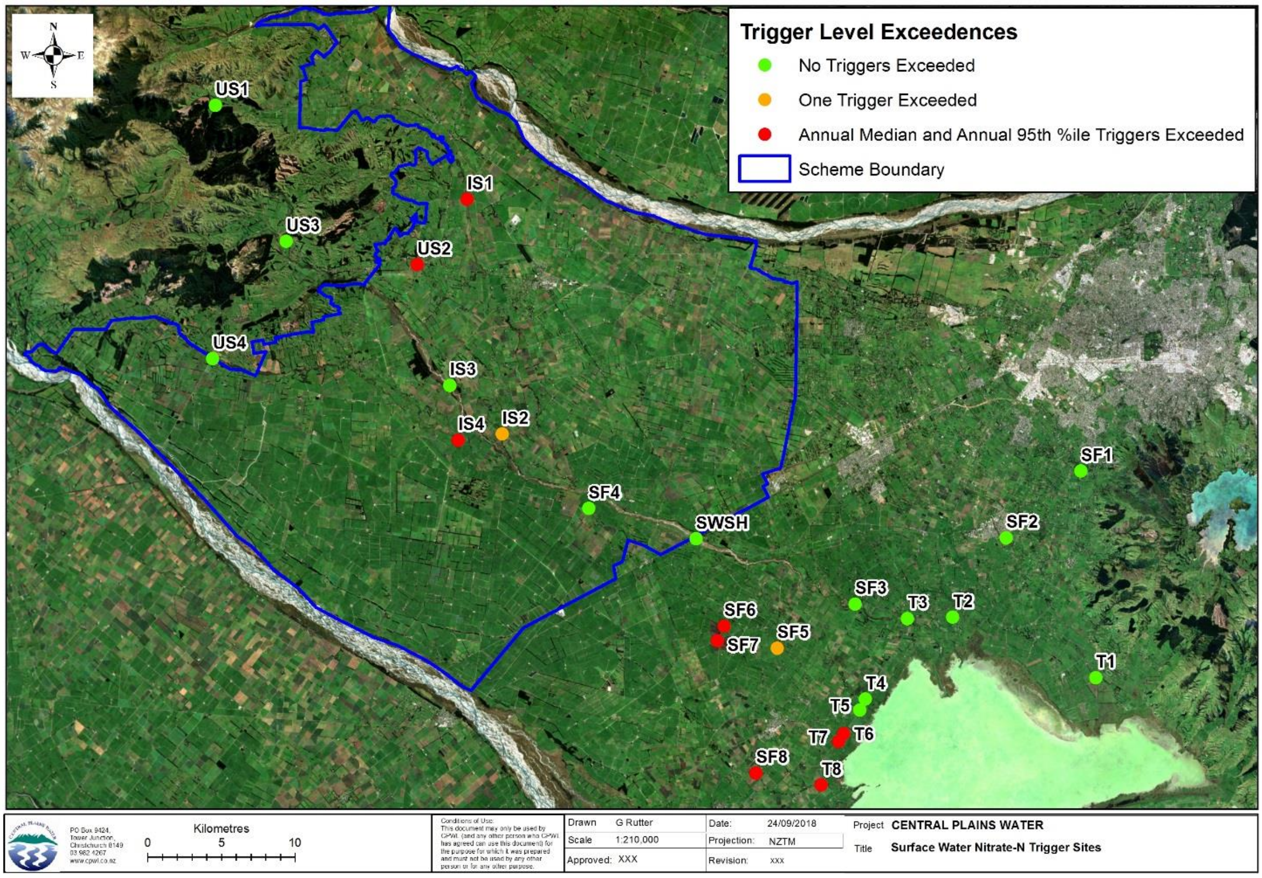



**Figure 9**. Surface Water Nitrate-N Trigger Level Exceedances

The trigger exceedances were from seven waterways, Hawkins River, Waianiwaniwa River, Hororata River, Hanmer Road Drain, Boggy Creek, Doyleston Drain and Harts Creek.

Results presented in Part II of CPWL Ground and Surface Water Monitoring Plan also highlighted elevated nitrate readings, prior to commencement of CPWL irrigation, from sites in the Hawkins River, Selwyn River, Boggy Creek, Doyleston Drain and Harts Creek that would have exceeded CPWL's trigger limits when based on 2014 and/or 2010-15 data.

**HILL-FED LOWER SITES - Annual Median Nitrate-N Trigger = 1.8mg/L, 95$^{th}$%ile Trigger = 2.6mg/L**

Hawkins River at the Deans Road location monitored by ECan had a lower annual median (2.50mg/L vs 2.69mg/L) but a higher annual 95$^{th}$ percentile (3.45mg/L vs 3.11mg/L) Nitrate-N concentration compared to CPWL's Hawkins River instream site (located 3.5km downstream) during 2017-18 (refer to Figure 10).

Annual Median and 95th Percentile Nitrate concentrations measured at both the ECan and CPWL locations were greater for the 2017-18 period compared to 2016-17. A review of historic ECan data shows that greater concentrations have been measured in the past compared to 2017-18 (refer to Figure 10).

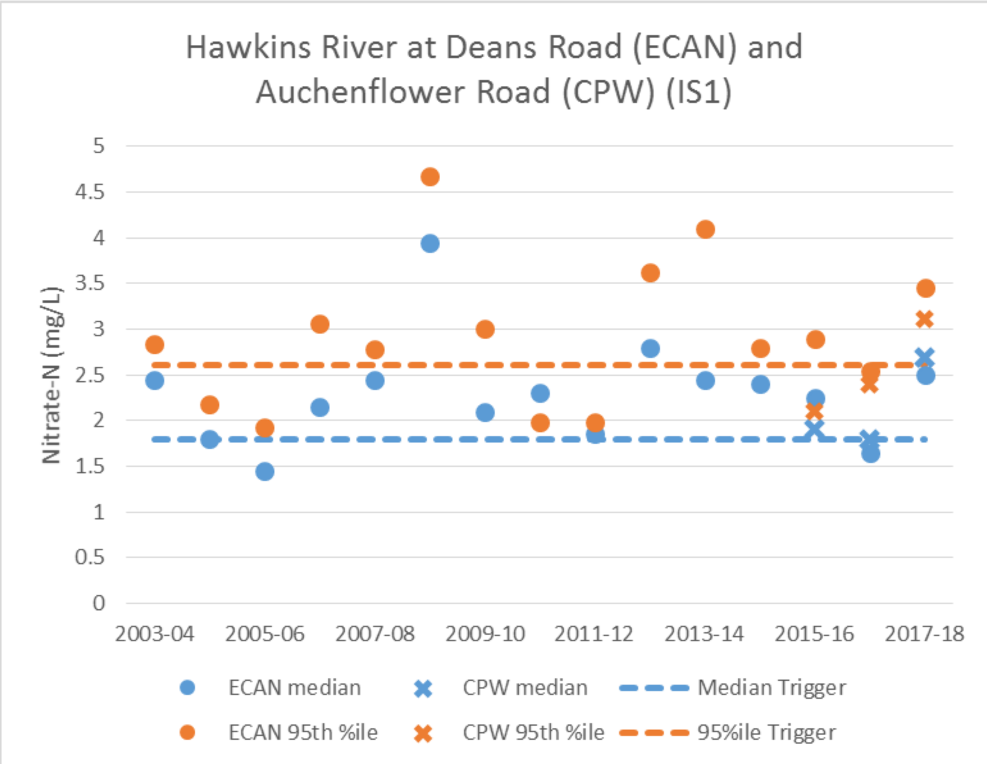



**Figure 10**. Hawkins River at Deans and Auchenflower (IS1) roads – Nitrate-N concentrations 2003-04 to 2017-18

The Annual 95th Percentile Nitrate-N concentration at 3.05mg/L meant the Trigger limit was exceeded for the in-scheme site, IS2, on the Waianiwaniwa River (N = 6). The Annual Median met but did not exceed the 1.8mg/L Trigger limit. There is not enough historic data to determine any trends. However, the 'upstream of scheme' site on the Waianiwaniwa River, US2, exceeded both Median and 95$^{th}$ Percentile trigger levels with Nitrate-N concentrations of 1.87 and 2.78mg/L respectively (N = 9). Median and 95th Percentile Nitrate-N concentrations from site US2 during 2016-17 (N = 9) were lower, at 0.49 and 1.29mg/L, which may indicate that the exceedance of the annual 95th Percentile at IS2 during 2017-18 may be more to do with climatic or fluctuations in baseline water quality rather than CPWL and/or farming activities from the Sheffield Scheme.

Annual Median and 95th Percentile Nitrate-N triggers were both exceeded at the in-scheme site IS4, on the Hororata River (refer to Figure 11) whereas they were not for 2016-17. There is no historic monitoring data from any nearby sites to show whether the 2017-18 results represent a new peak in Nitrate-N or whether they fit within typical inter-annual variation. Site US4, the upstream of scheme site on the Hororata River did however show an increase in Annual Median Nitrate-N, but a small decrease in Annual 95th Percentile Nitrate-N concentration from 2017-18 compared to 2016-17 (refer to Figure 12).

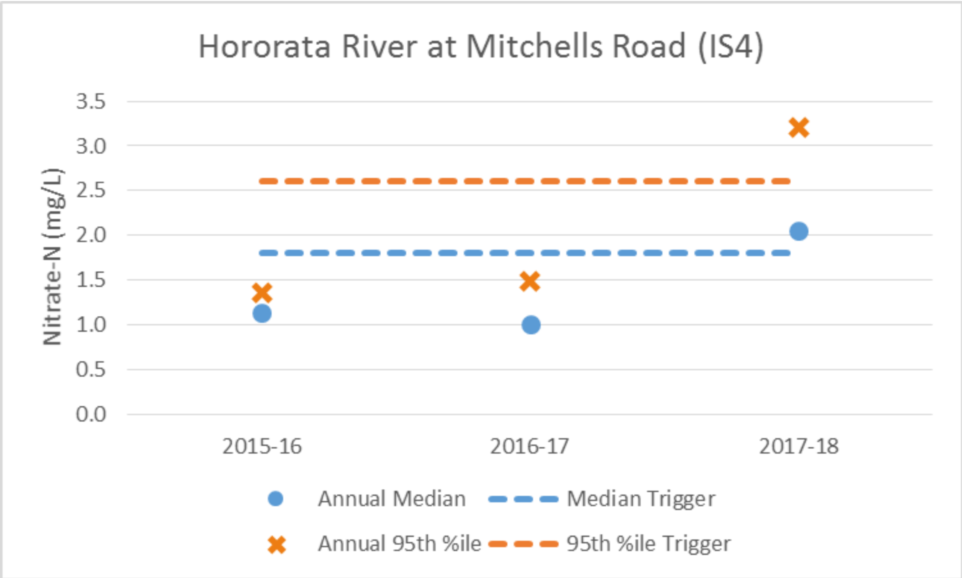



**Figure 11**. Hororata River In-scheme location – Nitrate-N concentrations 2015-16 to 2017-18

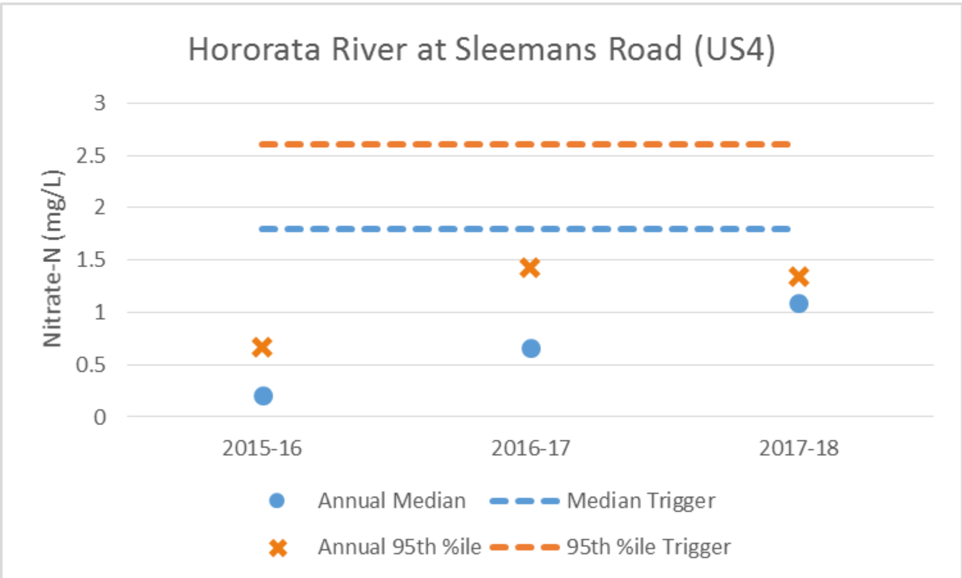



**Figure 12**. Hororata River Upstream location – Nitrate-N concentrations 2015-16 to 2017-18

**SPRING-FED PLAINS SITES - Annual Median Trigger = 5.2mg/L, 95th%ile Trigger = 7.4mg/L**

With the exception of Harts Creek, the southern-most waterway that CPWL monitors, the Spring-Fed source and discharge sites south of the Selwyn River (Sites SF4, SF5, SF6 and SF7, and T4, T5, T6 and T7) generally showed Nitrate-N concentrations that peaked in July 2017 (NB: SF4 peaked in June 2017 and T7 peaked in August) before declining until January or February whereby concentrations started to rise again. Nitrate-N concentrations remained relatively consistent throughout the monitoring period at sites SF1 and T1, SF2 and T2, and SF8 and T8. SF3 had T3 showed large decreases in Nitrate-N following the significant July 2017 rain event.

Site SF5's (Hanmer Road Drain Source) Annual 95th Percentile Nitrate-N concentration was 7.96mg/L for 2017-18 (N=12).

The Annual Median Nitrate-N concentration was 4.23mg/L. Figure 13 displays monthly spot readings against the Annual Median and 95th Percentile Trigger Limits since October 2015. The recommencement of flow at site SF5 appears to show a pulse of elevated Nitrate-N readings that diminished in the following months.

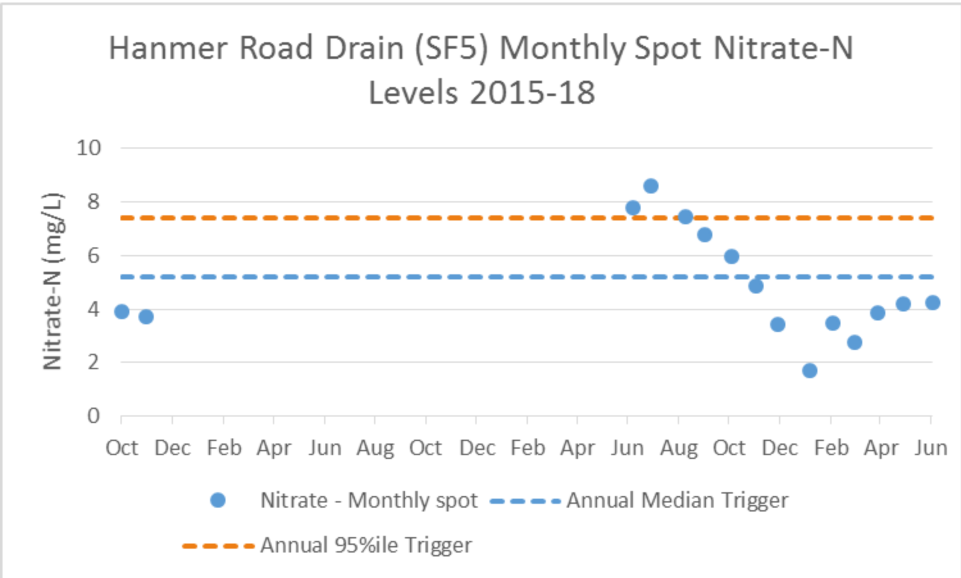



**Figure 13**. Hanmer Road Drain Source location –Spot Nitrate-N concentrations 2015-18

Annual median and 95th percentile Nitrate-N concentrations at the Boggy Creek 'source' site were 8.1mg/L and 12.9mg/L respectively during 2017-18. This compares to values of 8.3mg/L (median) and 12.2mg/L (95th percentile) for the 2016-17 period (refer to Figure 14).

Nitrate-N concentrations at the Boggy Creek Discharge location (T6) were also above the respective Trigger levels at 7.3 and 10.9mg/L for the Annual Median and Annual 95th Percentile. At 10.7mg/L, the Annual 95th Percentile was the highest level determined since monitoring began in 2003-04 (refer to Figure 15. The corresponding Median concentration at 8.18mg/L was also the highest value since monitoring began 2003-04 (refer to Figure 15).

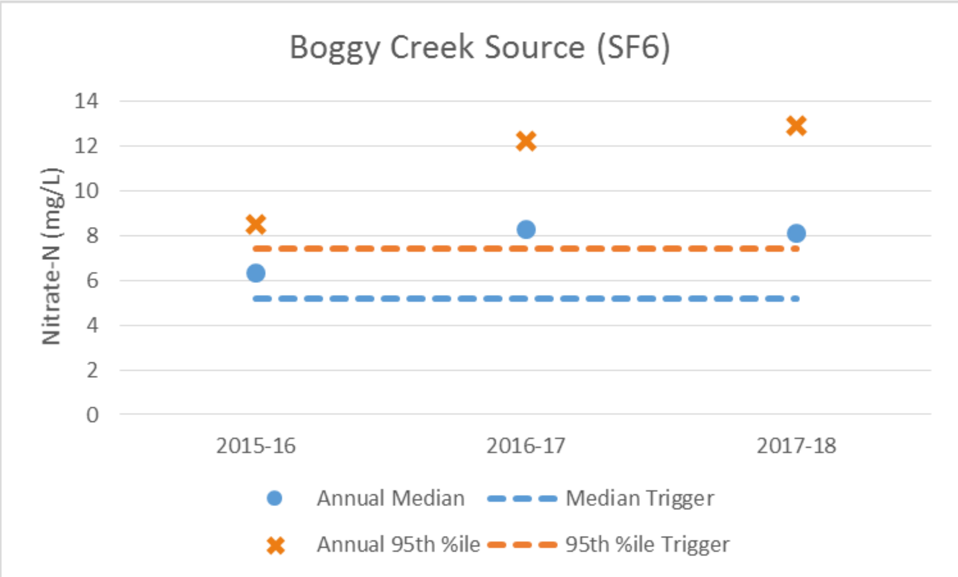



**Figure 14**. Boggy Creek Source location – Nitrate-N concentrations 2015-16 to 2017-18

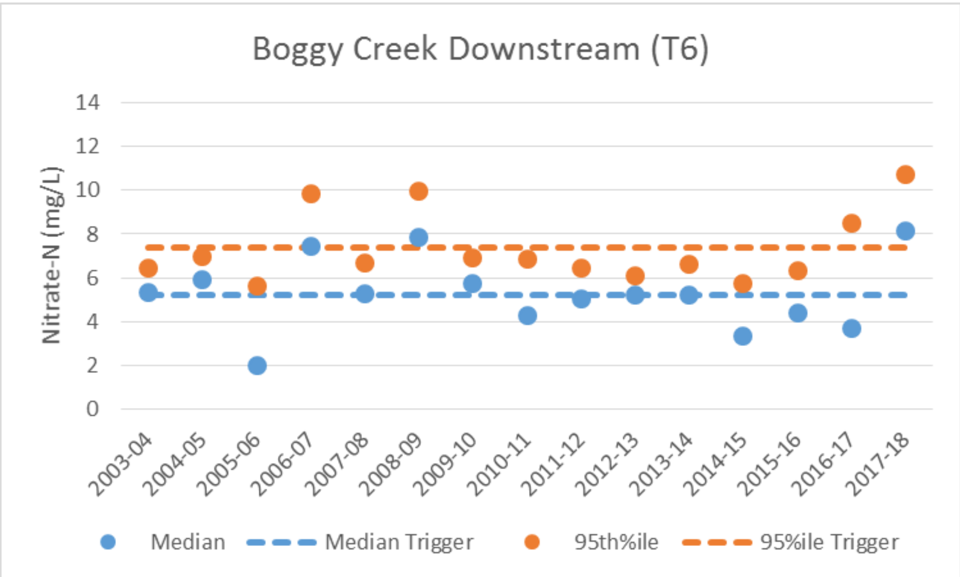



**Figure 15**. Boggy Creek Discharge location – Nitrate-N concentrations 2003-04 to 2017-18

The CPWL surface water monitoring programme began in September 2015 and July 2017 was the first month that site SF7 (Doyleston Drain Source) was found to be flowing (flow had previously been measured at this site in November 2014). The Annual Median and Annual 95th Percentile Nitrate-N concentrations for 2017-18 at 8.10 and 14.5mg/L, exceeded their respective 5.2 and 7.4mg/L Trigger Levels. Figure 16 shows the highest Nitrate-N level was recorded in July 2017 (sampling took place on 25 July, post the large complex low pressure system that brought heavy rain to Canterbury during the period 20-22 July 2017). The Nitrate-N concentration appeared to decrease for several months following the July event before stabilising at around the 5-7mg/L level.

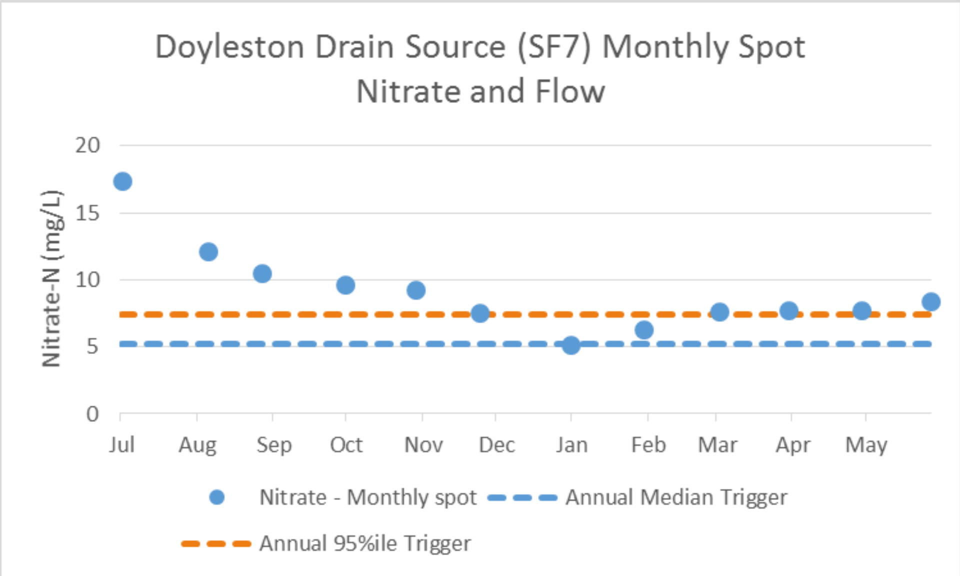



**Figure 16**. Doyleston Source location –Spot Nitrate-N concentrations 2017-18

Both the Annual Median and Annual 95th Percentile Nitrate-N concentrations at the Doyleston Drain Discharge site (T7) were exceeded for the 2017-18 period with levels of 6.0 and 10.6mg/L respectively, the highest levels recorded to date. Figure 17 shows the Annual Median and 95th Percentile Nitrate-N concentrations were notably higher in 2017-18 compared to 2015-16 and 2016-17 levels but that Nitrate-N levels had exceeded the respective trigger levels in the past.

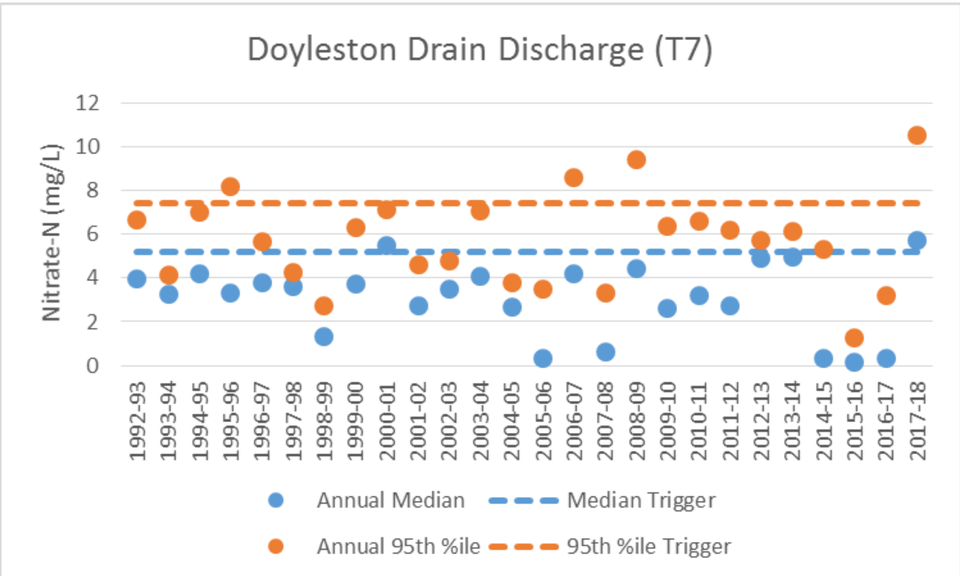



**Figure 17**. Doyleston Drain Discharge location – Nitrate-N concentrations 1992-93 to 2017-18

For all 12 occasions during the 2017-18 monitoring period Nitrate-N concentrations were found to be greater at site SF7 compared to the downstream site T7 (refer to Figure 18).

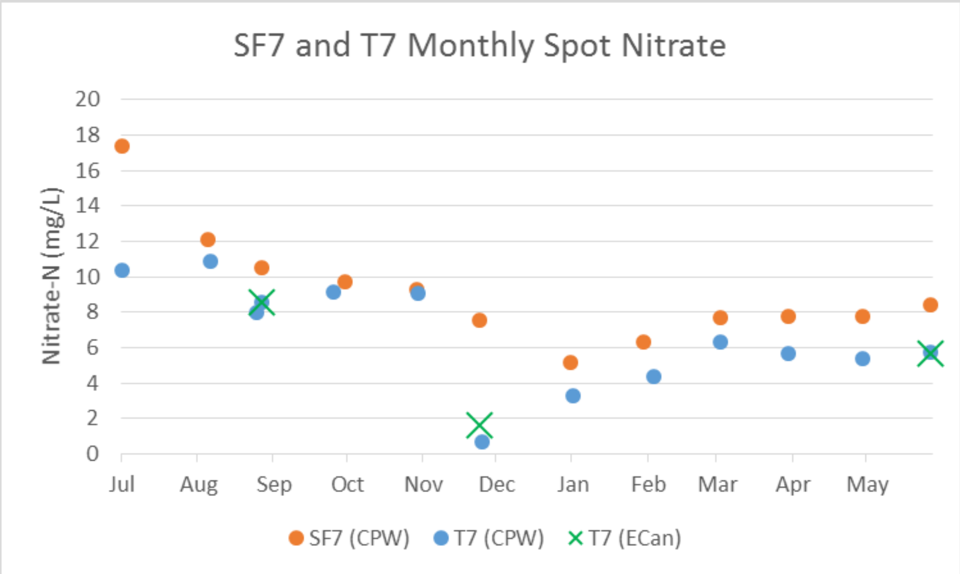



**Figure 18** Doyleston Drain Source and Discharge locations – Discrete Monthly Nitrate-N concentrations 2017-18.
NB: Samples for paired SF7 and T7 sites were taken on the same day on five out of 12 occasions during the monitoring period. CPWL and ECan both sampled the T7 site during September and December 2017 and June 2018.

Annual Median and 95th Percentile Nitrate-N concentrations both exceeded trigger levels at the Harts Creek Source Site (SF8) (refer to Figure 19). Spot Nitrate-N concentrations at the downstream Harts Creek Discharge (T8) site have been found to be consistently lower than those from the Source site, SF8 (Refer to Figure 20).

A review of Annual Median and Annual 95th Percentile Nitrate-N data from site T8 as far back as the 1994-95 period (refer to Figure 21) shows that while the Annual Median Nitrate-N concentration reached a new high in 2017-18 [7.6mg/L] it had previously reached similar levels [2013-14 - 7.4mg/L]). At 7.9mg/L, the 2017-18 Annual 95th Percentile Nitrate-N concentration was less than the 2013-14 value [8.4mg/L], and similar to the 2014-15 value [7.8mg/L].

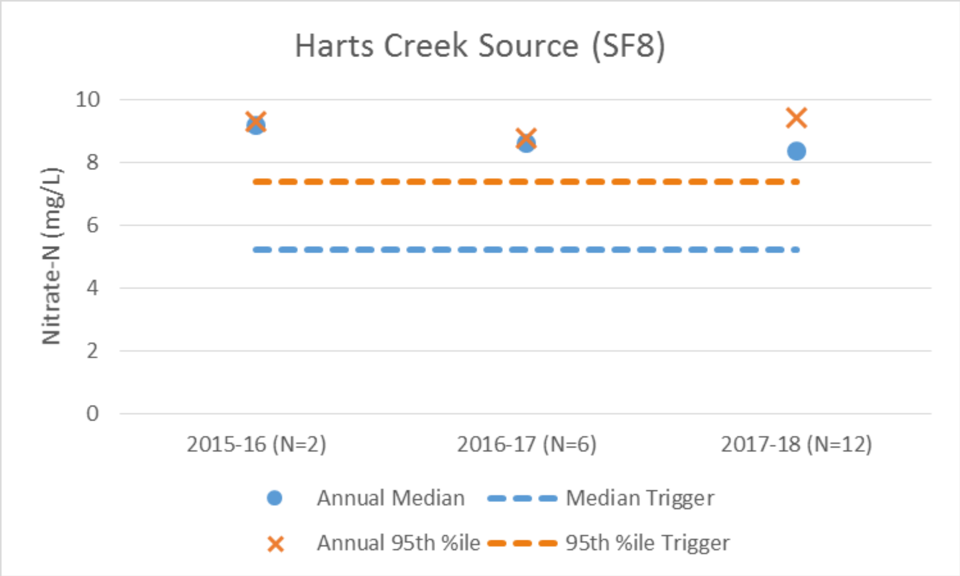



**Figure 19** Harts Creek Source location – Nitrate-N concentrations 2015-16 to 2017-18

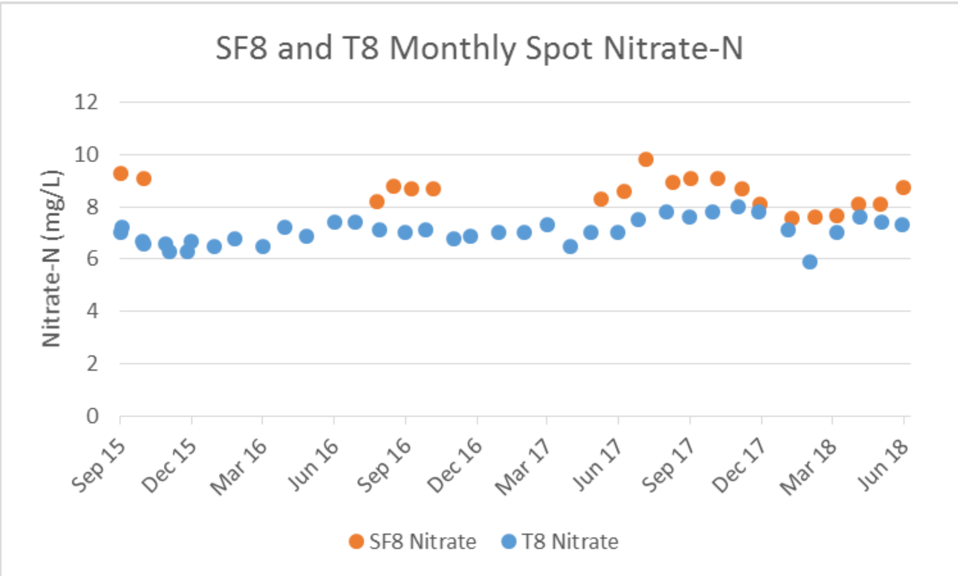



**Figure 20** Harts Creek Source and Discharge locations – Discrete Monthly Nitrate-N concentrations 2017-18.
NB: Data gaps for site SF8 represent times when the Creek was dry.

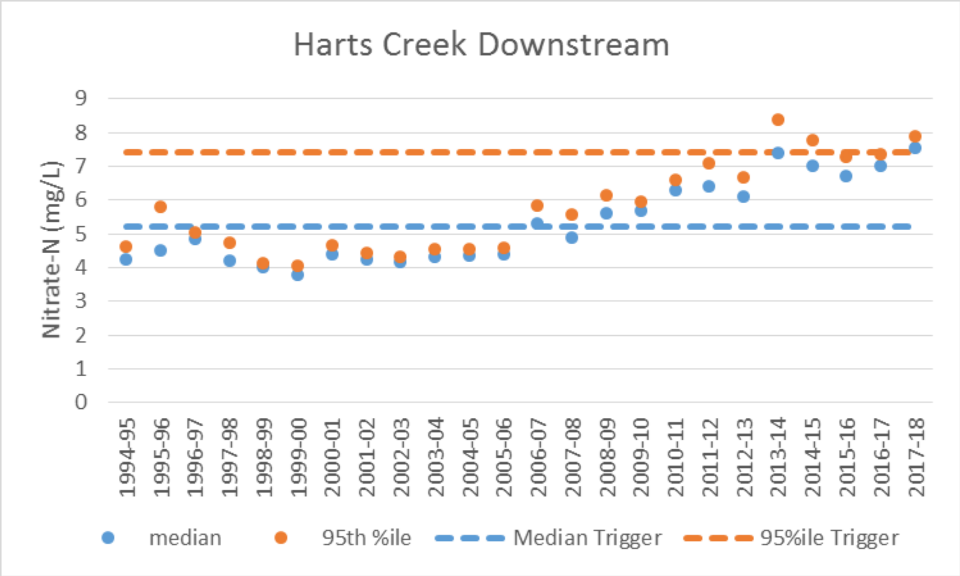



**Figure 21** Harts Creek Discharge location – Nitrate-N concentrations 1994-95 to 2017-18

## 4.2. Lake Water Quality

The trigger levels for Lake Water Quality are listed in Table 3. The trigger levels have been taken from the water quality limits contained in Table (l) of the Land and Water Regional Plan.

**Table 3**. Lake Water Quality Triggers

| **Monitoring Location** | **Chlorophyll *a* (µg/L)[(b)]** | **Total Phosphorus (mg/L)[(b)]** | **Total Nitrogen (mg/L)[(b)]** | **TLI[(a)]** |
|---|---|---|---|---|
| Mid-Lake | 74 | 0.1 | 3.4 | 6.6 |
| Lake Margins | no trigger | no trigger | no trigger | 6 |

(a) TLI (Trophic Level Index) assumed to be calculated as TLI3 (using TP, TN and chl a)

(b) As a maximum annual average determined from 12 (monthly) rounds of monitoring results.

During the 1 July 2017 to 30 June 2018 period, 12 rounds of monitoring data was obtained by Environment Canterbury.

The total phosphorus trigger limit is an annual average of no more than 0.1mgL$^{-1}$. The 12 month average for total phosphorus at the Mid Lake monitoring site was 0.19mgL$^{-1}$. (see Table 4, NB: data in red indicates an exceedance of the applicable trigger limit). This was the only lake water quality trigger level exceedance for an individual parameter during the reporting period.

**Table 4**. Lake Water Quality Monitoring Results 2017-2018

| **Te Waihora Site** | Chlorophyll *a* (µg/L) | Total Phosphorus[A] (mg L$^{-1}$) | Total Nitrogen[A] (mg L$^{-1}$) | $TLI_3$ |
|---|---|---|---|---|
| Mid Lake (2017-18) | 62 | **0.19** | 2.00 | **6.85** |
| Lake Margin Sites | | | | |
| • Kaituna Lagoon (2017-18)[B] | 17 | 0.14 | 1.11 | 5.78 |
| • Off Selwyn River Mouth (2017-18) | 58 | 0.16 | 2.20 | **6.61** |
| • South of Timber Yard (2017-18) | 65 | 0.16 | 2.15 | **6.63** |
| • Taumutu (2017-18) | 57 | 0.15 | 1.95 | **6.51** |

A Annual Mean

B Kaituna Lagoon is included for comparison only; it is not a trigger level site.

ECan has generally monitored the Mid Lake location on at least a monthly basis since July 1993. During this time the mean annual (July to June) Total Phosphorus level has been 0.24mg $L^{-1}$ (Figure 22).

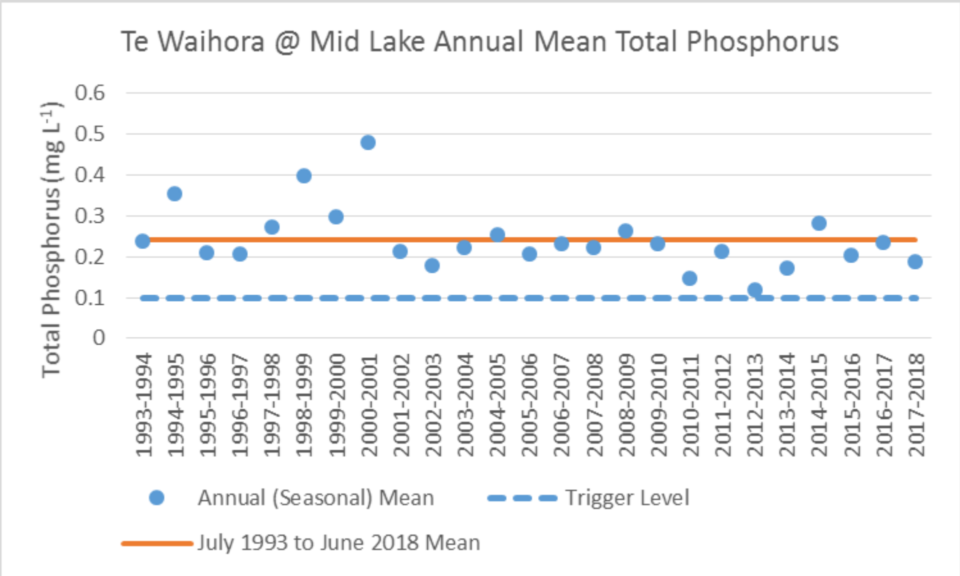



**Figure 22**. Total Phosphorus at Mid Lake in Te Waihora from 1993 - 2017

Figure 22 suggests that although the result for Total Phosphorus at 'Mid Lake' for 2017-2018 exceeded the trigger level, the level is not inconsistent with previous years' (pre CPWL scheme operation) results that ranged between 0.12mg/L and 0.48mg/L between 1993-94 and 2014-15. CPWL therefore attributes the exceedance of the phosphorus trigger at Mid Lake to elevated baseline levels.

The Trophic Level Index ($TLI_3$) is an indicator of lake water quality specifically developed for New Zealand lakes. The $TLI_3$ is derived from a number of water quality measures including total nitrogen, total phosphorus and chlorophyll *a* (found in algae). Triggers were exceeded at all lake water monitoring sites (see Table 4).

A review of monitoring data from the Mid Lake monitoring site from 2013-14 and 2014-15 (see Table 5, NB: trigger exceedances are depicted in red) illustrates that Scheme irrigation in the Stage 1 area during 2015-16, 2016-17 and 2017-18 has had no perceptible effect on trigger level exceedances.

**Table 5**. Site Mid Lake, Te Waihora Monitoring Results 2013-14 to 2017-2018.

| **Mid Lake, Te Waihora** | Chlorophyll *a* (µg/L) | Total Phosphorus[A] (mg/L) | Total Nitrogen[A] (mg/L) | $TLI_3$ |
|---|---|---|---|---|
| 2017-18 | 62 | **0.19** | 2.00 | **6.85** |
| 2016-17 | 71 | **0.24** | 2.30 | **6.86** |
| 2015-16 | 70 | **0.22** | 2.31 | **6.83** |
| 2014-15 | **119** | **0.28** | 2.82 | **7.21** |
| 2013-14 | **76** | **0.17** | 2.19 | **6.73** |

The discharge of phosphate laden sediment to surface waters is not a significant issue for CPWL farms when compared to farms in the lowland areas surrounding Lake Ellesmere/Te Waihora. The discharge of Nitrogen is a more significant issue for (but not exclusive to), CPWL Scheme farms. It is noted that whilst the lake Trophic Level Index was exceeded, the trigger level for total Nitrogen concentration was not.

## 4.3. Groundwater Quality

CPWL have trigger levels in place for *E. coli* and Nitrate-N (Table 6). With only 34 months of groundwater monitoring results available post commencement of irrigation in Stage 1, it is not possible to assess the results against the trigger level for Nitrate-N (being a five-year annual average concentration of 7.65mg/L).

**Table 6**. Groundwater Quality Trigger Levels

| Contaminant | Measurement | Trigger |
| --- | --- | --- |
| Nitrate-Nitrogen | 5-year annual average concentration[(a)] | 7.65 mg/L |
| E.coli | Median concentration[(b)] | <1 organism/100 millilitres |

(a) In shallow groundwater <50 metres below groundwater level

(b) Measured over the length of record

There are however several CPWL monitoring bores across both Stage 1 and Stage 2 where Nitrate-N concentrations have been found to be consistently greater than 7.65mg/L (refer to Tables 8 and 10 and Figures 5 and 30).

### 4.3.1. Stage 1

***E. coli***

During routine monitoring *E. coli* was detected on a single occasion from five bores from within the operational Stage 1 area of the Scheme during 2017-18 (16% of samples [2016-17 - 15% of samples]).

Occasional occurrences of *E. coli* in groundwater bores are not uncommon particularly during wet weather sampling. ECan's annual regional groundwater surveys from 2009 to 2016 detected *E. coli* in 3.7% to 12.5% of bores. There is also the possibility that positive *E. coli* readings may result from the sample collection and handling procedures.
Four of the CPWL monitoring bores reported concentrations of 1-2MPN/100ml while a concentration of 68MPN/100ml was detected in the fifth bore, BX22/0041.

Rainfall data for up to a week preceding positive *E. coli* detections is shown in Table 7.

**Table 7**. Rainfall[A] associated with bore water samples that had positive detections of *E. coli*

<table>
<tr><th rowspan="2">Bore</th><th rowspan="2">Sample Date</th><th rowspan="2">Site Condition</th><th rowspan="2">E. coli (MPN/100ml)</th><th colspan="4">Rainfall (mm)</th></tr>
<tr><th>Sample Day</th><th>Previous 24hrs</th><th>Previous 48hrs</th><th>Previous week</th></tr>
<tr><td>BX22/0018</td><td>6/12/2017</td><td>Dry, no stock, no manure</td><td>2</td><td>0</td><td>0</td><td>0</td><td>1.5</td></tr>
<tr><td rowspan="2">BX22/0053</td><td>5/03/2018</td><td rowspan="2">No stock, no manure</td><td>1</td><td>0</td><td>0.7</td><td>0.7</td><td>19.4</td></tr>
<tr><td>15/03/2018</td><td><1</td><td>0</td><td>0</td><td>0</td><td>20.5</td></tr>
<tr><td rowspan="2">BX22/0044</td><td>12/03/2018</td><td rowspan="2">No stock, no manure</td><td>2</td><td>0</td><td>0</td><td>6.4</td><td>28.1</td></tr>
<tr><td>16/03/2018</td><td>4</td><td>0</td><td>0</td><td>0</td><td>6.4</td></tr>
<tr><td>BX22/0043</td><td>12/06/2018</td><td>No stock, old manure.</td><td>1</td><td>8.3</td><td>7</td><td>7</td><td>32.6</td></tr>
<tr><td rowspan="2">BX22/0041</td><td>15/6/2018</td><td rowspan="2">No stock, old pats</td><td>68</td><td>0</td><td>0.5</td><td>8.2</td><td>23.5</td></tr>
<tr><td>27/06/2018</td><td><1</td><td>0</td><td>0</td><td>0</td><td>4.5</td></tr>
</table>

[A] Rainfall from NIWA's Hororata Weather Station 4702.

When groundwater *E. coli* trigger levels are exceeded, CPWL works through a response flowchart as per Figure 33 of this report. The lower concentration results are considered to reflect baseline groundwater quality, especially where bores have shown similar *E. coli* levels prior to commencement of CPWL irrigation, and as such no further action was taken at the time.

It was noted that very little rain was measured at NIWA's Weather Station, 4702 in the lead up to monitoring where an *E. coli* level of 2 MPN/100ml was detected from BX22/0018 (SWL 83.15mbgl) on 6 December 2017. Half a millimetre and 1.0 mm of rainfall was recorded on 29 and 30 November respectively in the week prior to sampling, so rainfall was not likely to be a significant contributor to the positive *E. coli* detection. The bore is located adjacent to a road and there was no evidence that stock had been in the area recently. No potable water is sourced from any bore close to BX21/0018.

20.6mm of rainfall was recorded in the week prior to an *E. coli* level of 1MPN/100ml being detected from BX22/0053 on 5 March 2018, however no rain was recorded on the day of sampling and only 1.2mm was recorded in the 6 days prior to sampling. There was no evidence that stock had grazed the area adjacent to the bore for some time. A retest of this bore on 15 March 2018 did not detect *E. coli*.

28.1mm of rainfall was measured in the week before monitoring took place where an *E. coli* level of 2MPN/100ml was detected from BX22/0044 on 12 March 2018. 6.4mm fell two days before sampling and 14.1mm on the fourth day prior to sampling. At the time of sampling there were no stock grazing in the paddock containing the bore. Potable water for the nearby dwelling is sourced from a 62 deep bore located over 150m from BX22/0044, which showed water levels for 2017-18 of between 4-5mbgl.

An *E. coli* level concentration of 1 MPN/100ml was recorded from bore BX22/0043 on 12 June 2018. A reasonable amount of rain fell in the lead up to monitoring with 8.3mm falling on the monitoring day and 7mm falling the day before. A total of 32.6mm was recorded during the week prior to sampling taking place. No recent grazing was apparent around the bore. There are no potable water bores within several hundred meters of BX22/0043.

*E. coli* was detected in a sample taken from BX22/0041 (SWL 19.76) on 15 June 2018 at 68MPN/100ml. There were no stock in the paddock containing the bore at the time of sampling and no evidence any had grazed there recently, No rain was recorded at Weather Station 4702 on the day of sampling, and 0.5mm was measured on 14 June, however 7.0, 8.3, and 7.7mm was recorded on 11, 12 and 13 June respectively. The bore was re-sampled on 27 June 2018 (no rain fell during the preceding six days and 4.5mm fell on 20 June) and a result of <1MPN/100ml was detected. The significant decrease in *E. coli* concentration between 15 and 27 June 2018 suggests that the source of contamination was a short lived event possibly related to the rainfall on 11 – 13 June. There is a dwelling located within 100m (downgradient) of BX22/0041, however the farm owner confirmed the potable water supply for the dwelling is sourced from one of two 100m deep bores located several hundred metres from BX22/0041, which had water depths between 18-20mbgl for 2017-18. Further monitoring will help to establish any ongoing pattern of detections at this bore. *E. coli* was not detected in this bore during September 2018.

**Nitrate-Nitrogen**

Annual Medians >7.65mg/L

There are five Stage 1 bores that had an average Nitrate-N concentration for the 2017-18 monitoring period of greater than 7.65mg/L, namely BX21/0017, BX22/0043, BX22/0053, BX22/0044 and BX22/0046 (see blue shaded columns in Table 8). With the exception of BX22/0044, these bores also had average Nitrate-N concentrations greater than 7.65mg/L for the 2014/15, 2015/16 and 2016/17 monitoring periods. Although the results show BX22/0017, BX22/0043 and BX22/0046 exceeded 11.3mg/L the bores were either not within 100m of a dwelling, or if within 100m, the dwelling is connected to a reticulated potable water supply, and therefore did not breach any consent requirement or require notification to any owners/tenants.

**Table 8**. Stage 1 Bores Nitrate-N Results (mg/L) March 2014 to June 2018

| Date | BX21/0017 | BX21/0018 | BX22/0041 | BX22/0042 | BX22/0043 | BX22/0053^ | BX22/0044 | BX22/0046 |
|---|---|---|---|---|---|---|---|---|
| Jun-18 | **13** | 4.98 | 5.02 | 4.76 | **11.2** | **9.35** | 5.46 | **16.8** |
| Mar-18 | **16.7** | 4.04 | 6.97 | 2.42 | **11.2** | **10.7** | 7.19 | **18.9** |
| Dec-17 | **14.4** | 4.22 | 6.31 | 2.86 | **14.9** | **10.5** | 6.46 | **19.2** |
| Sep-17 | **17.3** | 3.79 | 6.77 | 4.18 | **11** | **13.3** | **12.6** | **22.2** |
| Jun-17 | **14** | 3.2 | 4.8 | 3.8 | **10.4** | **8.3** | 7.2 | **13.9** |
| Mar-17 | **8.8** | 5.4 | 5.5 | 5.2 | **9.4** | **9.7** | 6.3 | **11.8** |
| Dec-16 | 5.2 | 3.5 | 4.9 | 5.5 | **12.7** | **8.3** | 6.7 | **11.9** |
| Sep-16 | 6.8 | 3.3 | 4 | 5 | **13.7** | **7.8** | 5.2 | **11.9** |
| Jun-16 | **9.2** | 3.6 | 4.5 | 5.4 | **13** | **9** | 5.9 | **12.2** |
| Mar-16 | **8.5** | 4.4 | 6.7 | 5.7 | **13** | **9.8** | 5 | **12.3** |
| Dec-15 | **9.1** | 3.5 | 5.3 | 6.1 | **13.1** | **8.5** | 5.6 | **12.4** |
| Sep-15 | **8.5** | 2.9 | 4.1 | 4.9 | **14.3** | **8.3** | 6 | **12.5** |
| Jun-15 | 5.9 | 3.2 | 2.7 | 5.2 | **14.6** | **10.5** | 4.5 | **12.6** |
| Mar-15 | 7.1 | 4 | 3.1 | 3.5 | **10.9** | **11** | 4.6 | **12.8** |
| Dec-14 | **7.9** | 3.6 | 4.9 | 6.2 | **13** | **8** | 3.9 | **12.4** |
| Sep-14 | **10.2** | 3.1 | 3.9 | 5.5 | **10.2** | 6.3 | 4.5 | **13.2** |
| Jun-14 | **11.2** | 4.3 | 4.6 | 5.7 | **9.9** | - | 7.4 | **14.4** |
| Mar-14 | **7.8** | 4.3 | 4.3 | 5.3 | **13.6** | - | 4.1 | **12.9** |
| 2017-18 Mean | 15.4 | 4.3 | 6.3 | 3.6 | 12.1 | 11.0 | 7.9 | 19.3 |
| 2016-17 Mean | 8.7 | 3.9 | 4.8 | 4.9 | 11.6 | 8.5 | 6.4 | 12.4 |
| 2015-16 Mean | 8.8 | 3.6 | 5.2 | 5.5 | 13.4 | 8.9 | 5.6 | 12.4 |
| 2014-15 Mean | 7.8 | 3.5 | 3.7 | 5.1 | 12.2 | 9.0 | 4.4 | 12.8 |
| All Data Mean | 10.1 | 3.9 | 4.9 | 4.8 | 12.2 | 9.3 | 6.0 | 14.1 |
| Screened Interval (mbgl) | 1.1 - 11.1 | 55.1 - 105.1 | 10.1 - 40.1 | 29.4 - 69.4 | 20.1 - 70.1 | 20.3 - 50.3 | 1.0 - 9.0 | 1.0 - 30.0 |
| Water level range (mbgl)* | 6.4 - 9.9 | 67.0 - 93.7 | 18.6 - 23.8 | 40.3 - 49.5 | 50.7 - 65.2 | 33.6 - 46.4 | 4.8 - 7.6 | 7.1 - 14.4 |

^ BX22/0045 is located 5m from BX22 /0053. It is no longer monitored by CPW because it only extends 30m below ground.

* To 1 decimal place.

Figure 23 shows the land use, and Figure 24 the irrigation type, of CPWL shareholder farmland located up-gradient of the monitoring bores that had mean annual Nitrate-N concentrations of greater than 7.65mg

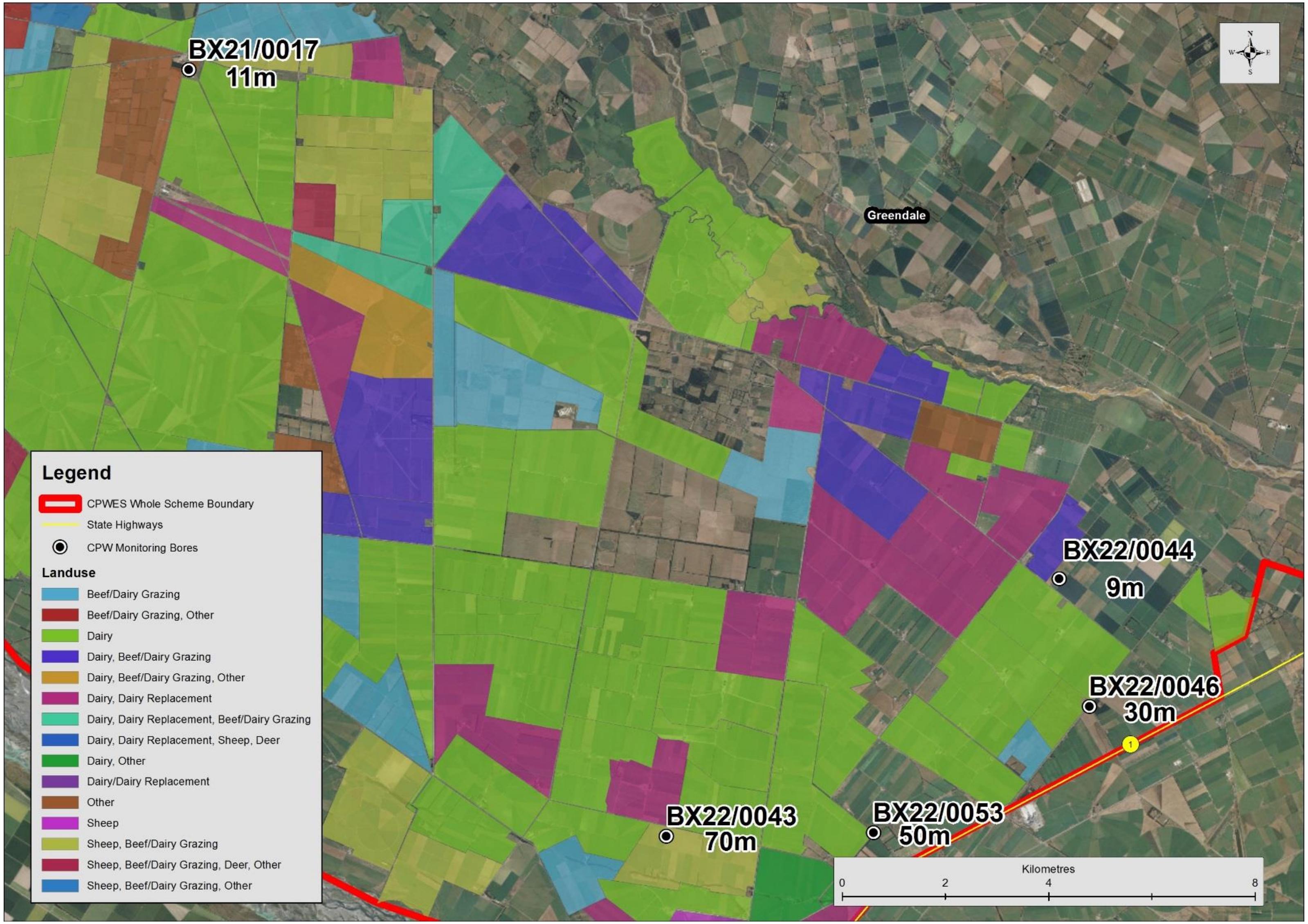



**Figure 23**. Shareholder Land Use Up-Gradient of the Stage 1 Elevated Nitrate-N Bores


**Figure 24**. CPWL Shareholder Irrigation Types for Farms Up-Gradient of Stage 1 Elevated Nitrate-N Bores

Bores with new maximum Nitrate-N concentrations measured within the last 12 months

Nitrate-N concentrations from Bores BX21/0017, BX22/0041, BX22/0043, BX22/0053, BX22/0044 and BX22/0046, reached new maxima during the 2017-18 monitoring period, with BX21/0017, BX22/0053, BX22/0044 and BX22/0046 exhibiting the greatest concentrations in the September 2017 monitoring round (Refer to Figure 25).

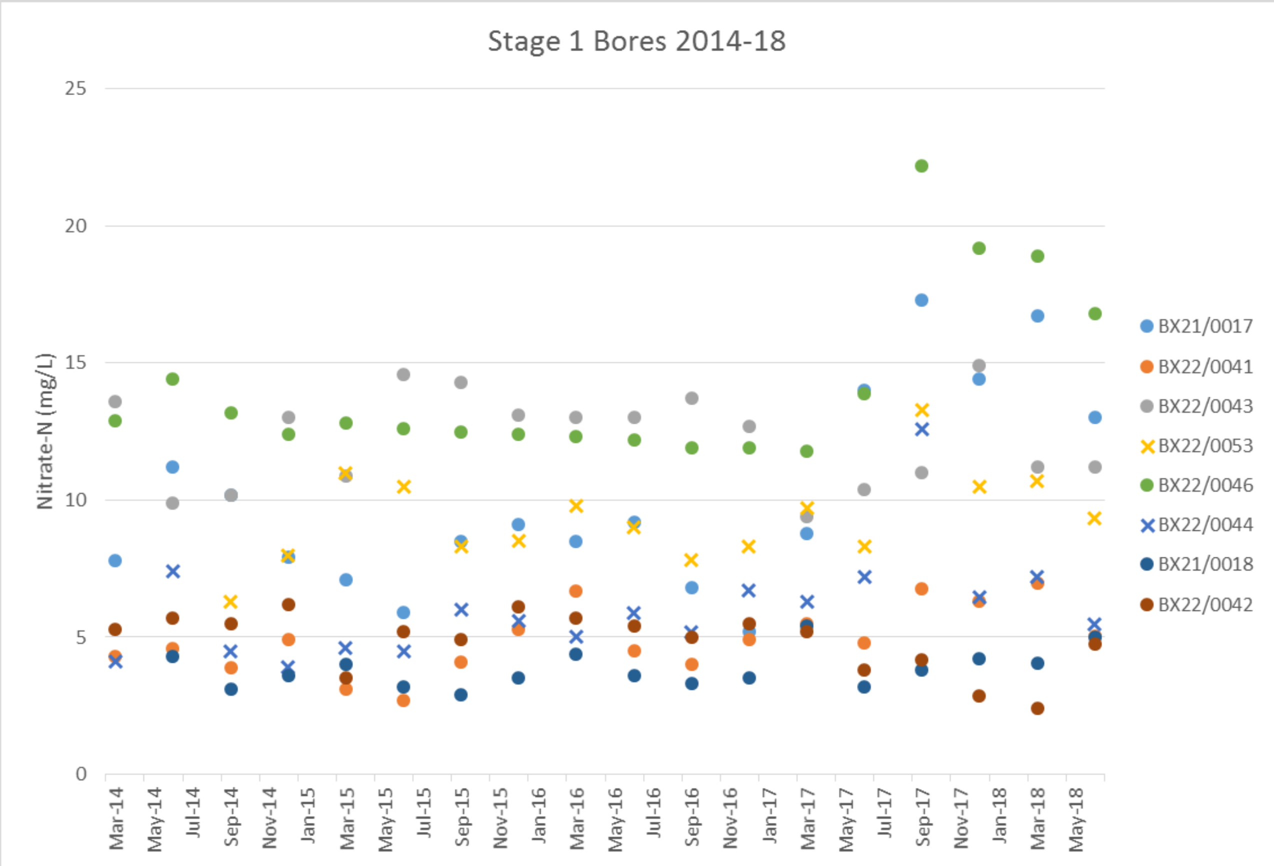



**Figure 25**. Stage 1 Groundwater Nitrate-N; March 2014 to June 2018

A search of ECan's Water Quality database revealed no instances of higher Nitrate-N levels being determined from any bore adjacent to a CPWL Stage 1 monitoring bore that recorded new maximum Nitrate-N concentration during the July 2017 to June 2018 period . [NB: ECan determined a Nitrate-N concentration of 21mg/L from bore L36/0003 on 24 August 2017. CPWL monitoring determined a maximum to date Nitrate-N concentration of 17.3mg/L from bore BX21/0017 on 7 September 2017. L36/0003 and BX21/0017 are located approximately 10m apart and were well correlated 'paired bores' that CPWL monitored during 2014-15].

In the absence of long term Nitrate-N data from long-screen monitoring bores there is no way yet of knowing whether the new maximum Nitrate-N readings obtained from Stage 1 bores actually represent new absolute maximum concentrations in the environment or whether this is simply the first instance where Nitrate-N readings have been taken from immediately below the static water level following a significant rain event that followed three 'dry' years.

Table 3 from the CPWL's Baseline Water Quality assessment (Part 1 of the Ground and Surface Water Plan) contains a summary of ECAN monitoring data (to June 2013), which showed Nitrate-N levels have been recorded as high as 36.9mg/L.

For comparison, eight out of 10 Stage 2 monitoring bores showed new maximum Nitrate-N concentrations in the 2017-18 monitoring period.

### 4.3.2. Sheffield

***E. coli***

*E. coli* was not found above the detection limit in Bore BW22/0041 during the monitoring period. *E. coli* concentrations of 1, 1, and 26 MPN/100ml were recorded from BW22/0042 during routine September 2017, December 2017 and March 2018 monitoring rounds.

The following 'Sheffield' rainfall data was sourced from a Weather Station located in nearby Waddington (Weather Station ID: ICANTERB351 on Weather Underground (https://www.wunderground.com/personal-weather-station/dashboard?ID=ICANTERB351.

Very little rain was recorded prior to an *E. coli* level of 1MPN/100ml being measured on 13 September with 5.3mm falling on 10 September. 7.2mm of rain fell during the three days prior to an *E. coli* level of 1MPN/100ml being measured on 4 December with 21.4mm falling during the week prior to sampling.

A greater amount of rain was recorded prior to an *E. coli* level of 26MPN being measured on 7 March 2018 with 1.8, 19.6, 1 and 4.6mm being recorded on 7, 6, 5 and 2 March respectively. It was noted that sheep dung was present around the immediate bore area on 7 March 2018 so contamination during acquisition of the water sample may explain the elevated, albeit short-term, *E. coli* level.

BW22/0042 was retested for *E. coli* following receipt of the 26MPN/100ml result from the 7 March 2018 sample. A concentration of 2MPN/100ml was determined for the retest sample taken on 14 March 2018. No rain was recorded on the day of, and for four days prior to sampling but 12.2mm was recorded on 9 March. The nearest dwelling to this bore is located further than 200m away and up-gradient so no further action was deemed necessary.

The presence of rain prior to sampling isn't always a predictor of *E. coli* subsequently being found in water samples. No *E. coli* was detected in the June 2018 monitoring round but 21.8mm and 37.6mm of rain was recorded in the three and seven days prior to sampling respectively, and pooled water was observed at the gateway entrance to the paddock containing the bore.

Further monitoring will help to establish any patterns related to *E. coli E. coli* detections.

**Nitrate-Nitrogen**

Nitrate-N levels measured in the two Sheffield monitoring bores between September 2017 and June 2018 were within the ranges previously measured (before such time as the Sheffield Scheme was operating) (refer to Figure 26). Annual Medians Nitrate-N concentrations were 7.0mg/L for BW22/0041 and 4.7mg/L for BW22/0042.

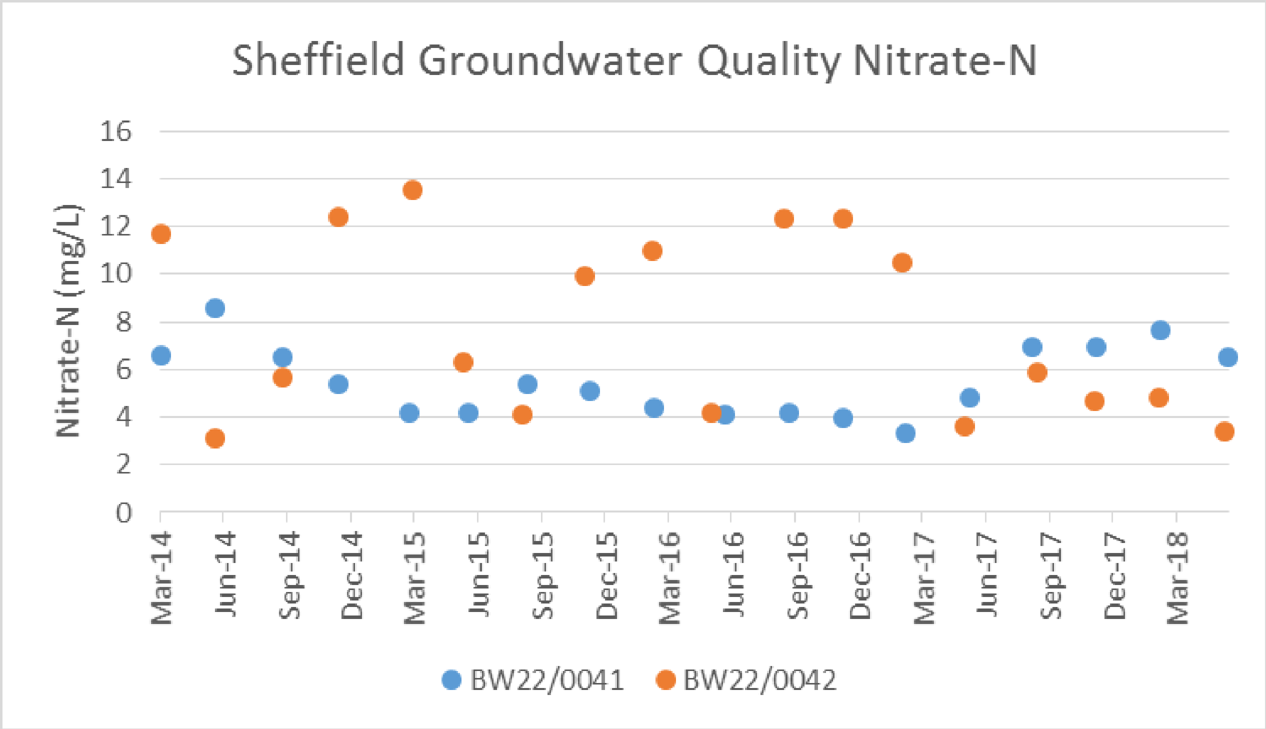



**Figure 26**. Nitrate-N Concentrations in CPWLs Sheffield Monitoring Bores

### 4.3.3. Stage 2

***E. coli***

CPWL are not yet operating Stage 2 of the Scheme so all results in Table 9 form part of the baseline to which future monitoring results will be compared to.

The detection of *E. coli* continues to occur at a higher frequency in bores from Stage 2 bore compared to Stage 1. For the 2017-18 monitoring period, *E. coli* was detected in 25% of routine Stage 2 samples compared to 15.6% for Stage 1 [2016-17 - 22% for Stage 2 compared to 12.5% for Stage 1]. Results from the eight Stage 2 bores that had samples test positive for *E. coli* are shown in Table 9 below. Rainfall data for up to a week preceding positive *E. coli* detections is shown in Table 10.

**Table 9**. Stage 2 Bores in which Samples of *E. coli* were Detected (MPN/100ml).

| Date | BX22/0065 | BX22/0066 | BX22/0067 | BX22/0068 | BX22/0070 | BX22/0071 | BX23/0423 | BX22/0072 |
|---|---|---|---|---|---|---|---|---|
| Jun-18 | <1 | <1 | 16 | 18 | <1 | 2 | 2 | 1 |
| Mar-18 | 4 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Dec-17 | 12 | <1 | 29 | <1 | <1 | <1 | <1 | <4 |
| Sep-17 | <1 | 2 | <1 | <4 | 1 | <4 | <4 | <1 |
| Jun-17 | 0 | 0 | 0 | 3 | 10 | 0 | 2 | 0 |
| Mar-17 | 0 | 0 | 78 | 0 | well dry | 0 | well dry | 0 |
| Jan-17 | 0 | 0 | 34 | - | - | - | - | - |
| Dec-16 | 3 | 8 | >201 | 0 | 0 | 2 | 0 | 0 |
| Sep-16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-16 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| Mar-16 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| Dec-15 | 12 | 0 | >201 | 2 | 0 | 0 | 0 | 0 |
| Sep-15 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Jun-15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 10**. Rainfall[A] associated with bore water samples that had positive detections of *E. coli*.

| Bore | Sample Date | Site Condition | *E. coli* (MPN/ 100ml) | Rainfall (mm) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Sample Day | Previous 24hrs | Previous 48hrs | Previous week |
| BX22/0070 | 12/9/2017 | | 1 | 0 | 0.5 | 1 | 1 |
| BX22/0066 | 15/9/2017 | | 2 | 0 | 0 | 0 | 1 |
| BX22/0067 | 5/12/2017 | No stock, cow manure near bore | 29 | 0 | 0 | 0 | 0 |
| | 12/12/2017 | No stock, cow manure near bore (1 wk older) | 2 | 2.5 | 0 | 0 | 0 |
| BX22/0065 | 7/12/2017 | No stock, no manure | 12 | 0 | 0 | 0 | 0 |
| BX22/0065 | 2/3/2018 | No stock, no manure | 4 | 1 | 0 | 0 | 15 |
| | 14/3/2018 | | 1 | 0 | 0 | 0 | 4 |
| BX22/0071 | 5/6/2018 | No stock, some sheep manure around bore | 2 | 7.5 | 6.5 | 11 | 13.5 |
| BX22/0072 | 5/6/2018 | No stock or manure | 1 | 7.5 | 6.5 | 11 | 13.5 |
| BX22/0068 | 8/6/2018 | Cattle in paddock, bare soil around bore with some pooled water | 18 | 0 | 2 | 12 | 30.5 |
| BX22/0067 | 14/6/2018 | No stock, pooled water in vicinity of bore | 16 | 0 | 4.5 | 8.5 | 15.5 |
| BX23/0423 | 14/6/2018 | Sheep in paddock, site free of manure | 2 | 0 | 4.5 | 8.5 | 15.5 |

[A] Rainfall from ECan's Ridgens Road Monitoring Site.

*E. coli* was detected in bore BX22/0067 in two routine monitoring rounds in 2017-18, for a total of seven positive detections out of 13 routine monitoring rounds carried out to date. Although positive detections during 2016-17 appeared to be correlated to rainfall, this does not appear to be the case for 2017-18. A stock water trough located approximately 30m west of BX22/0067, may still be a contributor to the elevated *E. coli* levels found during some monitoring rounds.

No potable water is sourced from within 100m any of the Stage 2 Bores that had positive *E. coli* detections during 2017-18. Dwellings are located within 100m of BX22/0065 and BX22/0067 but their water sources are located further than 1km and 250m away respectively.

With the exception of BX22/0071, the bores listed in Tables 9 and 10 are all located in areas where stock periodically graze but there are no other readily apparent factors (other than those explained above for BX22/0067), i.e. a septic tank located up-gradient of the bores, that help explain the positive *E. coli* readings recorded.

Figures 27 and 28 display the land use and irrigation type used by farms up-gradient of the groundwater that gave samples positive for *E. coli* in 2017-18. There is expected to be notable changes to land use between 2017-18 and 2018-19 due to up take of CPWL water in the Stage 2 area.

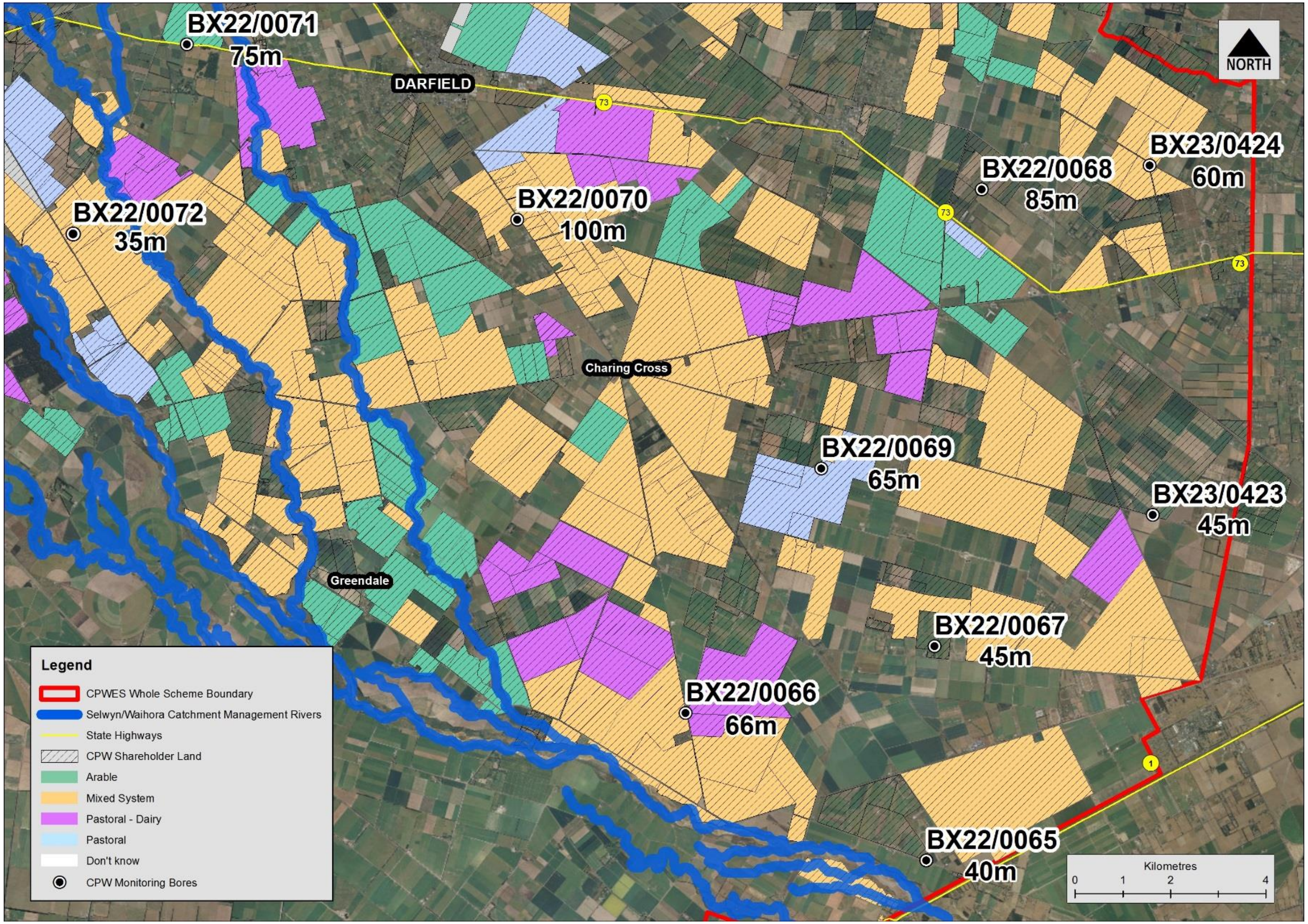
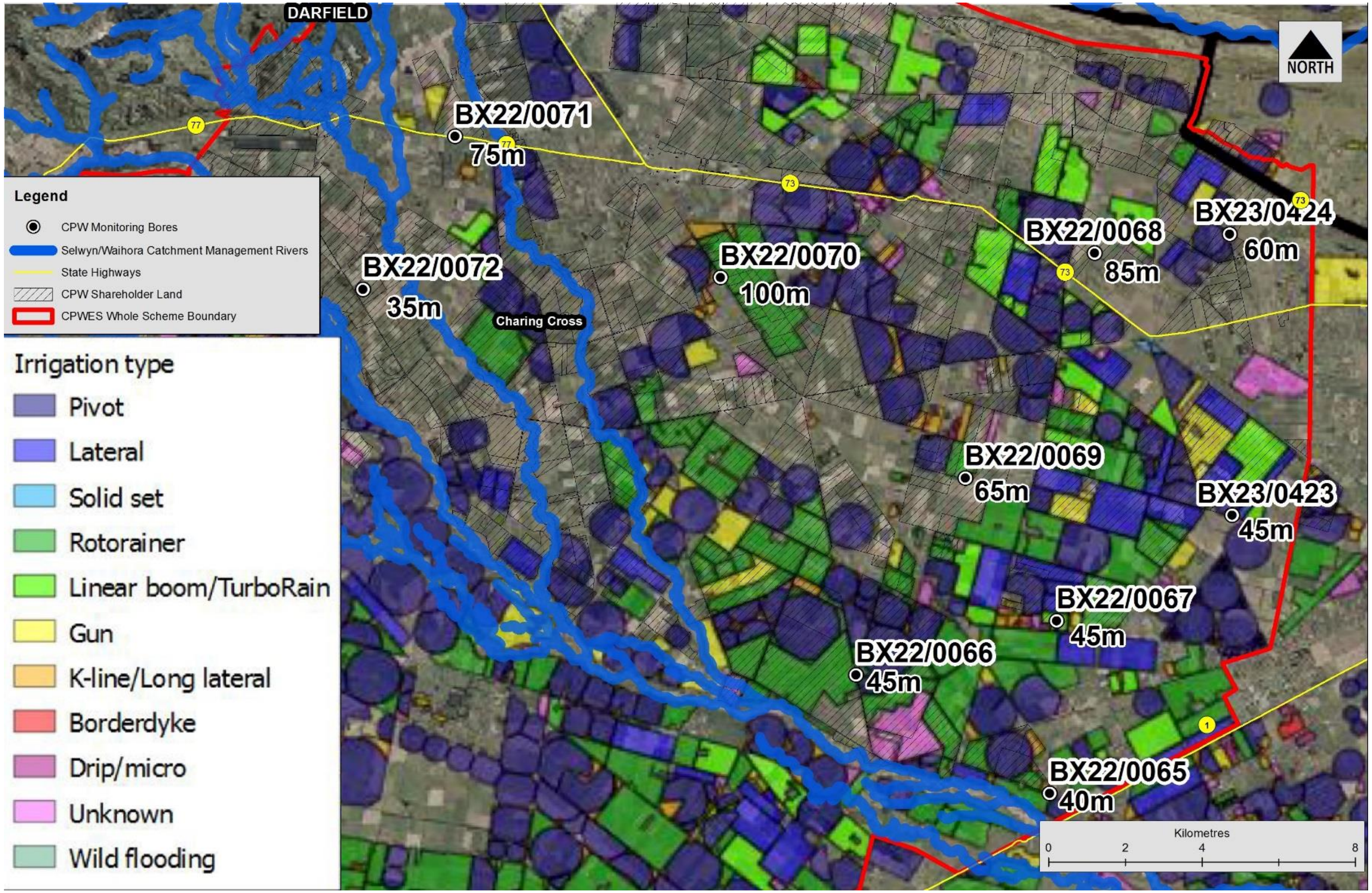



**Figure 27**. Land use of Stage 2 farms located up-gradient of *E. coli* positive, and/or elevated Nitrate-N, bores




*Irrigation Type data sourced from 'Canterbury Detailed Irrigated Area Mapping' prepared for ECan by Aqualinc 5 July 2016.*

**Figure 28.** Irrigation status of Stage 2 farms located up-gradient of *E. coli* positive, and/or elevated Nitrate-N, bores.

**Nitrate-Nitrogen**

Eight of the ten Stage 2 bores had a 12-month mean Nitrate-N concentration of greater than 7.65mg/L (see blue shaded columns in Table 11). Five bores had a mean Nitrate-N concentration greater than 7.65mg/L for the 2016-17 monitoring period.

**Table 11** Stage 2 Bores Nitrate-N Results (mg/L) March 2014 to June 2018

| Date | BX22/0065 | BX22/0066 | BX22/0067 | BX22/0068 | BX22/0069 | BX22/0070 | BX22/0071 | BX22/0072 | BX23/0423 | BX23/0424 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jun-18 | **13.5** | 5.21 | **17.4** | **15.7** | **9.76** | **9.47** | 3.4 | **14.6** | **18.2** | **10.7** |
| Mar-18 | **15.5** | 5.87 | **16.9** | **17.7** | **13.5** | **10.1** | 3.51 | **15** | **17.9** | **16** |
| Dec-17 | **14.1** | 3.88 | **16.1** | **15.7** | **11.7** | **9.48** | 3.34 | **16.6** | **17.5** | **13.1** |
| Sep-17 | **21.3** | 6.54 | **18.5** | **24.8** | **15.7** | **14.6** | 3.59 | **15.2** | **18.1** | **13** |
| Jun-17 | **17.8** | 3 | **11.9** | 2.8 | well dry | 7.6 | 3 | **11.3** | **11.2** | 7.5 |
| Mar-17 | **8.9** | 4.1 | **12.7** | 2.5 | well dry | well dry | 2.9 | 6.4 | well dry | 7.6 |
| Dec-16 | 6.4 | 3.9 | **12.2** | 3.3 | **9.7** | **7.7** | 3 | 7.5 | 4.4 | **7.8** |
| Sep-16 | **9.1** | 7.2 | **9.6** | 2.8 | **9.4** | 7.5 | 3 | 7.2 | 4.9 | **7.9** |
| Jun-16 | **9.1** | **13.1** | **13.1** | 2.9 | **9.6** | 7.6 | 3.6 | 4.6 | **10.3** | **7.9** |
| Mar-16 | **8.9** | **8.9** | **12.1** | 3.3 | **9.8** | **7.7** | 3.2 | 5.8 | 5.5 | **8.1** |
| Dec-15 | **9.5** | 6.2 | **13** | 3.5 | **10.2** | 7.6 | 2.8 | 7.4 | **9.1** | **9** |
| Sep-15 | **10.9** | 4.9 | **14.5** | **11.9** | **9.9** | 7.5 | 3.1 | **9.0** | **10.7** | **11** |
| Jun-15 | **12.0** | **10.1** | **12.7** | 2.7 | **9.9** | 7.5 | 3.2 | 4.9 | **13.9** | **11.4** |
| 2017-18 Mean | **16.1** | 5.4 | **17.2** | **18.5** | **12.7** | **10.9** | 3.5 | **15.4** | **17.9** | **13.2** |
| 2016-17 Mean | **10.6** | 4.6 | **11.6** | 2.9 | **9.6** | 7.6 | 3.0 | **8.1** | 6.8 | **7.7** |
| 2015-16 Mean | **9.6** | **8.3** | **13.2** | 5.4 | **9.9** | 7.6 | 3.2 | 6.7 | **8.9** | **9.0** |
| All Data Mean | **12.1** | 6.4 | **13.9** | **8.4** | **10.8** | **8.7** | 3.2 | **9.7** | **11.8** | **10.1** |
| Screened Interval (mbgl) | 10.3 - 40.3 | 15.5 - 45.5 | 15.3 - 45.3 | 39.6 - 84.6 | 30.6 - 65.6 | 60.7 - 100.7 | 35.0 - 79.0 | 10.0 - 35.2 | 20.0 - 47.4 | 15.3 - 60.3 |
| Water Level Range (mbgl) | 6.7 - 19.1 | 19.3 - 36.4 | 29.6 - 43.4 | 59.5 - 70.2 | 54.1 - 63.6 | 80.7 - 99.3 | 46.7 - 71.0 | 6.7 - 21.5 | 26.9 - 41.8 | 37.3 - 53.5 |

NB: Water level ranges shaded with green highlight cases where water samples may have on occasion during 2017-18 been sampled from above the screen level but still 1m below the static water level.

Bores with new maximum Nitrate-N concentrations measured within the last 12 months

Nitrate-N concentrations from Bores BX22/0065, BX22/0067, BX22/0068, BX22/0069, BX22/0070, BX22/0072, BX23/0423 and BX23/0424, reached new maxima during the 2017-18 monitoring period, with BX22/0065, BX22/0067, BX22/0068, BX22/0069 and BX22/0070 exhibiting the greatest concentrations in the September 2017 monitoring round (Refer to Figure 29).

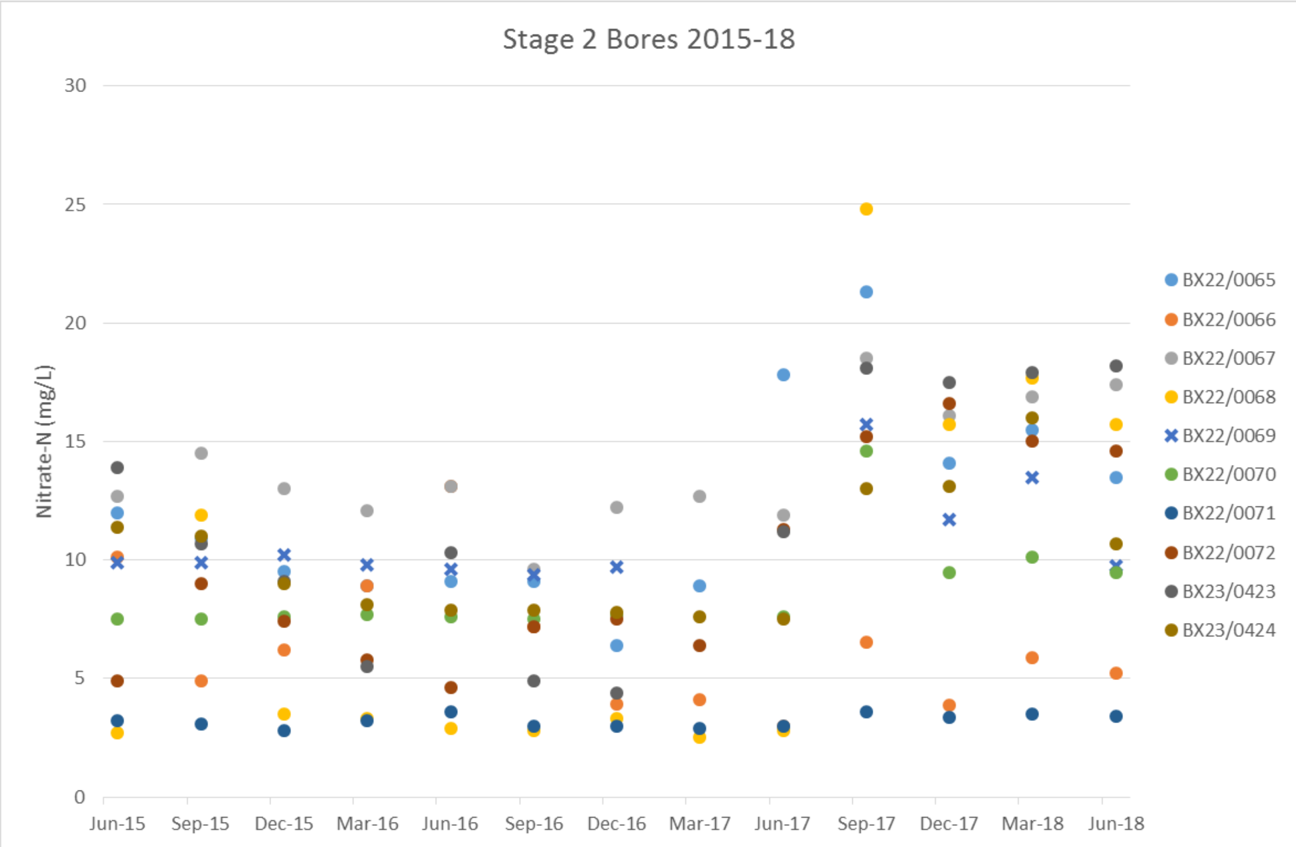



**Figure 29**. Stage 2 Groundwater Nitrate; June 2015 to June 2018

Overall one additional Stage 1 bore and three Stage 2 bores had a mean annual Nitrate-N concentration of greater than 7.65mg/L in 2017-18 compared to 2016-17.Figure 30 displays which of CPWL's 20 monitoring bores had a 2017-18 mean Nitrate-N concentration of more than 7.65 mg $L^{-1}$. NB: Trigger levels for Nitrate-N in groundwater are based on a five-year annual average so cannot be assessed against (for Stage 1) until the June 2020 groundwater monitoring round is completed.

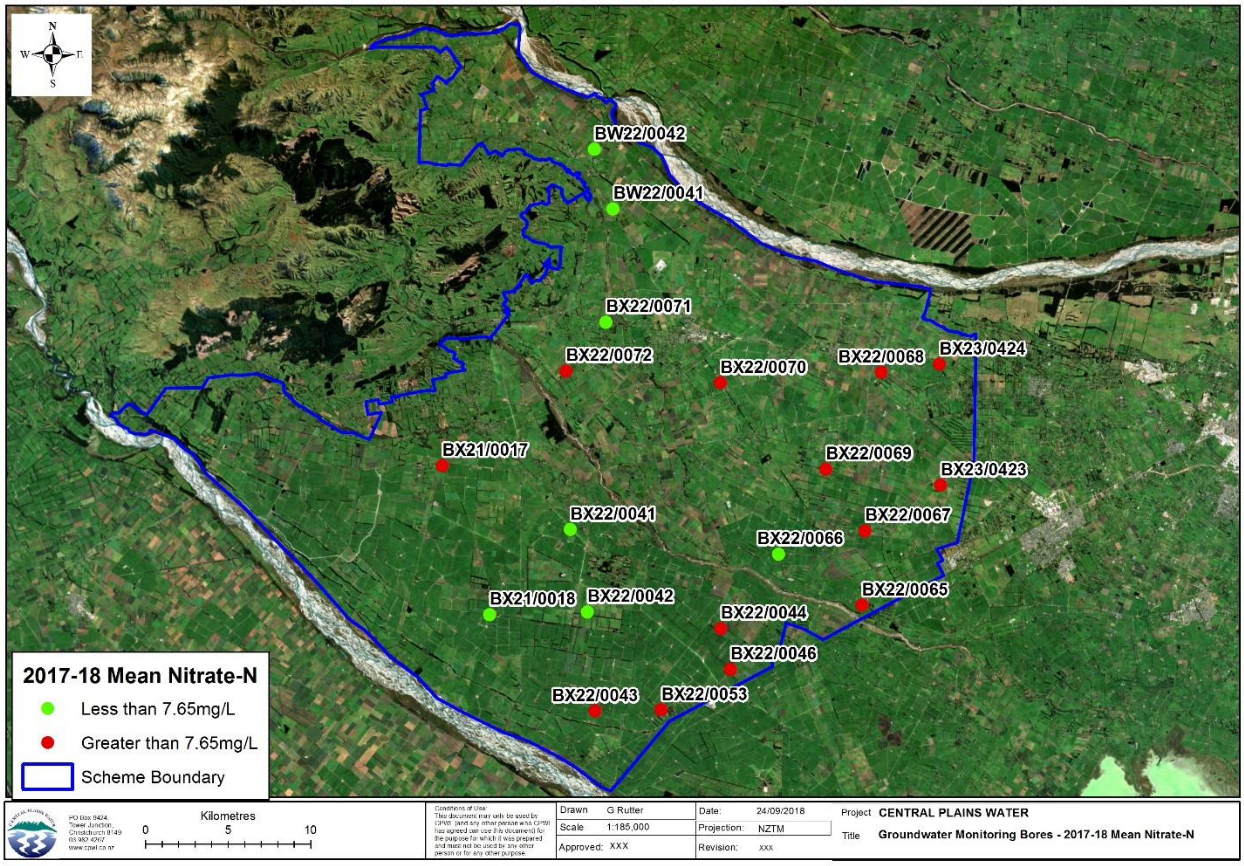



**Figure 30** Groundwater monitoring bores 2017-18 Mean Nitrate-N

## 4.4. Lowland Groundwater Level Monitoring

ECan replaced monitoring bore L36/0142 with monitoring bore L36/2369 from July 2017. The bores are located 2m apart so CPWL has carried the trigger level for L36/0142 across to L36/2369.

The Lowland groundwater level triggers are set at the 95th percentile of the (at least 40 year) historical record.

Between July 2017 and June 2018 groundwater trigger levels were reached in five of the 12 monitoring bores, namely L36/0182, L36/0202, M36/7880, M36/0419 and M37/0010 (refer to Figure 31 and Table 12). No trigger levels were exceeded during the 2015-16 and 2016-17 monitoring periods.

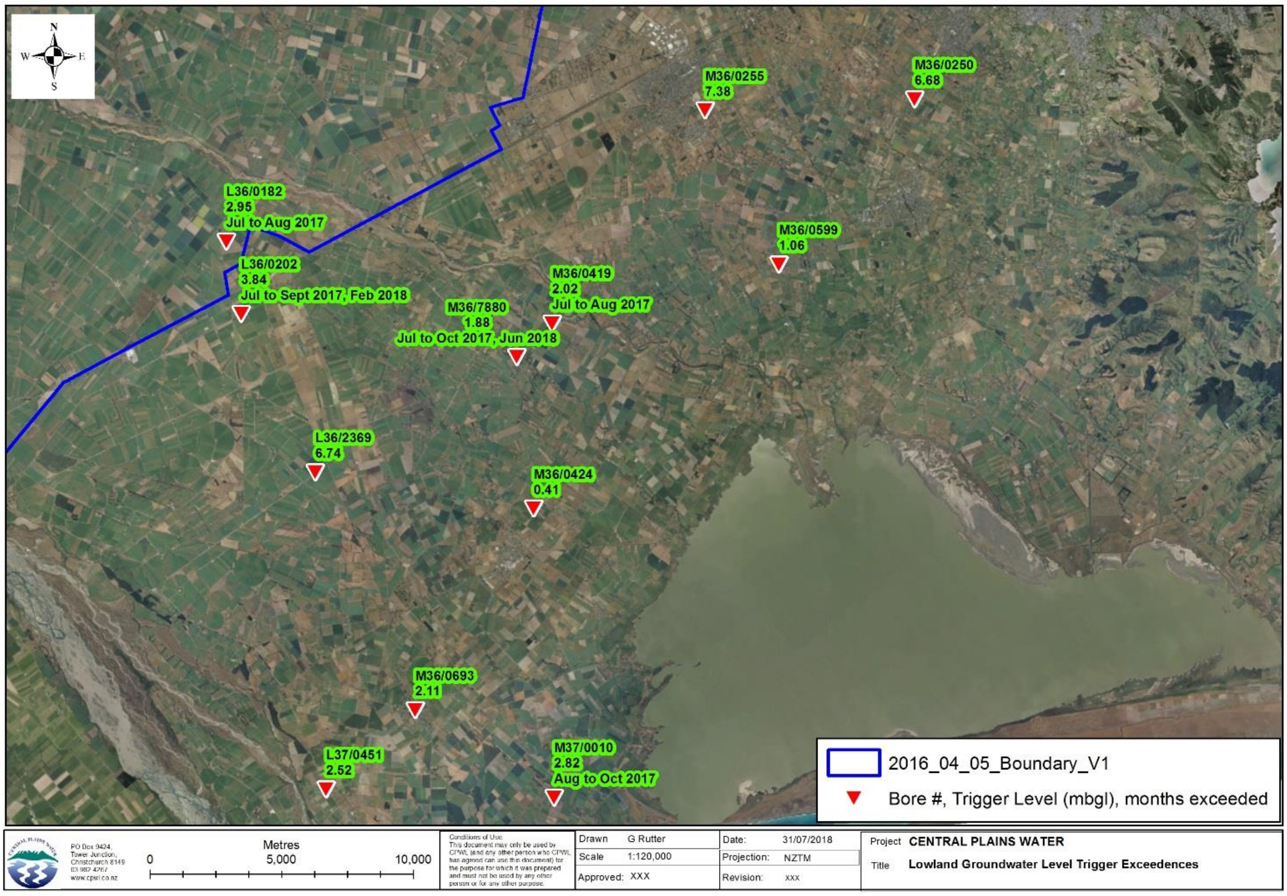



**Figure 31.** Lowland Groundwater Level Exceedance of Trigger Levels.

**Table 12** Stage 2 Bores Nitrate-N Results (mg/L) March 2014 to June 2018

| | | Trigger Level Exceeded | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bore | # Monthly Trigger Exceedances | Jul-17 | Aug-17 | Sep-17 | Oct-17 | Nov-17 | Dec-17 | Jan-18 | Feb-18 | Mar-18 | Apr-18 | May-18 | Jun-18 |
| L36/2369 | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| L36/0182 | **2** | yes | yes | - | - | - | - | - | - | - | - | - | - |
| L36/0202 | **4** | yes | yes | yes | - | - | - | - | yes | - | - | - | - |
| L37/0451 | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| M36/0250 | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| M36/0255 | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| M36/0419 | **2** | yes | yes | - | - | - | - | - | - | - | - | - | - |
| M36/0424 | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| M36/0599 | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| M36/0693 | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| M36/7880 | **5** | yes | yes | yes | yes | - | - | - | - | - | - | - | yes |
| M37/0010 | **3** | - | yes | yes | yes | - | - | - | - | - | - | - | - |

Groundwater levels rose appreciably following the 20-22 July rain event. The majority of the trigger exceedances occurred in the months following the July event with only two trigger exceedances coming after groundwater levels had receded below trigger levels.

CPWL did not receive any complaints concerning regarding elevated groundwater levels, or impacts on land drainage or on-site wastewater systems in the Lowland Plains Area.

# 5. Conclusion

Central Plains Water has now supplied irrigation water to the Stage one area for three seasons and to the Sheffield Scheme area for one season.

The large complex low pressure system brought heavy rain to Canterbury during 20-22 July 2017 which subsequently raised groundwater levels, and brought water to all of CPWL's surface water monitoring sites for the first time.

Following a three-year dry period, the July 2017 rain event appears to have acted as a catalyst to obscure any developing water quality trends for the catchment as a whole. Half of CPWLs surface water monitoring sites continued patterns of either not exceeding or exceeding their respective Nitrate-N trigger levels, while the other half switched from not exceeding to exceeding, or vice versa. Although some surface water and lake water quality trigger levels were exceeded, the levels were found to be consistent with results from previous years (prior to the CPWL Scheme operating) and therefore not attributable to effects of the Scheme. Annual Median and 95$^{th}$ Percentile Nitrate-N levels at the Doyleston Drain and Boggy Creek 'downstream' sites for 2017-18 were at the highest levels encountered since monitoring commenced in 1992-93 and 2003-04 respectively. However, trends of decreasing monthly spot sample Nitrate-N levels at both sites as the year progressed suggest the July rain event may be responsible for the new maximum Nitrate-N levels recorded.

For the first monitoring period since CPWL began supplying water some lowland groundwater level reached their respective trigger levels. The trigger levels were exceeded in July or August but by November groundwater levels had receded back below the respective trigger levels, although two monitoring bores exceeded the trigger levels later in the year.

No complaints were received during 2017-18 concerning any adverse environmental effects of the Scheme on groundwater or surface water, including more specifically, impacts on land drainage, or on-site wastewater systems.

During routine monitoring *E. coli* was detected from five Stage 1 monitoring bores on a single occasion each during 2017-18. Only a single result could be considered to be greater than a low level concentration and *E. coli* was not detected in this bore during a retest 12 days later. *E. coli* was detected in a significantly lower number of Stage 1 bore water samples compared to Stage 2 bore samples.

*E. coli* was detected in one of two Sheffield monitoring bores, twice at the lowest level possible and once at a greater than low level. A low level was detected during a retest a week later and *E. coli* was not detected during the following monitoring round.

Nitrate-N levels measure in the Sheffield monitoring bores were found to be within ranges previously encountered before the Scheme commenced operating. One bore consistently exhibited a Nitrate-N concentration at the lower end of the pre operating range.

New maximum Nitrate-N concentrations were measured in six of eight Stage 1 Monitoring bores during 2017-18. For comparison, new maximum Nitrate-N concentration were measured in eight out of 10 Stage 2 monitoring bores. In the absence of long term records from dedicated long-screen monitoring bores, it is not certain whether these new measured maximum Nitrate-N concentrations actually represent new absolute maximum concentrations present in the environment.

In general the monitoring results from three years of partial Scheme operation (Stage 2 not yet receiving CPWL water) are insufficient to confidently detect and attribute any effects of the Scheme on water quality, particularly when compared against some existing elevated and increasing contaminant trends caused by historic land uses and practices whose effects are time-lagged.

Some years of further water quality monitoring will be necessary, together with on-going assessment of CPWL and other land use change patterns in the catchment, to determine any significant change to existing elevated Nitrate-N concentrations and increasing trends, and whether any cause is attributable to CPWL, to previous land use changes and/or to improving practices through time.

# 6. Appendices

## 6.1. Ground and Surface Water Plan Part II – Trigger Limits and Trigger Response Processes

**Table 13**. Surface water quality triggers (Nitrate-N (mg/L)) for the CPWL monitoring programme

| River Type | pLWRP Variation 1 | | CPWL surface water monitoring | |
|---|---|---|---|---|
| | Annual Median | Annual 95$^{th}$ percentile | Annual Median | Annual 95$^{th}$ percentile |
| Spring-fed plains | 6.9 | 9.8 | 5.2 | 7.4 |
| Hill-fed lower | 2.4 | 3.5 | 1.8 | 2.6 |

**Table 14**. Water quality triggers for CPWL lake water quality monitoring

| Monitoring Location | TLI[(a)] | Total Phosphorus (mg/L)[(b)] | Total Nitrogen (mg/L)[(b)] | Chlorophyll A (µg/L)[(b)] |
|---|---|---|---|---|
| Mid-Lake | 6.6 | 0.1 | 3.4 | 74 |
| Lake Margins | 6 | n/a | n/a | n/a |

(a) TLI assumed to be calculated as TLI3 (using TP, TN and chl a)

(b) As a maximum annual average

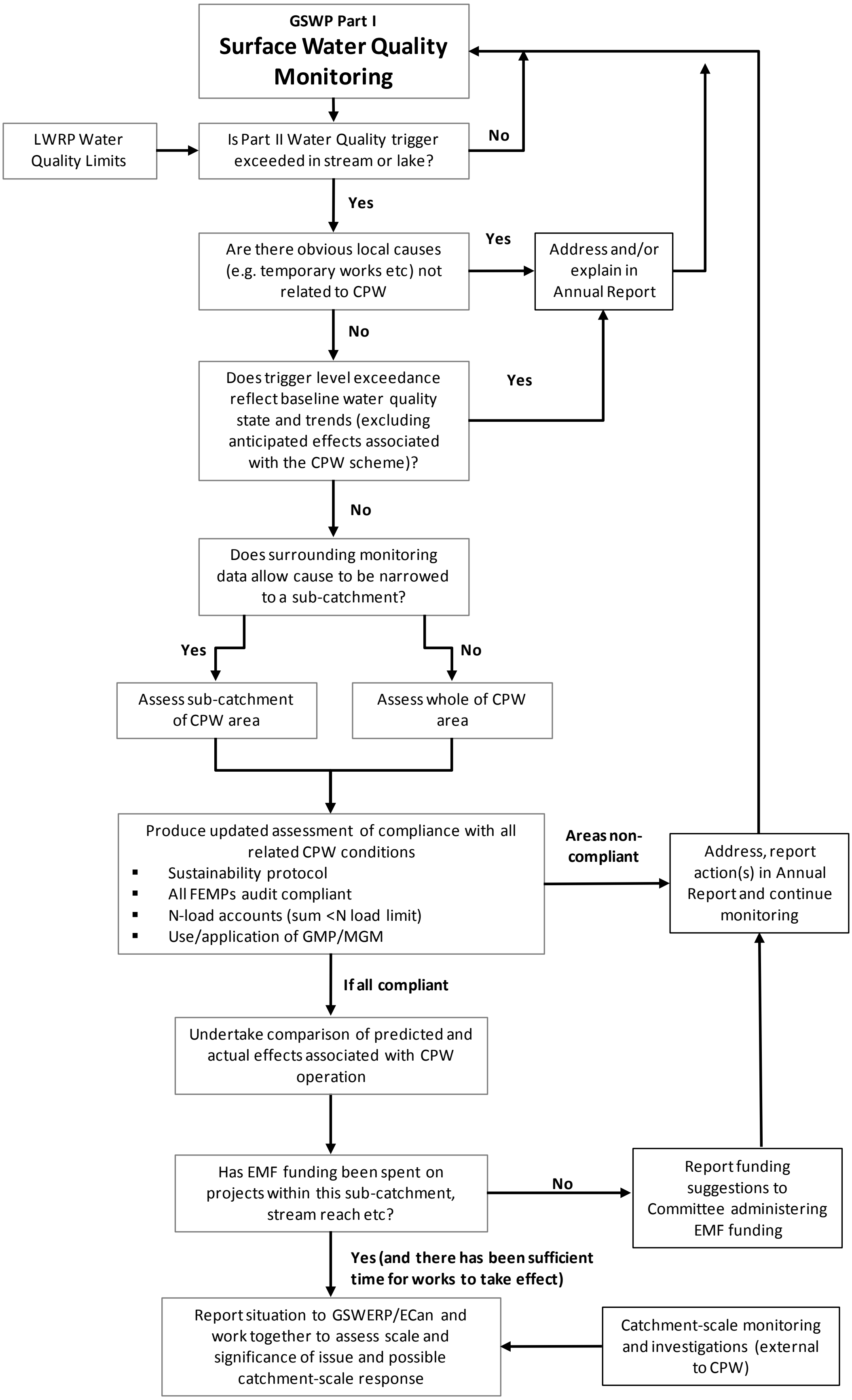



**Figure 32**. CPWL response to surface water quality trigger level exceedance

The CPWL response initiated following an exceedance of lake water quality triggers is consistent with that established for surface water quality monitoring.

**Table 15**. Groundwater quality triggers for the CPWL monitoring programme

| Contaminant | Measurement | Trigger |
|---|---|---|
| Nitrate-Nitrogen | 5-year annual average concentration(a) | 7.65 mg/L |
| E.coli | Median concentration(b) | <1 organism/100 millilitres |

(a) In shallow groundwater <50 metres below groundwater level

(b) Measured over the length of record

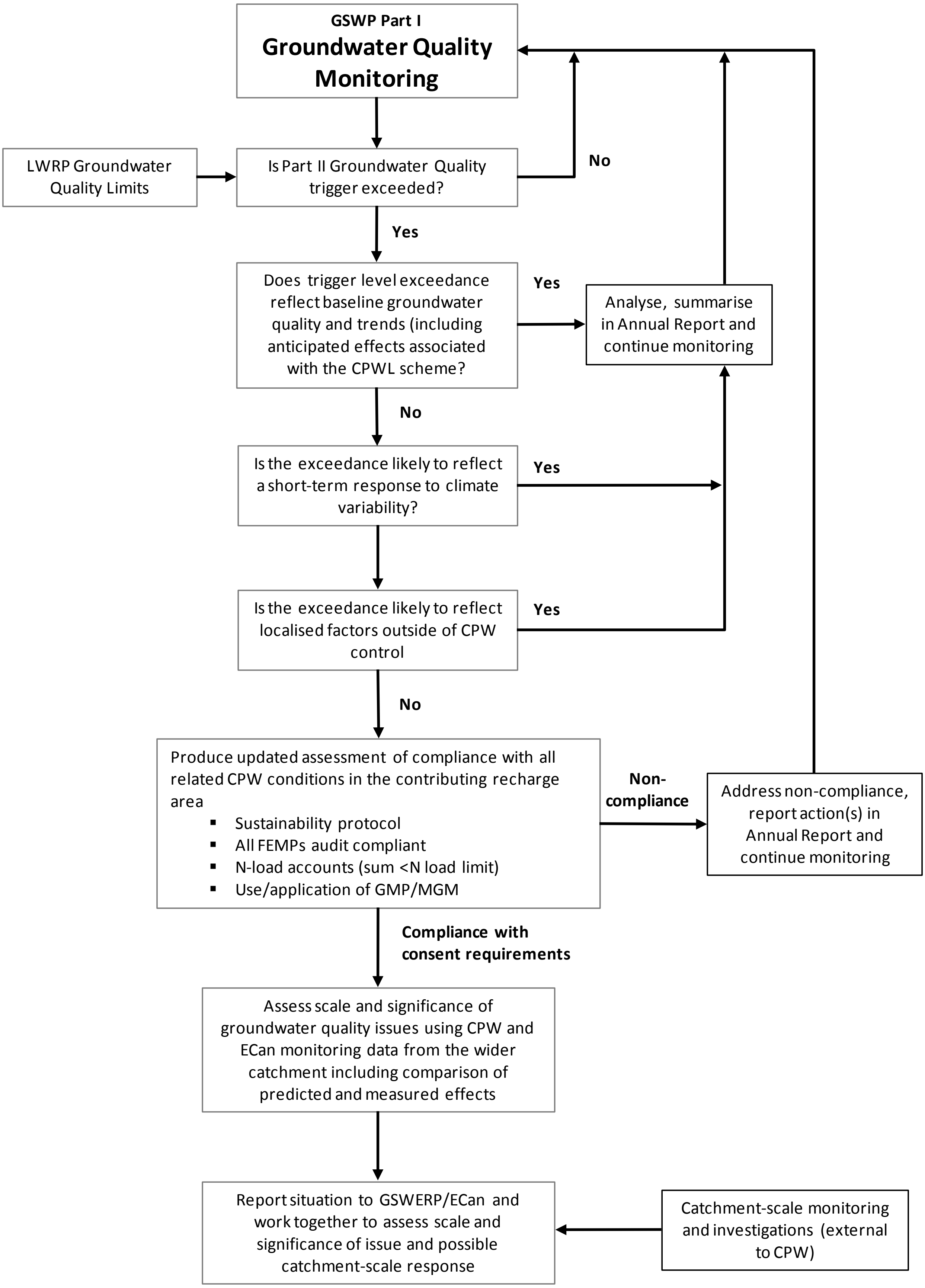



**Figure 33**. CPWL response to groundwater quality trigger level exceedance

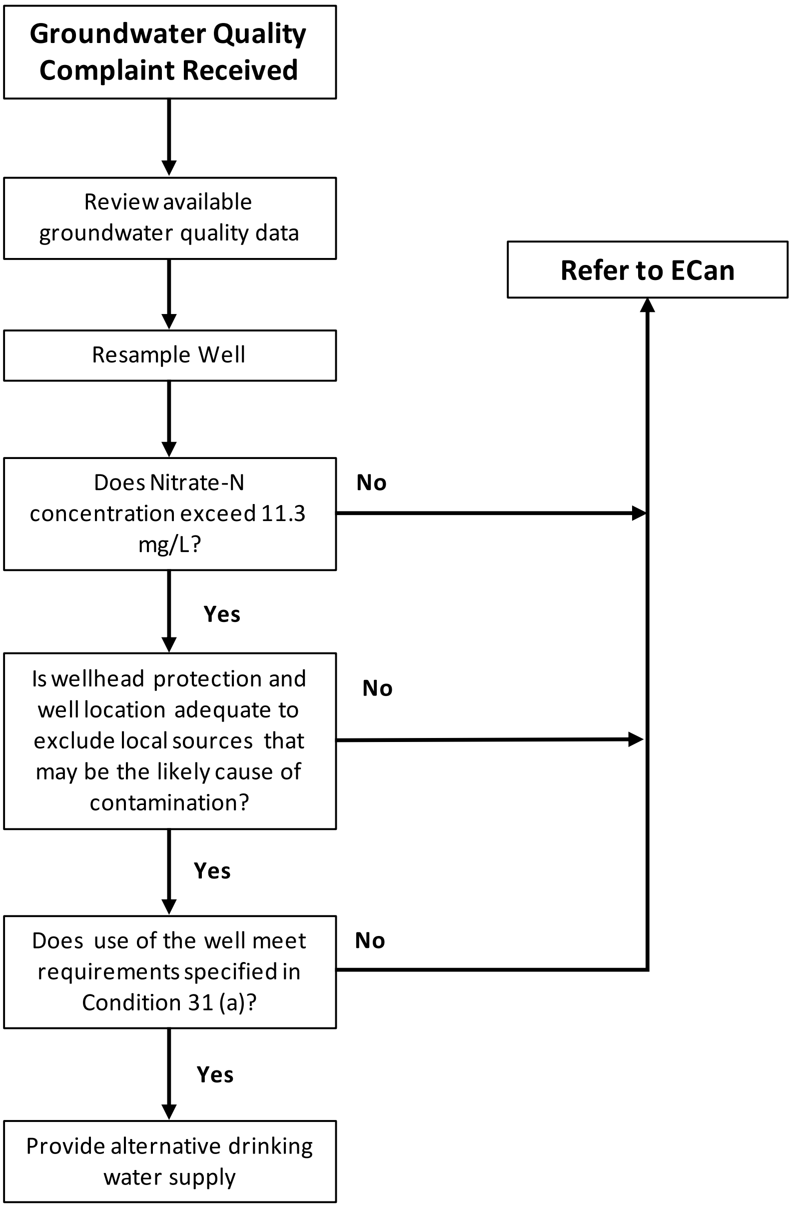



**Figure 34**. CPWL response to groundwater quality complaints

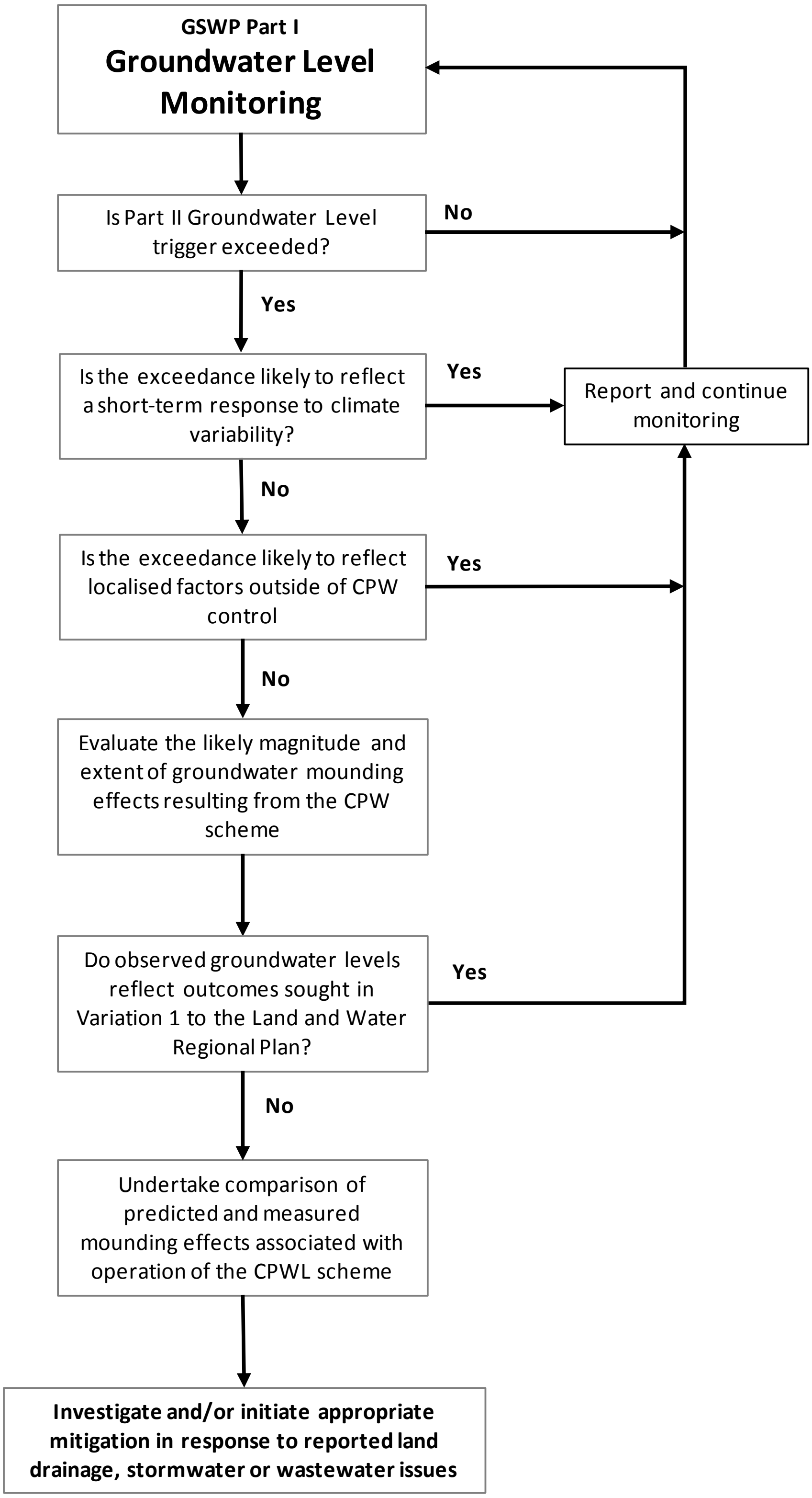



**Figure 35**. CPWL response to groundwater level trigger exceedance

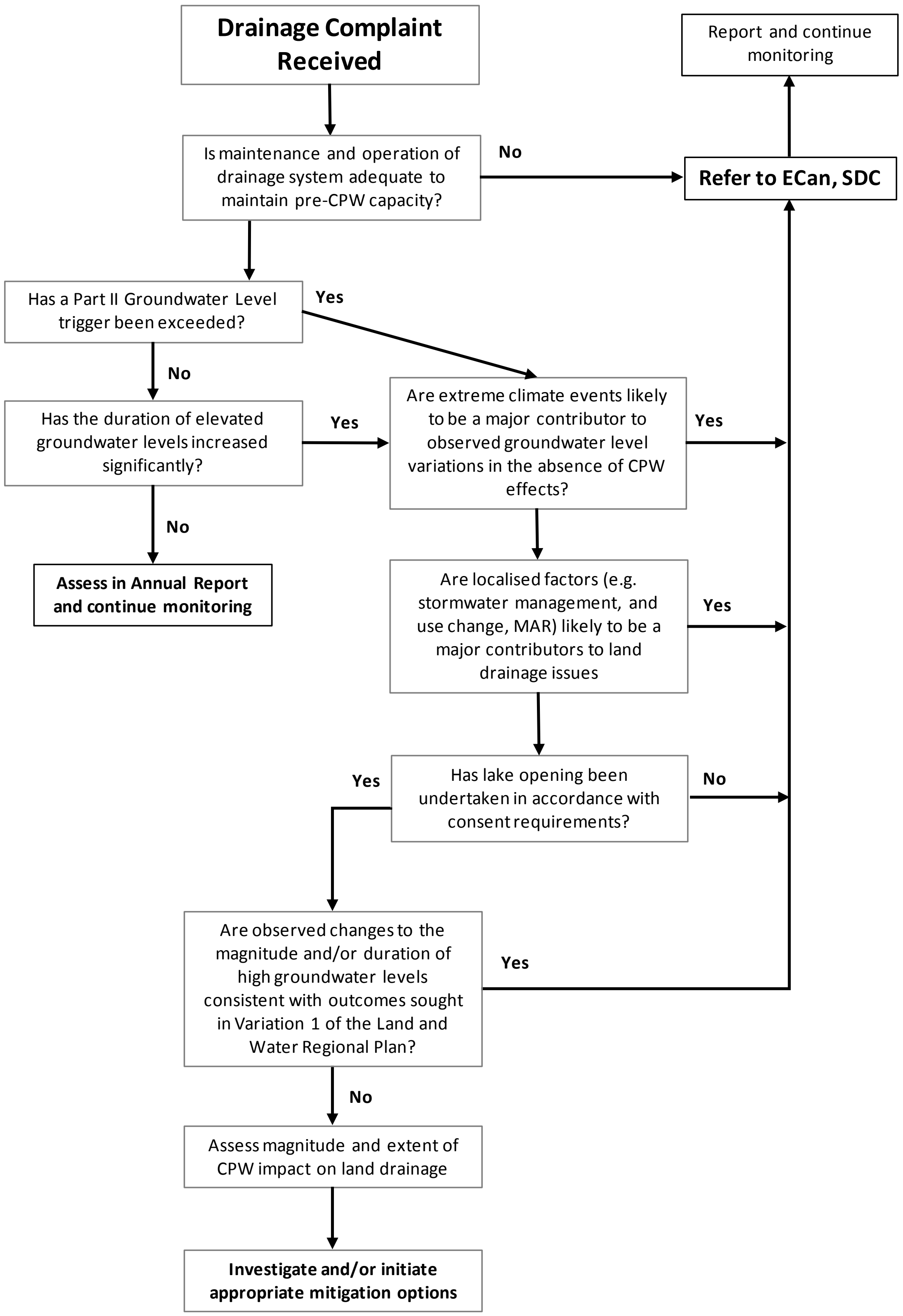



**Figure 36**. CPWL land drainage complaint response procedure

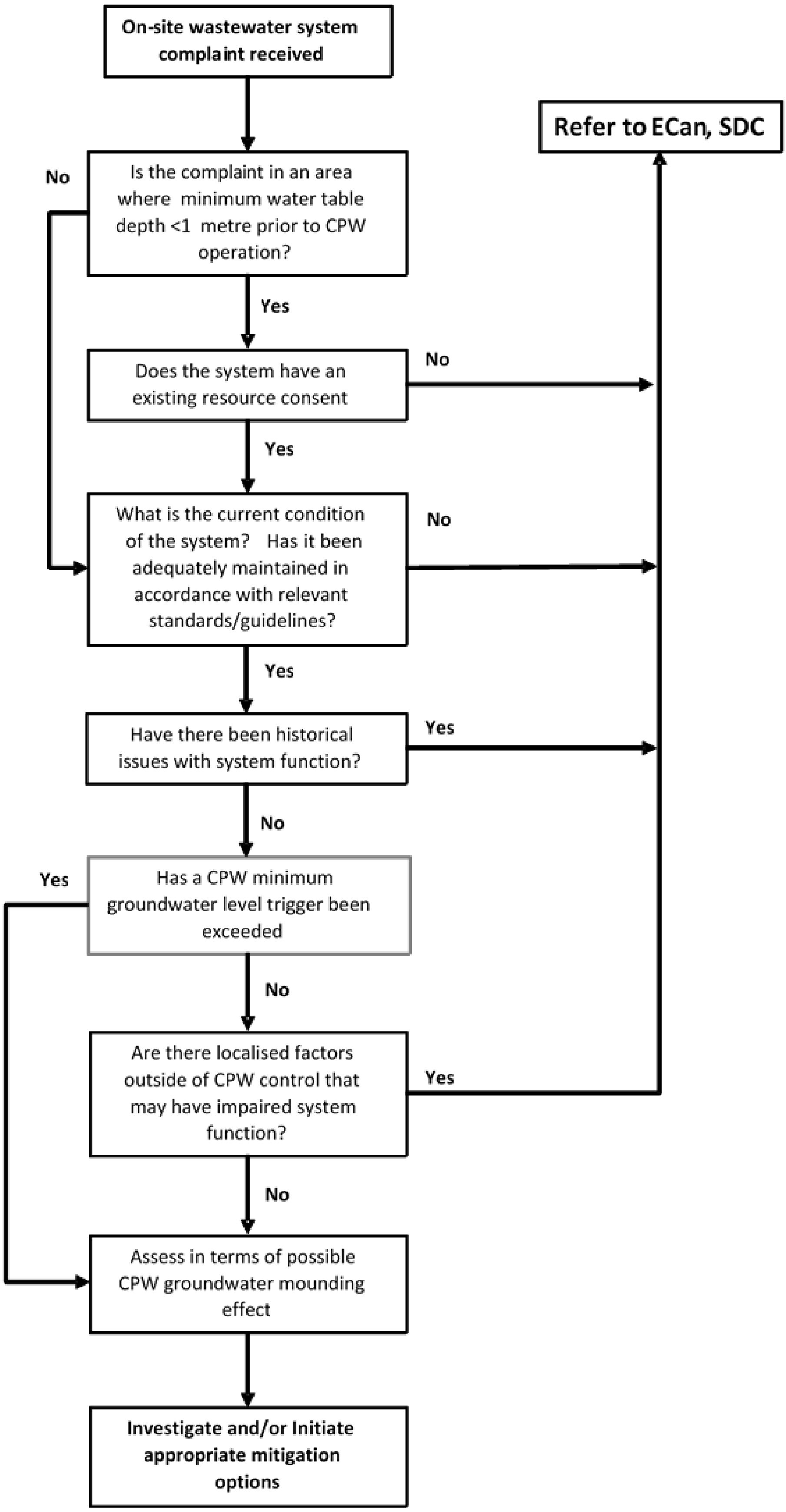



**Figure 37**. CPWL on-site wastewater complaint response procedure

## 6.2. Central Plains Water Ltd Annual Compliance Report 2017/2018 Irrigation Season

## 6.3. River and Stream Monitoring Data (ECan data shown blue)

| US1 | 26/07/2017 | 29/08/2017 | 18/09/2017 | 25/10/2017 | 22/11/2017 | 14/12/2017 | 17/01/2018 | 16/02/2018 | 14/03/2018 | 13/04/2018 | 9/05/2018 | 19/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 1.600 | 0.910 | 0.282 | 0.445 | 0.227 | 0.199 | 0.676 | 0.323 | 0.490 | 0.602 | 0.595 | 0.636 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | 0.010 | <0.010 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 1.86 | 1.04 | 0.72 | 0.54 | 0.31 | 0.41 | 0.88 | 0.43 | 0.56 | 0.76 | 0.72 | 0.69 |
| E. coli (MPN/100ml) | 15 | 58 | 480 | 120 | 100 | 1400 | 670 | nt | 120 | 57 | 370 | 76 |
| Dissolved Reactive Phosphorus (mg/L) | <0.004 | 0.006 | 0.008 | 0.007 | 0.005 | 0.009 | 0.009 | 0.007 | 0.007 | 0.007 | 0.010 | 0.010 |
| Total Phosphorus (mg/L) | 0.010 | 0.009 | 0.070 | 0.010 | 0.008 | 0.018 | 0.015 | 0.008 | 0.011 | 0.014 | 0.011 | 0.015 |
| Electrical Conductivity (µS/cm) | 78 | 81 | 61 | 79 | 94 | 103 | 77 | 96 | 76 | 74 | 81 | 76 |
| Dissolved Oxygen (% Sat.) | 96.1 | 98.7 | 98.5 | 94.6 | 97.8 | 95.1 | 99.7 | 95.4 | 97.9 | 100.8 | 101.4 | 98.7 |
| pH | 7.3 | 7.5 | 7.3 | 7.5 | 7.7 | 7.6 | 7.5 | 7.6 | 7.7 | 7.3 | 7.3 | 7.3 |
| Temperature (DegC) | 6.5 | 7.1 | 6.6 | 9.1 | 11.4 | 12.8 | 14.4 | 13.3 | 10.4 | 6.9 | 8.7 | 6.4 |
| Turbidity (NTU) | 1.50 | 0.66 | 10.10 | 0.50 | 0.35 | 0.73 | 0.64 | 0.30 | 0.68 | 1.14 | 0.66 | 2.18 |
| Flow (cumec) | 0.771 | 0.262 | 1.143 | 0.151 | 0.045 | 0.048 | 0.296 | 0.065 | 0.285 | 0.510 | 0.193 | 0.364 |

| US2 | 20/07/2017 | 24/08/2017 | 25/09/2017 | 17/10/2017 | 13/11/2017 | 14/12/2017 | 15/01/2018 | 16/02/2018 | 19/03/2018 | 13/04/2018 | 9/05/2018 | 18/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 2.400 | 2.100 | 1.390 | 1.080 | dry | dry | 2.860 | dry | 0.980 | 2.660 | 1.390 | 1.870 |
| Total Ammoniacal-N (mg/L) | <0.010 | 0.010 | <0.01 | 0.020 | dry | dry | <0.01 | dry | <0.01 | <0.01 | <0.01 | 0.020 |
| Total Nitrogen (mg/L) | 3.00 | 2.52 | 1.79 | 1.63 | dry | dry | 3.29 | dry | 1.34 | 3.00 | 1.87 | 2.26 |
| E. coli (MPN/100ml) | 133 | 58 | 140 | 600 | dry | dry | 870 | dry | nt | 3700 | 160 | 190 |
| Dissolved Reactive Phosphorus (mg/L) | 0.016 | 0.009 | 0.010 | 0.012 | dry | dry | 0.018 | dry | 0.011 | 0.014 | 0.012 | 0.013 |
| Total Phosphorus (mg/L) | 0.035 | 0.042 | 0.049 | 0.067 | dry | dry | 0.047 | dry | 0.019 | 0.068 | 0.042 | 0.046 |
| Electrical Conductivity (µS/cm) | 159 | 147 | 143 | 150 | dry | dry | 156 | dry | 162 | 146 | 169 | 166 |
| Dissolved Oxygen (% Sat.) | 95.8 | 91.8 | 97.5 | 96.2 | dry | dry | 96.1 | dry | 87.5 | 94.9 | 106.9 | 96.3 |
| pH | 7.4 | 6.9 | 7.3 | 7.2 | dry | dry | 7.0 | dry | 6.9 | 7.1 | 7.6 | 7.4 |
| Temperature (DegC) | 6.3 | 7.3 | 12.4 | 10.0 | dry | dry | 18.3 | dry | 14.5 | 9.4 | 10.8 | 6.7 |
| Turbidity (NTU) | 8.30 | 7.73 | 6.16 | 13.30 | dry | dry | 5.00 | dry | 0.78 | 8.89 | 2.65 | 5.55 |
| Flow (cumec) | 0.867 | 0.985 | 0.703 | 0.832 | 0.000 | 0.000 | 0.344 | 0.000 | 0.037 | 0.941 | 0.147 | 0.436 |

| US3 | 17/07/2017 | 15/08/2017 | 19/09/2017 | 18/10/2017 | 1/11/2017 | 1/12/2017 | 1/01/2018 | 1/02/2018 | 16/03/2018 | 19/04/2018 | 15/05/2018 | 18/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 0.490 | 0.660 | 0.320 | 0.430 | 0.340 | 0.300 | 0.640 | 0.340 | 0.380 | 0.350 | 0.450 | 0.580 |
| Total Ammoniacal-N (mg/L) | < 0.010 | < 0.010 | 0.026 | < 0.010 | <0.010 | <0.010 | <0.010 | 0.012 | < 0.010 | < 0.010 | <0.010 | <0.010 |
| Total Nitrogen (mg/L) | 0.72 | 0.91 | 1.12 | 0.57 | 0.36 | 0.31 | 0.70 | 0.32 | 0.48 | 0.47 | 0.53 | 0.65 |
| E. coli (MPN/100ml) | 117 | 727 | > 2420 | 93 | 40 | 172 | 238 | 72 | 78 | 39 | 20 | 17 |
| Dissolved Reactive Phosphorus (mg/L) | 0.005 | 0.004 | 0.010 | 0.001 | 0.002 | 0.001 | 0.002 | 0.001 | 0.007 | <0.004 | <0.0040 | 0.003 |
| Total Phosphorus (mg/L) | 0.014 | 0.044 | 0.410 | 0.008 | <0.004 | 0.006 | 0.008 | <0.004 | 0.007 | 0.025 | <0.004 | 0.006 |
| Electrical Conductivity (µS/cm) | 92 | 80 | 58 | 93 | 98 | 99 | 99 | 103 | 99 | 94 | 61 | 95 |
| Dissolved Oxygen (% Sat.) | 100.9 | 95.1 | 99.6 | 99.1 | 99.7 | 96.4 | 98.1 | 103.9 | 97.1 | 104.5 | 98.3 | 96.3 |
| pH | 7.6 | 7.6 | 7.5 | 7.5 | 7.5 | 7.5 | 7.1 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 |
| Temperature (DegC) | 5.5 | 5.2 | 7.9 | 9.8 | 0.0 | 0.0 | 0.0 | 0.0 | 13.7 | 10.2 | 10.7 | 7.0 |
| Turbidity (NTU) | 6.30 | 24.00 | 250.00 | 2.40 | 0.30 | 0.40 | 0.80 | 0.30 | 0.53 | 1.39 | 0.50 | 1.10 |
| Flow (cumec) | 7.054 | 18.607 | 41.426 | 5.729 | 1.653 | 0.813 | 3.949 | 1.534 | 2.944 | 4.166 | 2.283 | 4.052 |

| US4 | 17/07/2017 | 17/07/2017 | 24/08/2017 | 25/09/2017 | 17/10/2017 | 13/11/2017 | 14/12/2017 | 16/01/2018 | 16/02/2018 | 19/03/2018 | 16/04/2018 | 16/05/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 0.490 | 1.030 | 1.420 | 1.190 | 1.280 | 1.230 | 0.617 | 0.870 | 0.425 | 1.030 | 0.516 | 1.170 |
| Total Ammoniacal-N (mg/L) | < 0.010 | <0.010 | <0.01 | 0.050 | <0.010 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.010 |
| Total Nitrogen (mg/L) | 0.72 | 1.47 | 1.61 | 1.30 | 1.58 | 1.40 | 0.85 | 1.12 | 0.62 | 1.26 | 0.69 | 1.34 |
| E. coli (MPN/100ml) | 117 | 228 | 12 | 120 | 210 | 96 | 1000 | 310 | nt | nt | 510 | 81 |
| Dissolved Reactive Phosphorus (mg/L) | 0.005 | 0.013 | 0.008 | 0.013 | 0.010 | 0.010 | 0.021 | 0.017 | 0.008 | 0.009 | <0.005 | 0.010 |
| Total Phosphorus (mg/L) | 0.014 | 0.033 | 0.019 | 0.025 | 0.260 | 0.019 | 0.032 | 0.027 | 0.020 | 0.017 | 0.021 | 0.020 |
| Electrical Conductivity (µS/cm) | 92 | 74 | 83 | 83 | 88 | 107 | 110 | 82 | 100 | 96 | 82 | 102 |
| Dissolved Oxygen (% Sat.) | 100.9 | 93.2 | 94.6 | 95.6 | 90.9 | 92.7 | 91.9 | 93.7 | 97.0 | 93.1 | 96.7 | 99.3 |
| pH | 7.6 | 7.2 | 7.2 | 7.3 | 7.1 | 7.2 | 7.4 | 7.3 | 7.6 | 7.4 | 7.1 | 7.2 |
| Temperature (DegC) | 5.5 | 5.7 | 7.4 | 11.6 | 9.5 | 10.4 | 13.6 | 17.2 | 16.1 | 13.7 | 10.3 | 9.0 |
| Turbidity (NTU) | 6.30 | 6.70 | 1.97 | 2.72 | 3.31 | 1.12 | 1.34 | 1.31 | 0.63 | 1.08 | 2.12 | 1.40 |
| Flow (cumec) | 7.054 | 2.233 | 1.350 | 1.625 | 1.007 | 0.260 | 0.161 | 0.470 | 0.103 | 0.341 | 0.860 | 0.307 |

| IS1 | 20/07/2017 | 24/08/2017 | 25/09/2017 | 17/10/2017 | 13/11/2017 | 8/12/2017 | 22/01/2018 | 16/02/2018 | 19/03/2018 | 13/04/2018 | 9/05/2018 | 19/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 2.100 | 2.690 | 2.690 | 2.770 | 3.070 | 2.970 | 3.050 | 3.150 | 2.370 | 2.290 | 2.190 | 2.440 |
| Total Ammoniacal-N (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 2.40 | 2.92 | 2.84 | 2.97 | 3.14 | 3.32 | 3.32 | 3.10 | 2.51 | 2.48 | 2.52 | 2.58 |
| E. coli (MPN/100ml) | 91 | 87 | 160 | 150 | 130 | 230 | 300 | nt | nt | 640 | 78 | 81 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.008 | 0.011 | 0.010 | <0.005 | <0.005 | 0.005 | 0.005 | 0.009 | 0.012 | 0.012 | 0.013 |
| Total Phosphorus (mg/L) | 0.012 | 0.019 | 0.022 | 0.016 | 0.006 | 0.011 | 0.005 | <0.005 | 0.007 | 0.027 | 0.013 | 0.017 |
| Electrical Conductivity (µS/cm) | 117 | 126 | 126 | 134 | 147 | 147 | 149 | 154 | 141 | 128 | 132 | 129 |
| Dissolved Oxygen (% Sat.) | 95.0 | 98.4 | 95.1 | 97.0 | 98.4 | 100.4 | 112.3 | 104.6 | 96.5 | 97.2 | 100.2 | 99.1 |
| pH | 7.2 | 7.1 | 7.2 | 7.0 | 7.4 | 7.6 | 7.5 | 7.6 | 7.4 | 7.2 | 7.3 | 7.4 |
| Temperature (DegC) | 6.8 | 6.5 | 10.5 | 8.7 | 10.3 | 14.6 | 14.9 | 14.6 | 13.1 | 10.7 | 10.8 | 9.2 |
| Turbidity (NTU) | 5.60 | 1.37 | 2.09 | 1.85 | 0.54 | 0.30 | 0.42 | 0.27 | 0.33 | 1.90 | 0.44 | 1.35 |
| Flow (cumec) | 2.732 | 3.332 | 2.238 | 2.165 | 0.248 | 0.050 | 0.262 | 0.045 | 0.437 | 1.824 | 0.702 | 1.225 |

| IS2 | 17/07/2017 | 25/08/2017 | 25/09/2017 | 18/10/2017 | 8/11/2017 | 19/12/2017 | 15/01/2018 | 16/02/2018 | 20/03/2018 | 4/04/2018 | 3/05/2018 | 18/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 1.880 | 3.430 | 1.890 | 1.650 | dry | dry | dry | dry | dry | dry | 1.710 | 1.530 |
| Total Ammoniacal-N (mg/L) | 0.011 | <0.01 | <0.01 | 0.020 | dry | dry | dry | dry | dry | dry | 0.010 | <0.01 |
| Total Nitrogen (mg/L) | 2.50 | 3.79 | 2.33 | 2.03 | dry | dry | dry | dry | dry | dry | 2.17 | 2.03 |
| E. coli (MPN/100ml) | 131 | 8 | 34 | 96 | dry | dry | dry | dry | dry | dry | 80 | 12 |
| Dissolved Reactive Phosphorus (mg/L) | 0.020 | 0.009 | 0.006 | 0.009 | dry | dry | dry | dry | dry | dry | 0.020 | 0.019 |
| Total Phosphorus (mg/L) | 0.041 | 0.018 | 0.023 | 0.020 | dry | dry | dry | dry | dry | dry | 0.053 | 0.031 |
| Electrical Conductivity (µS/cm) | 133 | 157 | 138 | 97 | dry | dry | dry | dry | dry | dry | 131 | 141 |
| Dissolved Oxygen (% Sat.) | 89.7 | 99.9 | 119.3 | 90.7 | dry | dry | dry | dry | dry | dry | 82.5 | 73.2 |
| pH | 6.8 | 7.2 | 7.4 | 7.2 | dry | dry | dry | dry | dry | dry | 6.2 | 6.5 |
| Temperature (DegC) | 5.4 | 8.7 | 14.2 | 12.7 | dry | dry | dry | dry | dry | dry | 10.5 | 9.1 |
| Turbidity (NTU) | 4.50 | 1.42 | 1.34 | 1.45 | dry | dry | dry | dry | dry | dry | 10.10 | 1.75 |
| Flow (cumec) | 0.485 | 0.892 | 0.463 | 0.465 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 | 0.005 |

| IS3 | 17/07/2017 | 25/08/2017 | 27/09/2017 | 18/10/2017 | 8/11/2017 | 19/12/2017 | 15/01/2018 | 16/02/2018 | 1/03/2018 | 13/04/2018 | 9/05/2018 | 18/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 0.790 | 0.724 | 0.544 | 0.619 | dry | dry | 0.866 | dry | 0.660 | 0.615 | 0.816 | 0.618 |
| Total Ammoniacal-N (mg/L) | < 0.010 | <0.01 | <0.01 | <0.010 | dry | dry | <0.01 | dry | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 1.02 | 0.86 | 0.67 | 0.75 | dry | dry | 1.04 | dry | 0.77 | 0.81 | 0.94 | 0.66 |
| E. coli (MPN/100ml) | 70 | 4 | 21 | 4 | dry | dry | 78 | dry | 120 | 84 | 12 | 12 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.006 | 0.009 | 0.007 | dry | dry | 0.011 | dry | 0.018 | 0.007 | 0.010 | 0.006 |
| Total Phosphorus (mg/L) | 0.014 | 0.010 | 0.010 | 0.009 | dry | dry | 0.014 | dry | 0.014 | 0.014 | 0.009 | 0.009 |
| Electrical Conductivity (µS/cm) | 102 | 96 | 95 | 136 | dry | dry | 96 | dry | 99 | 104 | 103 | 102 |
| Dissolved Oxygen (% Sat.) | 93.1 | 97.8 | 96.4 | 113.2 | dry | dry | 96.0 | dry | 93.3 | 96.3 | 95.6 | 101.8 |
| pH | 7.4 | 7.4 | 7.4 | 7.2 | dry | dry | 7.4 | dry | 7.4 | 7.3 | 7.0 | 7.6 |
| Temperature (DegC) | 6.7 | 7.3 | 10.8 | 13.8 | dry | dry | 20.7 | dry | 15.6 | 12.6 | 12.5 | 8.1 |
| Turbidity (NTU) | 3.40 | 1.31 | 0.94 | 2.12 | dry | dry | 1.11 | dry | 0.83 | 1.74 | 0.50 | 0.81 |
| Flow (cumec) | 5.363 | 6.407 | 3.796 | 4.074 | 0.000 | 0.000 | 1.893 | 0.000 | 1.840 | 1.566 | 0.183 | 1.871 |

| IS4 | 17/07/2017 | 24/08/2017 | 18/09/2017 | 17/10/2017 | 13/11/2017 | 14/12/2017 | 16/01/2018 | 15/02/2018 | 20/03/2018 | 16/04/2018 | 16/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 1.570 | 3.080 | 3.360 | 2.570 | 2.670 | 2.160 | 1.850 | 1.800 | 1.960 | 1.870 | 2.140 | 1.930 |
| Total Ammoniacal-N (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.010 | <0.01 |
| Total Nitrogen (mg/L) | 1.90 | 3.28 | 3.51 | 2.76 | 2.72 | 2.32 | 2.02 | 1.86 | 2.09 | 1.95 | 2.18 | 2.07 |
| E. coli (MPN/100ml) | 57 | 21 | 1500 | 96 | 70 | 600 | 480 | nt | 220 | 80 | 80 | 80 |
| Dissolved Reactive Phosphorus (mg/L) | 0.012 | 0.010 | 0.007 | 0.011 | <0.005 | 0.009 | 0.016 | 0.006 | 0.009 | <0.005 | 0.008 | 0.011 |
| Total Phosphorus (mg/L) | 0.020 | 0.018 | 0.020 | 0.019 | 0.008 | 0.013 | 0.017 | 0.008 | 0.009 | 0.015 | 0.013 | 0.017 |
| Electrical Conductivity (µS/cm) | 117 | 143 | 154 | 137 | 148 | 147 | 135 | 144 | 144 | 140 | 145 | 137 |
| Dissolved Oxygen (% Sat.) | 93.9 | 92.4 | 94.6 | 88.8 | 95.9 | 91.8 | 94.1 | 94.9 | 84.1 | 87.5 | 93.9 | 89.8 |
| pH | 7.3 | 7.2 | 7.1 | 7.1 | 7.3 | 7.3 | 7.3 | 7.4 | 7.2 | 7.1 | 7.1 | 7.0 |
| Temperature (DegC) | 8.0 | 9.9 | 9.6 | 12.4 | 11.9 | 13.4 | 18.0 | 16.3 | 12.9 | 12.9 | 11.1 | 9.9 |
| Turbidity (NTU) | 3.00 | 1.50 | 1.49 | 1.82 | 1.08 | 0.59 | 1.17 | 0.41 | 0.58 | 0.64 | 0.72 | 0.97 |
| Flow (cumec) | 6.483 | 5.341 | 3.176 | 4.962 | 2.135 | 1.053 | 1.680 | 0.905 | 2.285 | 2.688 | 2.586 | 3.378 |

| SWT1 | 25/07/2017 | 25/08/2017 | 18/09/2017 | 19/10/2017 | 14/11/2017 | 14/12/2017 | 25/01/2018 | 22/02/2018 | 20/03/2018 | 16/04/2018 | 16/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 0.260 | 0.047 | 0.143 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.006 | <0.005 | 0.025 | 0.046 |
| Total Ammoniacal-N (mg/L) | 0.340 | <0.01 | 0.070 | <0.010 | <0.01 | <0.01 | <0.01 | 0.010 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 2.10 | 0.19 | 0.53 | 0.09 | 0.20 | 0.22 | 0.09 | 0.10 | 0.08 | 0.07 | 0.06 | 0.07 |
| E. coli (MPN/100ml) | 1553 | 160 | 4800 | 460 | 3900 | 2200 | 430 | 650 | 690 | 54 | 120 | 29 |
| Dissolved Reactive Phosphorus (mg/L) | 0.033 | 0.005 | 0.023 | 0.005 | <0.005 | 0.012 | <0.005 | 0.011 | 0.005 | <0.005 | <0.005 | <0.005 |
| Total Phosphorus (mg/L) | 0.380 | 0.039 | 0.074 | 0.022 | 0.053 | 0.041 | 0.018 | 0.156 | 0.012 | 0.013 | 0.008 | 0.008 |
| Electrical Conductivity (µS/cm) | 94 | 66 | 63 | 64 | 60 | 58 | 63 | 58 | 65 | 61 | 62 | 69 |
| Dissolved Oxygen (% Sat.) | 89.7 | 97.3 | 95.9 | 97.8 | 100.6 | 104.6 | 103.3 | 95.2 | 101.4 | 104.2 | 105.0 | 101.0 |
| pH | 7.4 | 7.8 | 7.3 | 7.9 | 7.7 | 8.3 | 7.9 | 7.6 | 7.8 | 8.3 | 7.8 | 7.8 |
| Temperature (DegC) | 3.5 | 10.0 | 9.5 | 15.3 | 13.0 | 20.6 | 20.8 | 11.5 | 15.7 | 13.9 | 9.3 | 7.8 |
| Turbidity (NTU) | 247.00 | 8.29 | 21.40 | 10.30 | 15.20 | 14.80 | 8.84 | 269.00 | 5.06 | 3.18 | 4.36 | 2.70 |
| Flow (cumec) | 0.063 | 0.071 | 0.054 | 0.064 | 0.056 | 0.054 | 0.065 | 0.074 | 0.067 | 0.053 | 0.059 | 0.069 |

| SWT2 | 25/07/2017 | 24/08/2017 | 18/09/2017 | 19/10/2017 | 14/11/2017 | 14/12/2017 | 16/01/2018 | 15/02/2018 | 20/03/2018 | 16/04/2018 | 16/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 0.350 | 0.434 | 1.310 | 0.041 | 0.185 | 0.040 | dry | 0.432 | <0.005 | <0.005 | <0.005 | 0.021 |
| Total Ammoniacal-N (mg/L) | 0.610 | 0.120 | 0.770 | 0.010 | <0.01 | 0.050 | dry | 0.330 | <0.01 | <0.01 | 0.020 | 0.080 |
| Total Nitrogen (mg/L) | 2.40 | 1.94 | 4.16 | 0.84 | 0.43 | 0.94 | dry | 1.20 | 0.18 | 0.12 | 0.12 | 0.15 |
| E. coli (MPN/100ml) | 435 | 12 | 9700 | 190 | 610 | 2200 | dry | nt | 200 | 140 | 200 | 47 |
| Dissolved Reactive Phosphorus (mg/L) | 0.100 | 0.018 | 0.393 | 0.039 | 0.012 | 0.094 | dry | 0.099 | 0.020 | 0.013 | 0.012 | 0.029 |
| Total Phosphorus (mg/L) | 0.250 | 0.057 | 0.739 | 0.274 | 0.052 | 0.208 | dry | 0.187 | 0.034 | 0.039 | 0.036 | 0.020 |
| Electrical Conductivity (µS/cm) | 79 | 69 | 106 | 55 | 63 | 72 | dry | 88 | 64 | 62 | 59 | 68 |
| Dissolved Oxygen (% Sat.) | 94.7 | 107.5 | 90.4 | 112.4 | 101.5 | 114.9 | dry | 84.0 | 86.7 | 97.7 | 101.4 | 99.4 |
| pH | 7.5 | 7.7 | 7.0 | 8.0 | 7.5 | 8.3 | dry | 7.0 | 7.1 | 7.3 | 7.2 | 7.4 |
| Temperature (DegC) | 4.4 | 13.5 | 9.5 | 19.6 | 12.7 | 23.4 | dry | 24.9 | 15.7 | 13.9 | 9.3 | 7.8 |
| Turbidity (NTU) | 79.30 | 8.71 | 77.10 | 57.90 | 12.90 | 38.60 | dry | 21.30 | 2.48 | 3.21 | 5.06 | 2.97 |
| Flow (cumec) | 0.012 | 0.002 | 0.012 | 0.008 | 0.008 | 0.005 | 0.000 | 0.000 | 0.002 | 0.015 | 0.012 | 0.022 |

| SWT3 | 26/07/2017 | 21/08/2017 | 18/09/2017 | 19/10/2017 | 14/11/2017 | 15/12/2017 | 16/01/2018 | 15/02/2018 | 21/03/2018 | 16/04/2018 | 16/05/2018 | 25/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 0.830 | 0.254 | 0.935 | 1.160 | 1.160 | 0.870 | 0.555 | 0.365 | 0.213 | 0.688 | 0.845 | 1.230 |
| Total Ammoniacal-N (mg/L) | <0.010 | 0.020 | 0.060 | <0.010 | <0.01 | 0.010 | 0.020 | 0.020 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 1.23 | 0.60 | 1.51 | 1.35 | 1.34 | 1.15 | 0.87 | 0.60 | 0.39 | 0.83 | 0.95 | 1.28 |
| E. coli (MPN/100ml) | 61 | <4 | >9700 | 340 | 410 | 800 | 660 | nt | 250 | 75 | 30 | 16 |
| Dissolved Reactive Phosphorus (mg/L) | <0.004 | 0.006 | 0.018 | <0.005 | <0.005 | 0.011 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| Total Phosphorus (mg/L) | 0.026 | 0.046 | 0.082 | 0.020 | 0.021 | 0.034 | 0.026 | 0.014 | 0.010 | 0.011 | 0.008 | 0.010 |
| Electrical Conductivity (µS/cm) | 77 | 69 | 77 | 97 | 89 | 96 | 84 | 78 | 92 | 86 | 89 | 97 |
| Dissolved Oxygen (% Sat.) | 96.9 | 99.2 | 96.3 | 95.2 | 97.5 | 98.1 | 98.3 | 109.3 | 98.0 | 106.3 | 99.8 | 104.1 |
| pH | 7.6 | 8.2 | 7.5 | 7.5 | 7.6 | 7.5 | 7.6 | 8.7 | 7.7 | 8.4 | 7.8 | 8.0 |
| Temperature (DegC) | 7.8 | 9.9 | 10.1 | 8.8 | 14.1 | 15.0 | 18.8 | 23.3 | 15.4 | 15.7 | 10.4 | 5.8 |
| Turbidity (NTU) | 13.50 | 13.40 | 15.80 | 7.27 | 8.62 | 2.81 | 6.63 | 3.88 | 0.98 | 1.36 | 1.20 | 1.79 |
| Flow (cumec) | 0.005 | 0.004 | 0.013 | 0.010 | 0.008 | 0.010 | 0.016 | 0.009 | 0.006 | 0.006 | 0.006 | 0.011 |

| SWT4 | 19/07/2017 | 28/08/2017 | 19/09/2017 | 13/10/2017 | 20/11/2017 | 14/12/2017 | 15/01/2018 | 15/02/2018 | 21/03/2018 | 17/04/2018 | 18/05/2018 | 22/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 0.190 | 0.157 | 0.294 | 0.152 | 0.029 | 0.049 | 0.079 | 0.018 | 0.084 | 0.112 | 0.154 | 0.207 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | 0.040 | <0.010 | <0.01 | 0.010 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.010 |
| Total Nitrogen (mg/L) | 0.24 | 0.23 | 0.51 | 0.24 | 0.10 | 0.13 | 0.18 | <0.05 | 0.17 | 0.22 | 0.17 | 0.24 |
| E. coli (MPN/100ml) | 34 | 420 | 1000 | 160 | 2300 | 870 | 230 | nt | 160 | 500 | 200 | 110 |
| Dissolved Reactive Phosphorus (mg/L) | <0.004 | <0.005 | 0.009 | 0.005 | <0.005 | 0.008 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| Total Phosphorus (mg/L) | 0.010 | 0.020 | 0.069 | 0.037 | 0.016 | 0.020 | 0.034 | 0.017 | 0.018 | 0.128 | 0.012 | 0.009 |
| Electrical Conductivity (µS/cm) | 78 | 76 | 68 | 72 | 70 | 76 | 67 | 72 | 81 | 64 | 73 | 83 |
| Dissolved Oxygen (% Sat.) | 98.5 | 98.1 | 96.5 | 99.2 | 99.8 | 93.3 | 97.5 | 96.7 | 95.0 | 97.3 | 97.7 | 98.9 |
| pH | 7.8 | 7.6 | 7.5 | 7.5 | 8.1 | 7.8 | 7.7 | 7.7 | 7.6 | 7.3 | 7.4 | 7.4 |
| Temperature (DegC) | 7.3 | 9.1 | 9.1 | 11.0 | 16.6 | 17.8 | 22.7 | 18.5 | 16.9 | 11.3 | 8.7 | 4.8 |
| Turbidity (NTU) | 4.70 | 7.21 | 59.70 | 36.90 | 4.51 | 5.39 | 16.40 | 8.29 | 5.97 | 212.00 | 5.73 | 0.28 |
| Flow (cumec) | 0.132 | 0.070 | 0.187 | 0.158 | 0.182 | 0.169 | 0.201 | 0.195 | 0.175 | 0.071 | 0.186 | 0.154 |

| SWSH | 20/07/2017 | 28/08/2017 | 28/09/2017 | 19/10/2017 | 14/11/2017 | 19/12/2017 | 15/01/2018 | 15/02/2018 | 1/03/2018 | 4/04/2018 | 3/05/2018 | 18/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 1.320 | 2.360 | 1.860 | 1.720 | 1.140 | dry | dry | dry | 1.720 | 1.430 | 1.410 | 1.530 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | <0.01 | <0.010 | <0.01 | dry | dry | dry | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 1.56 | 2.59 | 2.06 | 1.92 | 1.27 | dry | dry | dry | 1.81 | 1.68 | 1.47 | 1.67 |
| E. coli (MPN/100ml) | 47 | <4 | 16 | 21 | 12 | dry | dry | dry | 25 | 160 | 34 | 21 |
| Dissolved Reactive Phosphorus (mg/L) | 0.006 | 0.007 | 0.006 | 0.008 | 0.007 | dry | dry | dry | 0.012 | 0.008 | 0.009 | 0.009 |
| Total Phosphorus (mg/L) | 0.009 | 0.010 | 0.008 | 0.011 | 0.008 | dry | dry | dry | 0.012 | 0.008 | 0.013 | 0.014 |
| Electrical Conductivity (µS/cm) | 115 | 130 | 124 | 121 | 125 | dry | dry | dry | 122 | 137 | 122 | 123 |
| Dissolved Oxygen (% Sat.) | 97.3 | 95.2 | 94.8 | 92.2 | 60.7 | dry | dry | dry | 93.5 | 95.1 | 98.5 | 96.4 |
| pH | 7.6 | 7.5 | 7.3 | 7.3 | 6.6 | dry | dry | dry | 7.4 | 6.7 | 7.1 | 7.4 |
| Temperature (DegC) | 9.0 | 10.9 | 10.1 | 12.0 | 12.4 | dry | dry | dry | 18.7 | 15.8 | 11.5 | 9.8 |
| Turbidity (NTU) | 4.40 | 0.57 | 0.44 | 0.82 | 0.33 | dry | dry | dry | 0.42 | 0.28 | 1.17 | 1.10 |
| Flow (cumec) | 7.082 | 6.123 | 4.359 | 5.447 | 0.010 | 0.000 | 0.000 | 0.000 | 2.051 | 0.040 | 5.666 | 3.354 |

| SF1 | 18/07/2017 | 21/08/2017 | 19/09/2017 | 13/10/2017 | 20/11/2017 | 13/12/2017 | 23/01/2018 | 19/02/2018 | 26/03/2018 | 23/04/2018 | 22/05/2018 | 21/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 3.000 | 2.750 | 2.710 | 3.150 | 3.120 | 3.110 | 3.010 | 3.300 | 3.350 | 3.370 | 3.600 | 3.390 |
| Total Ammoniacal-N (mg/L) | 0.024 | 0.050 | 0.050 | <0.010 | <0.01 | 0.010 | <0.01 | 0.010 | 0.020 | 0.010 | 0.020 | 0.050 |
| Total Nitrogen (mg/L) | 3.40 | 3.27 | 3.16 | 3.30 | 3.25 | 3.39 | 3.21 | 3.19 | 3.35 | 3.49 | 3.52 | 4.10 |
| E. coli (MPN/100ml) | 260 | 300 | 2200 | 340 | 350 | 900 | 950 | 520 | 380 | 360 | 270 | 180 |
| Dissolved Reactive Phosphorus (mg/L) | 0.028 | 0.031 | 0.049 | 0.025 | 0.016 | 0.033 | 0.024 | 0.030 | 0.022 | 0.017 | 0.019 | 0.028 |
| Total Phosphorus (mg/L) | 0.050 | 0.098 | 0.126 | 0.057 | 0.030 | 0.042 | 0.038 | 0.043 | 0.033 | 0.029 | 0.027 | 0.069 |
| Electrical Conductivity (µS/cm) | 244 | 264 | 240 | 236 | 216 | 217 | 218 | 216 | 223 | 219 | 234 | 281 |
| Dissolved Oxygen (% Sat.) | 86.8 | 86.5 | 89.6 | 114.4 | 86.3 | 110.9 | 93.0 | 134.3 | 73.7 | 89.5 | 80.3 | 74.2 |
| pH | 7.2 | 7.1 | 7.1 | 7.5 | 7.2 | 7.7 | 7.3 | 8.5 | 7.0 | 7.1 | 7.2 | 7.1 |
| Temperature (DegC) | 10.8 | 10.3 | 12.6 | 14.5 | 13.3 | 15.3 | 16.3 | 18.2 | 13.3 | 10.7 | 10.5 | 10.5 |
| Turbidity (NTU) | 7.20 | 17.60 | 19.80 | 2.67 | 1.15 | 0.99 | 1.45 | 0.94 | 1.13 | 0.05 | 1.24 | 7.95 |
| Flow (cumec) | 0.752 | 1.175 | 1.466 | 1.074 | 0.851 | 0.763 | 0.726 | 0.645 | 0.759 | 0.810 | 0.803 | 1.057 |

| SF2 | 18/07/2017 | 21/08/2017 | 19/09/2017 | 13/10/2017 | 20/11/2017 | 15/12/2017 | 23/01/2018 | 26/02/2018 | 26/03/2018 | 23/04/2018 | 22/05/2018 | 21/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 4.000 | 3.950 | 4.080 | 4.050 | 4.090 | 4.160 | 4.190 | 4.180 | 4.130 | 4.050 | 4.100 | 4.060 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | <0.01 | <0.010 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 4.10 | 4.01 | 3.87 | 4.04 | 4.16 | 4.23 | 4.37 | 4.15 | 4.07 | 4.11 | 3.91 | 4.52 |
| E. coli (MPN/100ml) | 65 | 4 | 4 | 39 | 100 | 120 | 340 | 64 | 80 | 52 | 16 | 4 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.009 | 0.012 | 0.012 | 0.010 | 0.015 | 0.011 | 0.009 | 0.012 | 0.009 | 0.013 | 0.016 |
| Total Phosphorus (mg/L) | 0.093 | 0.011 | 0.023 | 0.010 | 0.012 | 0.016 | 0.013 | 0.010 | 0.009 | 0.012 | 0.010 | 0.016 |
| Electrical Conductivity (µS/cm) | 230 | 232 | 226 | 223 | 225 | 226 | 227 | 228 | 226 | 226 | 228 | 237 |
| Dissolved Oxygen (% Sat.) | 90.0 | 98.5 | 86.7 | 79.9 | 77.1 | 78.4 | 81.2 | 82.8 | 76.5 | 86.4 | 78.8 | 78.9 |
| pH | 7.1 | 7.1 | 7.0 | 6.9 | 6.9 | 6.9 | 6.9 | 6.9 | 6.8 | 6.9 | 6.9 | 7.0 |
| Temperature (DegC) | 12.9 | 12.8 | 13.3 | 13.5 | 13.4 | 14.0 | 15.8 | 13.9 | 13.7 | 13.1 | 12.5 | 12.1 |
| Turbidity (NTU) | <0.5 | 0.33 | 0.54 | 0.33 | 0.61 | 0.41 | 0.33 | 0.28 | 0.61 | 0.96 | 0.20 | 0.34 |
| Flow (cumec) | 0.096 | 0.102 | 0.112 | 0.106 | 0.107 | 0.102 | 0.110 | 0.125 | 0.116 | 0.115 | 0.116 | 0.121 |

| SF3 | 26/07/2017 | 30/08/2017 | 28/09/2017 | 24/10/2017 | 20/11/2017 | 15/12/2017 | 22/01/2018 | 19/02/2018 | 20/03/2018 | 17/04/2018 | 18/05/2018 | 25/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 2.300 | 3.880 | 3.350 | 3.710 | 6.400 | 6.210 | 5.870 | 6.200 | 4.680 | 5.270 | 5.200 | 4.280 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | <0.01 | <0.010 | 0.010 | <.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 2.80 | 4.10 | 3.57 | 3.81 | 6.42 | 6.69 | 6.44 | 6.74 | 4.83 | 5.17 | 5.46 | 4.17 |
| E. coli (MPN/100ml) | 48 | 25 | 21 | 34 | 16 | 30 | 48 | 21 | 63 | 74 | 25 | 21 |
| Dissolved Reactive Phosphorus (mg/L) | <0.004 | 0.009 | 0.007 | 0.008 | 0.006 | 0.007 | 0.007 | 0.006 | 0.008 | <0.005 | 0.007 | 0.010 |
| Total Phosphorus (mg/L) | 0.030 | 0.011 | 0.010 | 0.008 | 0.006 | 0.009 | 0.007 | 0.007 | 0.006 | 0.006 | 0.009 | 0.011 |
| Electrical Conductivity (µS/cm) | 131 | 169 | 160 | 172 | 241 | 256 | 257 | 260 | 210 | 231 | 223 | 184 |
| Dissolved Oxygen (% Sat.) | 93.1 | 91.2 | 92.0 | 88.6 | 91.4 | 100.6 | 101.5 | 94.6 | 102.4 | 103.1 | 95.0 | 93.8 |
| pH | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.3 | 7.3 | 7.4 | 7.4 | 7.3 | 7.1 | 7.1 |
| Temperature (DegC) | 8.2 | 10.0 | 11.3 | 12.6 | 15.4 | 17.3 | 19.4 | 18.6 | 18.2 | 14.5 | 11.6 | 9.9 |
| Turbidity (NTU) | 17.70 | 0.52 | 0.63 | 0.36 | 0.23 | 0.17 | 0.24 | 0.19 | 0.27 | 0.44 | 0.32 | 0.42 |
| Flow (cumec) | 19.418 | 6.354 | 5.909 | 3.305 | 0.754 | 0.959 | 0.440 | 0.380 | 0.431 | 1.087 | 1.300 | 3.269 |

| SF4 | 26/07/2017 | 25/08/2017 | 27/09/2017 | 19/10/2017 | 13/11/2017 | 14/12/2017 | 22/01/2018 | 19/02/2018 | 20/03/2018 | 16/04/2018 | 16/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 3.600 | 3.070 | 2.190 | 1.880 | 1.530 | 1.500 | 1.850 | 1.240 | 1.930 | 1.970 | 2.380 | 2.420 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | <0.01 | <0.01 | <0.01 | 0.010 | <0.01 | 0.010 | <0.01 | <0.01 | 0.010 | <0.01 |
| Total Nitrogen (mg/L) | 3.90 | 3.47 | 2.41 | 2.05 | 1.67 | 1.77 | 2.18 | 1.34 | 2.10 | 2.07 | 2.46 | 2.52 |
| E. coli (MPN/100ml) | 77 | 2700 | 39 | 21 | 80 | 900 | 310 | 53 | 220 | 39 | 350 | 140 |
| Dissolved Reactive Phosphorus (mg/L) | 0.018 | 0.024 | 0.010 | 0.007 | 0.005 | 0.018 | 0.018 | 0.010 | 0.016 | 0.017 | 0.020 | 0.019 |
| Total Phosphorus (mg/L) | 0.026 | 0.068 | 0.012 | 0.010 | 0.008 | 0.025 | 0.022 | 0.013 | 0.017 | 0.027 | 0.026 | 0.021 |
| Electrical Conductivity (µS/cm) | 182 | 161 | 142 | 134 | 132 | 139 | 155 | 144 | 147 | 143 | 145 | 143 |
| Dissolved Oxygen (% Sat.) | 77.6 | 85.8 | 100.2 | 91.5 | 92.2 | 65.7 | 50.6 | 35.6 | 42.6 | 49.9 | 60.0 | 65.7 |
| pH | 6.6 | 6.7 | 6.7 | 6.8 | 6.8 | 6.7 | 6.5 | 6.5 | 6.6 | 6.5 | 6.5 | 6.6 |
| Temperature (DegC) | 10.5 | 10.8 | 11.1 | 11.4 | 12.0 | 14.0 | 14.9 | 14.4 | 15.0 | 14.5 | 12.8 | 11.6 |
| Turbidity (NTU) | 1.80 | 14.60 | 0.35 | 0.52 | 0.38 | 0.46 | 0.43 | 0.21 | 0.29 | 0.43 | 0.93 | 0.31 |
| Flow (cumec) | 0.300 | 0.187 | 0.162 | 0.159 | 0.099 | 0.043 | 0.098 | 0.040 | 0.132 | 0.120 | 0.109 | 0.100 |

| SF5 | 19/07/2017 | 29/08/2017 | 21/09/2017 | 24/10/2017 | 22/11/2017 | 18/12/2017 | 25/01/2018 | 23/02/2018 | 21/03/2018 | 17/04/2018 | 18/05/2018 | 22/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 8.600 | 7.440 | 6.800 | 5.960 | 4.850 | 3.420 | 1.730 | 3.460 | 2.750 | 3.870 | 4.210 | 4.250 |
| Total Ammoniacal-N (mg/L) | 0.011 | <0.01 | <0.01 | <0.010 | <0.01 | 0.020 | <0.01 | 0.030 | <0.01 | <0.01 | <0.01 | 0.010 |
| Total Nitrogen (mg/L) | 9.30 | 7.74 | 7.52 | 6.29 | 5.98 | 4.07 | 2.42 | 4.06 | 3.09 | 3.88 | 4.50 | 4.76 |
| E. coli (MPN/100ml) | 115 | 140 | 430 | 570 | 780 | 910 | 1500 | 1500 | 480 | 1100 | 310 | 590 |
| Dissolved Reactive Phosphorus (mg/L) | 0.062 | 0.026 | 0.045 | 0.019 | 0.058 | 0.085 | 0.012 | 0.109 | 0.021 | 0.031 | 0.038 | 0.034 |
| Total Phosphorus (mg/L) | 0.086 | 0.037 | 0.070 | 0.050 | 0.106 | 0.142 | 0.064 | 0.164 | 0.053 | 0.056 | 0.064 | 0.067 |
| Electrical Conductivity (µS/cm) | 479 | 362 | 363 | 314 | 266 | 260 | 310 | 343 | 306 | 313 | 293 | 313 |
| Dissolved Oxygen (% Sat.) | 93.5 | 115.5 | 95.7 | 138.0 | 132.4 | 108.6 | 141.5 | 90.6 | 117.3 | 100.7 | 100.4 | 98.5 |
| pH | 6.9 | 7.3 | 7.0 | 7.8 | 6.7 | 8.1 | 8.0 | 7.1 | 7.4 | 7.2 | 7.1 | 6.9 |
| Temperature (DegC) | 9.4 | 11.7 | 11.0 | 14.8 | 20.3 | 17.3 | 19.9 | 17.4 | 17.2 | 14.3 | 10.5 | 7.0 |
| Turbidity (NTU) | 3.20 | 1.55 | 2.65 | 2.78 | 5.26 | 5.51 | 7.42 | 2.82 | 3.28 | 3.33 | 2.54 | 5.13 |
| Flow (cumec) | 0.391 | 0.518 | 0.568 | 0.332 | 0.168 | 0.055 | 0.066 | 0.478 | 0.091 | 0.398 | 0.457 | 0.603 |

| SF6 | 25/07/2017 | 29/08/2017 | 20/09/2017 | 25/10/2017 | 23/11/2017 | 18/12/2017 | 24/01/2018 | 23/02/2018 | 27/03/2018 | 24/04/2018 | 23/05/2018 | 25/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 14.100 | 11.900 | 9.910 | 10.100 | 9.490 | 8.800 | 6.940 | 6.070 | 6.950 | 7.390 | 6.780 | 7.310 |
| Total Ammoniacal-N (mg/L) | 0.041 | <0.01 | 0.010 | <0.010 | <0.01 | 0.020 | <0.01 | 0.010 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 15.00 | 12.60 | 10.40 | 10.70 | 9.92 | 9.12 | 8.46 | 7.51 | 7.66 | 7.97 | 8.08 | 7.99 |
| E. coli (MPN/100ml) | 38 | 34 | 80 | 48 | 440 | 500 | 330 | 320 | 310 | 390 | 340 | 950 |
| Dissolved Reactive Phosphorus (mg/L) | 0.043 | 0.019 | 0.032 | 0.015 | 0.033 | 0.026 | 0.009 | 0.034 | 0.014 | 0.016 | 0.014 | 0.016 |
| Total Phosphorus (mg/L) | 0.059 | 0.031 | 0.054 | 0.030 | 0.043 | 0.028 | 0.029 | 0.052 | 0.014 | 0.033 | 0.026 | 0.022 |
| Electrical Conductivity (µS/cm) | 433 | 345 | 349 | 322 | 302 | 302 | 286 | 295 | 288 | 284 | 274 | 278 |
| Dissolved Oxygen (% Sat.) | 81.9 | 98.5 | 88.4 | 95.9 | 68.0 | 79.0 | 65.2 | 70.7 | 60.1 | 77.2 | 77.5 | 82.1 |
| pH | 6.5 | 6.7 | 6.6 | 6.6 | 6.6 | 6.6 | 6.5 | 6.6 | 6.5 | 6.6 | 6.7 | 6.7 |
| Temperature (DegC) | 9.4 | 11.3 | 10.7 | 13.0 | 13.6 | 14.4 | 16.2 | 15.0 | 14.6 | 12.4 | 11.1 | 9.1 |
| Turbidity (NTU) | 2.20 | 0.70 | 1.14 | 0.34 | 0.74 | 0.30 | 0.42 | 0.91 | 0.40 | 2.84 | 0.60 | 0.90 |
| Flow (cumec) | 0.272 | 0.196 | 0.264 | 0.123 | 0.109 | 0.074 | 0.102 | 0.254 | 0.164 | 0.146 | 0.204 | 0.222 |

| SF7 | 25/07/2017 | 29/08/2017 | 20/09/2017 | 24/10/2017 | 22/11/2017 | 18/12/2017 | 24/01/2018 | 23/02/2018 | 26/03/2018 | 23/04/2018 | 23/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 17.400 | 12.100 | 10.500 | 9.690 | 9.260 | 7.520 | 5.140 | 6.290 | 7.670 | 7.760 | 7.740 | 8.430 |
| Total Ammoniacal-N (mg/L) | 0.065 | <0.01 | 0.080 | <0.010 | <0.01 | 0.010 | <0.01 | 0.020 | <0.01 | 0.020 | 0.020 | 0.040 |
| Total Nitrogen (mg/L) | 18.70 | 13.30 | 11.40 | 10.30 | 10.30 | 8.35 | 6.54 | 7.66 | 8.19 | 8.71 | 8.86 | 8.16 |
| E. coli (MPN/100ml) | 206 | 44 | 190 | 280 | 230 | 330 | 130 | 300 | 160 | 170 | 450 | 170 |
| Dissolved Reactive Phosphorus (mg/L) | 0.062 | 0.026 | 0.078 | 0.028 | 0.030 | 0.027 | 0.007 | 0.032 | 0.014 | 0.008 | 0.018 | 0.059 |
| Total Phosphorus (mg/L) | 0.087 | 0.040 | 0.126 | 0.066 | 0.050 | 0.034 | 0.028 | 0.063 | 0.019 | 0.017 | 0.029 | 0.088 |
| Electrical Conductivity (µS/cm) | 433 | 372 | 357 | 333 | 316 | 322 | 300 | 321 | 313 | 307 | 307 | 307 |
| Dissolved Oxygen (% Sat.) | 72.4 | 95.9 | 77.5 | 105.3 | 106.0 | 82.5 | 128.7 | 52.9 | 92.0 | 95.7 | 88.0 | 89.3 |
| pH | 6.5 | 6.8 | 6.7 | 6.9 | 7.0 | 6.8 | 7.3 | 6.7 | 6.2 | 6.7 | 6.7 | 6.3 |
| Temperature (DegC) | 8.2 | 9.7 | 11.7 | 12.5 | 17.4 | 15.6 | 20.0 | 15.4 | 16.7 | 12.7 | 10.4 | 11.3 |
| Turbidity (NTU) | 4.40 | 0.82 | 2.77 | 2.89 | 1.87 | 0.50 | 0.43 | 0.64 | 0.44 | 0.45 | 1.63 | 3.71 |
| Flow (cumec) | 0.107 | 0.087 | 0.177 | 0.110 | 0.040 | 0.012 | 0.011 | 0.089 | 0.049 | 0.039 | 0.062 | 0.094 |

| SF8 | 26/07/2017 | 30/08/2017 | 21/09/2017 | 26/10/2017 | 27/11/2017 | 19/12/2017 | 29/01/2018 | 27/02/2018 | 27/03/2018 | 24/04/2018 | 23/05/2018 | 21/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 9.800 | 8.940 | 9.080 | 9.090 | 8.690 | 8.100 | 7.540 | 7.610 | 7.650 | 8.090 | 8.110 | 8.730 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | <0.01 | <0.01 | <0.01 | 0.010 | 0.010 | 0.010 | 0.030 | <0.01 | <0.01 | 0.010 |
| Total Nitrogen (mg/L) | 10.10 | 9.55 | 9.10 | 9.10 | 9.13 | 8.66 | 8.29 | 7.76 | 7.17 | 8.63 | 9.03 | 8.98 |
| E. coli (MPN/100ml) | 37 | 21 | 25 | 84 | 210 | 21 | 120 | 200 | 1200 | 120 | 130 | 86 |
| Dissolved Reactive Phosphorus (mg/L) | 0.018 | 0.024 | 0.019 | 0.012 | 0.006 | 0.012 | 0.011 | 0.013 | 0.034 | 0.008 | 0.009 | 0.017 |
| Total Phosphorus (mg/L) | 0.028 | 0.031 | 0.025 | 0.016 | 0.011 | 0.010 | 0.015 | 0.014 | 0.044 | 0.011 | 0.016 | 0.022 |
| Electrical Conductivity (µS/cm) | 354 | 304 | 295 | 284 | 287 | 302 | 302 | 307 | 314 | 303 | 309 | 339 |
| Dissolved Oxygen (% Sat.) | 76.6 | 80.6 | 87.9 | 81.8 | 70.7 | 55.8 | 51.9 | 65.2 | 60.2 | 78.4 | 74.0 | 76.5 |
| pH | 6.7 | 6.7 | 6.8 | 6.7 | 6.7 | 6.6 | 6.6 | 6.9 | 6.6 | 6.8 | 6.7 | 6.8 |
| Temperature (DegC) | 11.7 | 12.0 | 12.4 | 13.2 | 13.8 | 12.4 | 14.2 | 14.1 | 14.6 | 13.6 | 12.3 | 11.9 |
| Turbidity (NTU) | 0.70 | 0.29 | 0.38 | 0.38 | 0.20 | 0.40 | 0.62 | 0.39 | 0.91 | 0.38 | 0.21 | 0.35 |
| Flow (cumec) | 0.039 | 0.108 | 0.145 | 0.139 | 0.056 | 0.021 | 0.004 | 0.026 | 0.020 | 0.061 | 0.085 | 0.119 |

| T1 | 18/07/2017 | 21/08/2017 | 19/09/2017 | 13/10/2017 | 20/11/2017 | 13/12/2017 | 23/01/2018 | 19/02/2018 | 26/03/2018 | 23/04/2018 | 22/05/2018 | 21/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 2.500 | 2.090 | 1.620 | 2.460 | 2.530 | 2.290 | 2.060 | 2.190 | 2.380 | 2.570 | 2.760 | 2.170 |
| Total Ammoniacal-N (mg/L) | 0.060 | 0.120 | 0.110 | 0.070 | 0.010 | 0.020 | <0.01 | 0.010 | <0.01 | 0.010 | 0.050 | 0.160 |
| Total Nitrogen (mg/L) | 3.70 | 3.52 | 3.38 | 2.89 | 2.60 | 2.58 | 2.33 | 2.25 | 2.52 | 2.69 | 2.96 | 3.50 |
| E. coli (MPN/100ml) | 649 | 370 | 9700 | 390 | 480 | 1000 | 260 | 100 | 30 | 48 | 64 | 120 |
| Dissolved Reactive Phosphorus (mg/L) | 0.103 | 0.058 | 0.088 | 0.032 | 0.023 | 0.029 | 0.035 | 0.033 | 0.027 | 0.023 | 0.048 | 0.078 |
| Total Phosphorus (mg/L) | 0.250 | 0.248 | 0.360 | 0.235 | 0.045 | 0.046 | 0.059 | 0.048 | 0.038 | 0.036 | 0.162 | 0.258 |
| Electrical Conductivity (µS/cm) | 455 | 370 | 301 | 289 | 241 | 244 | 244 | 240 | 247 | 260 | 286 | 412 |
| Dissolved Oxygen (% Sat.) | 76.1 | 80.9 | 78.5 | 86.6 | 91.4 | 109.4 | 102.6 | 95.9 | 79.4 | 87.1 | 65.5 | 71.5 |
| pH | 7.3 | 7.1 | 7.0 | 7.4 | 7.8 | 8.1 | 7.8 | 7.7 | 7.2 | 7.3 | 7.3 | 7.2 |
| Temperature (DegC) | 9.5 | 10.0 | 11.7 | 15.4 | 15.4 | 17.2 | 21.5 | 18.6 | 16.3 | 12.0 | 9.8 | 9.5 |
| Turbidity (NTU) | 56.30 | 78.70 | 98.10 | 22.50 | 4.03 | 2.27 | 1.62 | 0.66 | 1.32 | 1.05 | 2.75 | 22.00 |
| Flow (cumec) | 1.771 | 1.839 | 1.924 | 1.730 | 0.979 | 0.845 | 1.291 | 1.005 | 1.281 | 1.260 | 1.461 | 2.036 |

| T2 | 17/07/2017 | 22/08/2017 | 20/09/2017 | 19/10/2017 | 22/11/2017 | 18/12/2017 | 24/01/2018 | 22/02/2018 | 27/03/2018 | 26/04/2018 | 24/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 2.900 | 3.000 | 2.900 | 3.000 | 3.400 | 3.400 | 3.000 | 2.600 | 3.400 | 3.600 | 3.500 | 3.200 |
| Total Ammoniacal-N (mg/L) | 0.016 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.065 | <0.01 | <0.01 | <0.010 | 0.014 |
| Total Nitrogen (mg/L) | 3.20 | 3.10 | 3.30 | 3.10 | 3.50 | 3.30 | 3.20 | 3.50 | 3.50 | 3.50 | 4.00 | 3.70 |
| E. coli (MPN/100ml) | 51 | 93 | 365 | 125 | 291 | 326 | 79 | >2420 | 240 | 308 | 167 | 248 |
| Dissolved Reactive Phosphorus (mg/L) | 0.024 | 0.023 | 0.028 | 0.010 | 0.006 | 0.003 | 0.028 | 0.167 | 0.010 | 0.008 | 0.012 | 0.049 |
| Total Phosphorus (mg/L) | 0.031 | 0.036 | 0.055 | 0.015 | 0.018 | 0.011 | 0.043 | 0.198 | 0.033 | 0.014 | 0.030 | 0.095 |
| Electrical Conductivity (µS/cm) | 259 | 250 | 257 | 220 | 224 | 231 | 230 | 286 | 224 | 232 | 237 | 298 |
| Dissolved Oxygen (% Sat.) | 82.0 | 86.0 | 88.7 | 113.3 | 103.5 | 83.6 | 91.4 | 88.7 | 81.4 | 92.1 | 79.9 | 57.4 |
| pH | 7.2 | 7.4 | 7.3 | 7.7 | 7.5 | 7.4 | 7.3 | 7.3 | 7.3 | 7.6 | 7.4 | 7.1 |
| Temperature (DegC) | 11.0 | 10.3 | 12.6 | 13.3 | 15.2 | 16.6 | 17.6 | 15.8 | 13.9 | 12.7 | 10.7 | 11.2 |
| Turbidity (NTU) | 2.40 | 2.30 | 2.80 | 0.73 | 0.75 | 0.54 | 0.90 | 4.20 | 1.97 | 1.74 | 1.40 | 7.00 |
| Flow (cumec) | 1.658 | 1.625 | 1.742 | 1.718 | 1.701 | 1.839 | 1.815 | 1.869 | 1.686 | 1.844 | 1.942 | 2.051 |

| T3 | 17/07/2017 | 22/08/2017 | 28/09/2017 | 19/10/2017 | 22/11/2017 | 18/12/2017 | 24/01/2018 | 22/02/2018 | 27/03/2018 | 26/04/2018 | 24/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 4.400 | 1.780 | 5.100 | 3.500 | 6.700 | 6.600 | 5.600 | 1.720 | 5.000 | 6.000 | 5.900 | 4.400 |
| Total Ammoniacal-N (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.010 | <0.010 |
| Total Nitrogen (mg/L) | 4.70 | 2.30 | 5.10 | 3.50 | 6.80 | 6.00 | 5.20 | 2.90 | 5.10 | 6.30 | 6.60 | 4.80 |
| E. coli (MPN/100ml) | 58 | 365 | 179 | 117 | 579 | 299 | 161 | >2420 | 199 | 105 | 159 | 134 |
| Dissolved Reactive Phosphorus (mg/L) | 0.012 | 0.008 | 0.004 | 0.005 | 0.010 | 0.006 | 0.009 | 0.030 | <0.004 | 0.004 | 0.007 | 0.015 |
| Total Phosphorus (mg/L) | 0.018 | 0.181 | 0.018 | <0.004 | 0.008 | 0.036 | 0.014 | 0.350 | 0.010 | 0.038 | 0.011 | 0.021 |
| Electrical Conductivity (µS/cm) | 219 | 114 | 125 | 186 | 213 | 274 | 278 | 101 | 239 | 258 | 249 | 217 |
| Dissolved Oxygen (% Sat.) | 102.1 | 92.3 | 94.5 | 91.6 | 80.4 | 116.4 | 127.9 | 87.8 | 89.4 | 82.7 | 100.2 | 97.0 |
| pH | 7.4 | 7.5 | 7.5 | 7.4 | 7.4 | 8.0 | 8.2 | 7.2 | 7.6 | 7.7 | 7.7 | 7.5 |
| Temperature (DegC) | 8.7 | 7.0 | 10.9 | 13.6 | 17.1 | 18.0 | 21.5 | 13.9 | 15.8 | 13.4 | 10.4 | 10.8 |
| Turbidity (NTU) | 1.21 | 80.00 | 1.57 | 0.86 | 0.39 | 1.15 | 0.53 | 230.00 | 0.68 | 1.21 | 0.60 | 1.30 |
| Flow (cumec) | 7.054 | 18.607 | 41.426 | 5.729 | 1.653 | 0.813 | 3.949 | 1.534 | 2.944 | 4.166 | 2.283 | 4.052 |

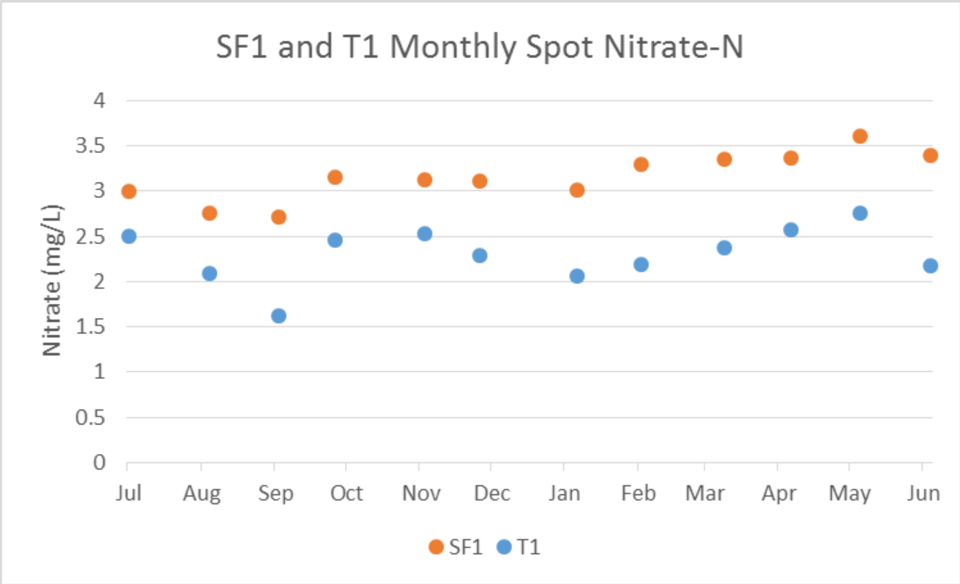
| T4 | 18/07/2017 | 28/08/2017 | 21/09/2017 | 26/10/2017 | 27/11/2017 | 15/12/2017 | 23/01/2018 | 27/02/2018 | 21/03/2018 | 24/04/2018 | 24/05/2018 | 25/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 5.300 | 4.510 | 3.790 | 2.170 | 0.802 | 0.117 | 0.015 | 1.220 | 1.370 | 1.730 | 2.120 | 2.430 |
| Total Ammoniacal-N (mg/L) | <0.010 | <0.01 | <0.01 | <0.01 | <0.01 | 0.010 | <0.01 | 0.020 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 5.80 | 4.74 | 3.90 | 2.44 | 1.15 | 0.61 | 0.60 | 1.57 | 1.74 | 1.99 | 2.20 | 2.43 |
| E. coli (MPN/100ml) | 75 | 49 | 78 | 160 | 120 | 190 | 770 | 400 | 220 | 250 | 150 | 150 |
| Dissolved Reactive Phosphorus (mg/L) | 0.036 | 0.006 | 0.013 | 0.009 | 0.013 | 0.047 | 0.026 | 0.029 | 0.012 | 0.011 | 0.017 | 0.016 |
| Total Phosphorus (mg/L) | 0.047 | 0.021 | 0.018 | 0.026 | 0.031 | 0.089 | 0.127 | 0.045 | 0.031 | 0.021 | 0.024 | 0.025 |
| Electrical Conductivity (µS/cm) | 343 | 271 | 253 | 226 | 218 | 234 | 375 | 264 | 225 | 230 | 225 | 233 |
| Dissolved Oxygen (% Sat.) | 84.6 | 97.1 | 96.1 | 81.5 | 78.8 | 89.8 | 54.8 | 69.3 | 99.2 | 86.9 | 90.6 | 91.7 |
| pH | 7.1 | 7.4 | 7.4 | 7.2 | 7.2 | 7.3 | 6.9 | 7.1 | 7.4 | 7.2 | 7.2 | 7.5 |
| Temperature (DegC) | 9.0 | 11.6 | 11.8 | 13.0 | 16.9 | 18.8 | 21.4 | 15.7 | 17.3 | 11.7 | 8.8 | 8.0 |
| Turbidity (NTU) | 1.70 | 0.90 | 1.19 | 0.99 | 0.72 | 0.92 | 3.66 | 0.71 | 1.17 | 0.98 | 0.94 | 1.28 |
| Flow (cumec) | 1.033 | 1.922 | 2.081 | 1.380 | 0.332 | 0.059 | 0.006 | 0.586 | 0.351 | 0.951 | 1.207 | 1.678 |

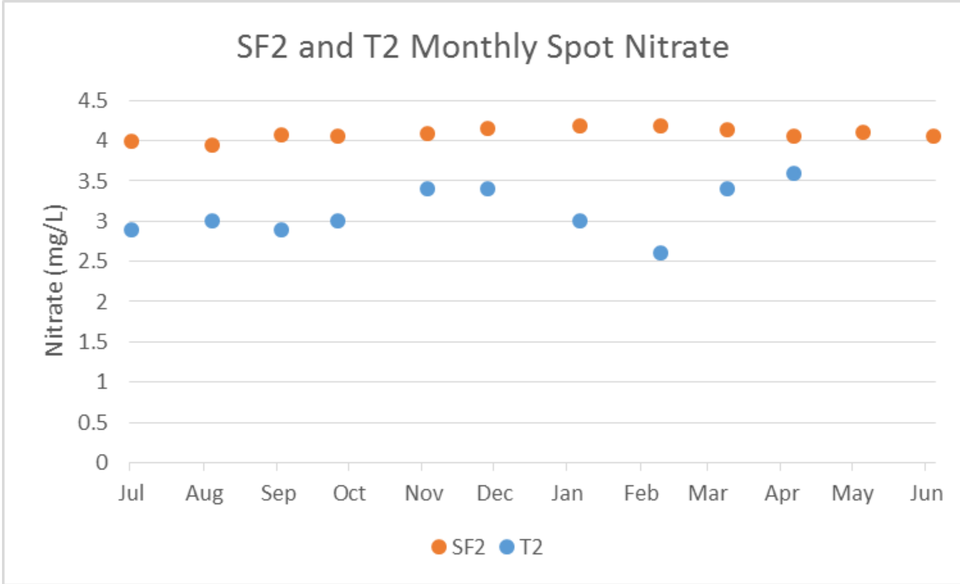
| T5 | 25/07/2017 | 29/08/2017 | 21/09/2017 | 24/10/2017 | 27/11/2017 | 15/12/2017 | 25/01/2018 | 27/02/2018 | 21/03/2018 | 17/04/2018 | 18/05/2018 | 22/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 7.200 | 6.570 | 5.770 | 4.930 | 3.330 | 2.580 | 0.434 | 2.390 | 2.100 | 3.110 | 3.460 | 3.580 |
| Total Ammoniacal-N (mg/L) | 0.055 | <0.01 | <0.01 | <0.010 | <0.01 | 0.020 | 0.020 | 0.020 | <0.01 | 0.010 | 0.010 | 0.010 |
| Total Nitrogen (mg/L) | 8.00 | 6.67 | 6.46 | 5.32 | 3.72 | 3.11 | 0.95 | 2.77 | 2.49 | 3.13 | 3.73 | 3.98 |
| E. coli (MPN/100ml) | 201 | 54 | 260 | 900 | 840 | 1500 | 81 | 420 | 630 | 310 | 530 | 300 |
| Dissolved Reactive Phosphorus (mg/L) | 0.121 | 0.027 | 0.052 | 0.018 | 0.039 | 0.068 | 0.062 | 0.063 | 0.027 | 0.033 | 0.042 | 0.034 |
| Total Phosphorus (mg/L) | 0.147 | 0.038 | 0.068 | 0.058 | 0.067 | 0.100 | 0.092 | 0.102 | 0.048 | 0.061 | 0.080 | 0.069 |
| Electrical Conductivity (µS/cm) | 475 | 400 | 391 | 347 | 297 | 296 | 359 | 378 | 332 | 355 | 347 | 355 |
| Dissolved Oxygen (% Sat.) | 89.2 | 97.5 | 101.3 | 96.3 | 93.4 | 94.5 | 100.8 | 95.6 | 107.4 | 98.1 | 98.5 | 98.8 |
| pH | 7.3 | 7.7 | 7.6 | 7.7 | 7.7 | 7.5 | 8.0 | 7.6 | 8.1 | 7.7 | 7.5 | 7.6 |
| Temperature (DegC) | 8.3 | 11.4 | 11.4 | 14.8 | 15.7 | 18.8 | 21.1 | 15.2 | 17.4 | 13.5 | 10.3 | 7.3 |
| Turbidity (NTU) | 8.30 | 1.44 | 2.41 | 1.33 | 1.76 | 1.52 | 1.54 | 2.05 | 2.10 | 5.55 | 4.16 | 4.91 |
| Flow (cumec) | 1.005 | 0.549 | 0.675 | 0.362 | 0.147 | 0.075 | 0.079 | 0.391 | 0.102 | 0.429 | 0.500 | 0.665 |

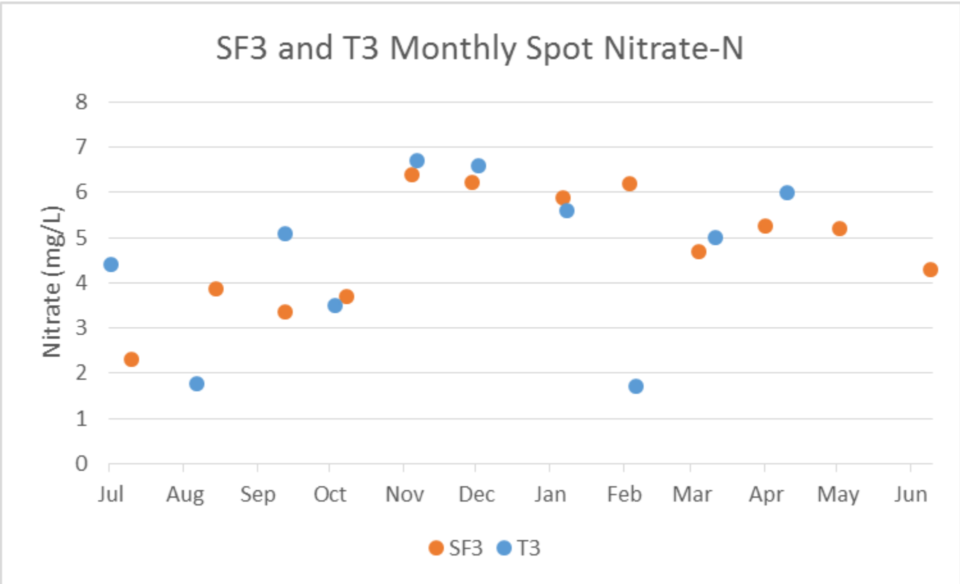
| T6 | 25/07/2017 | 30/08/2017 | 20/09/2017 | 21/09/2017 | 25/10/2017 | 23/11/2017 | 18/12/2017 | 18/12/2017 | 29/01/2018 | 26/02/2018 | 27/03/2018 | 24/04/2018 | 23/05/2018 | 20/06/2018 | 25/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 11.300 | 10.500 | 8.600 | 8.580 | 8.570 | 9.270 | 8.180 | 9.000 | 5.580 | 5.150 | 6.510 | 6.220 | 5.320 | 5.200 | 5.690 |
| Total Ammoniacal-N (mg/L) | 0.048 | <0.01 | <0.01 | <0.01 | 0.020 | <0.01 | 0.020 | 0.020 | 0.020 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Nitrogen (mg/L) | 12.40 | 11.20 | 9.10 | 9.80 | 9.30 | 10.00 | 8.82 | 8.40 | 6.99 | 6.01 | 6.86 | 6.59 | 6.07 | 5.40 | 6.09 |
| E. coli (MPN/100ml) | 89 | 190 | 517 | 260 | 510 | 3300 | 2200 | 1414 | 910 | 2500 | 630 | 920 | 740 | 162 | 340 |
| Dissolved Reactive Phosphorus (mg/L) | 0.061 | 0.011 | 0.009 | 0.023 | 0.018 | 0.013 | 0.040 | 0.021 | 0.025 | 0.063 | 0.027 | 0.019 | 0.022 | 0.045 | 0.019 |
| Total Phosphorus (mg/L) | 0.085 | 0.022 | 0.040 | 0.066 | 0.048 | 0.051 | 0.056 | 0.059 | 0.046 | 0.121 | 0.031 | 0.032 | 0.038 | 0.080 | 0.033 |
| Electrical Conductivity (µS/cm) | 573 | 468 | 425 | 447 | 400 | 361 | 360 | 355 | 352 | 379 | 357 | 354 | 361 | 371 | 382 |
| Dissolved Oxygen (% Sat.) | 88.1 | 103.4 | 118.2 | 116.7 | 105.2 | 104.1 | 99.3 | 97.4 | 85.8 | 88.7 | 101.8 | 98.9 | 101.3 | 99.4 | 96.7 |
| pH | 7.2 | 7.7 | 8.0 | 8.1 | 8.1 | 7.9 | 7.9 | 7.9 | 7.3 | 7.5 | 7.5 | 7.5 | 7.6 | 7.7 | 7.5 |
| Temperature (DegC) | 8.9 | 10.7 | 11.5 | 12.2 | 15.1 | 16.7 | 17.7 | 17.5 | 19.4 | 16.5 | 15.4 | 12.3 | 10.2 | 10.5 | 7.3 |
| Turbidity (NTU) | 5.30 | 0.55 | 2.60 | 1.05 | 1.88 | 1.91 | 1.17 | 1.51 | 1.93 | 2.30 | 1.22 | 1.47 | 1.29 | 2.40 | 1.41 |
| Flow (cumec) | 0.810 | 0.372 | not measured | 0.498 | 0.263 | 0.167 | 0.091 | not measured | 0.105 | 0.652 | 0.318 | 0.311 | 0.405 | not measured | 0.470 |

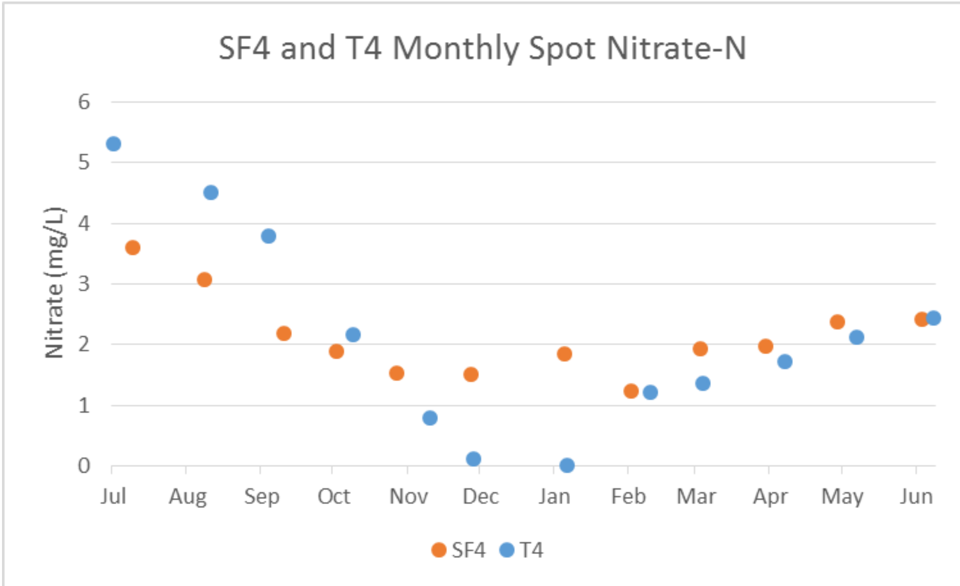
| T7 | 25/07/2017 | 30/08/2017 | 18/09/2017 | 20/09/2017 | 19/10/2017 | 23/11/2017 | 18/12/2017 | 19/12/2017 | 25/01/2018 | 27/02/2018 | 26/03/2018 | 23/04/2018 | 23/05/2018 | 20/06/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 10.400 | 10.900 | 7.970 | 8.600 | 9.170 | 9.050 | 1.610 | 0.691 | 3.280 | 4.360 | 6.340 | 5.680 | 5.410 | 5.700 | 5.720 |
| Total Ammoniacal-N (mg/L) | 0.053 | 0.020 | 0.020 | <0.01 | 0.020 | 0.010 | 0.059 | 0.060 | 0.030 | 0.010 | <0.01 | 0.020 | <0.01 | <0.010 | <0.01 |
| Total Nitrogen (mg/L) | 11.50 | 11.50 | 9.71 | 9.30 | 9.86 | 9.78 | 2.00 | 1.13 | 4.07 | 5.00 | 5.94 | 6.43 | 6.20 | 5.60 | 6.40 |
| E. coli (MPN/100ml) | 96 | 550 | 6200 | 210 | 420 | 480 | 1414 | 990 | 2000 | 220 | 300 | 160 | 450 | 131 | 130 |
| Dissolved Reactive Phosphorus (mg/L) | 0.060 | 0.010 | 0.013 | 0.006 | 0.013 | 0.010 | 0.072 | 0.085 | 0.087 | 0.078 | 0.014 | <0.005 | 0.017 | 0.035 | 0.035 |
| Total Phosphorus (mg/L) | 0.085 | 0.018 | 0.080 | 0.031 | 0.053 | 0.030 | 0.088 | 0.097 | 0.111 | 0.073 | 0.028 | 0.030 | 0.035 | 0.075 | 0.071 |
| Electrical Conductivity (µS/cm) | 566 | 481 | 407 | 424 | 393 | 373 | 315 | 318 | 366 | 412 | 378 | 378 | 378 | 379 | 403 |
| Dissolved Oxygen (% Sat.) | 89.6 | 96.0 | 99.6 | 116.6 | 105.8 | 106.3 | 116.2 | 74.9 | 154.1 | 91.4 | 122.1 | 102.1 | 102.7 | 97.3 | 96.3 |
| pH | 7.3 | 7.6 | 7.6 | 7.8 | 8.1 | 8.2 | 8.0 | 7.2 | 8.8 | 7.5 | 8.2 | 7.6 | 7.6 | 7.6 | 7.5 |
| Temperature (DegC) | 9.6 | 10.0 | 10.7 | 11.2 | 17.0 | 18.1 | 18.2 | 15.1 | 24.8 | 15.9 | 17.1 | 12.9 | 10.4 | 10.5 | 11.0 |
| Turbidity (NTU) | 4.80 | 0.92 | 5.94 | 2.50 | 4.32 | 1.11 | 1.42 | 0.65 | 0.94 | 0.76 | 3.80 | 1.47 | 1.65 | 5.50 | 4.49 |
| Flow (cumec) | 0.752 | 0.357 | 0.728 | 1.384 | 0.322 | 0.112 | 1.093 | 0.005 | 0.048 | 0.378 | 0.285 | 0.246 | 0.391 | 1.381 | 0.665 |

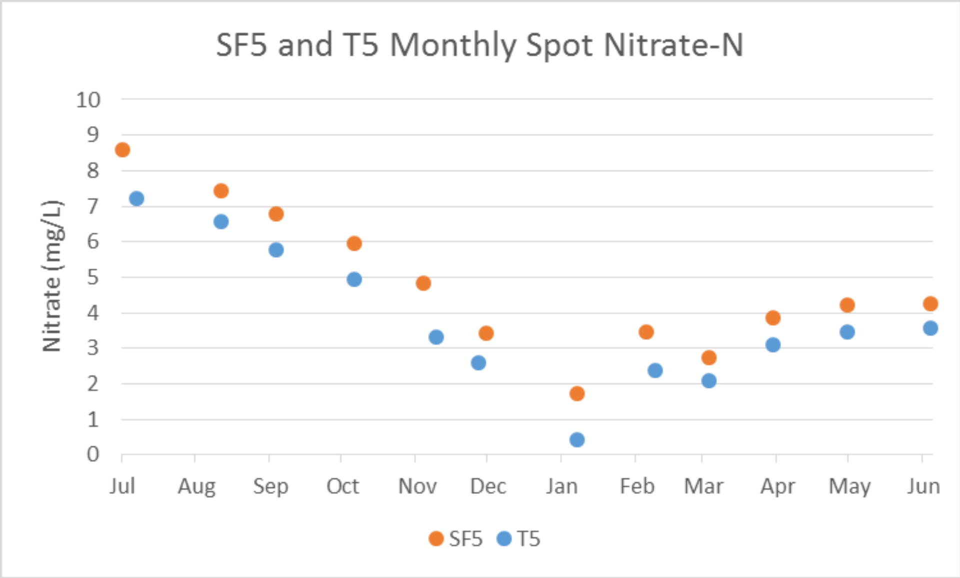
| T8 | 17/07/2017 | 22/08/2017 | 20/09/2017 | 19/10/2017 | 22/11/2017 | 18/12/2017 | 24/01/2018 | 22/02/2018 | 27/03/2018 | 26/04/2018 | 24/05/2018 | 20/06/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite-N (mg/L) | 7.500 | 7.800 | 7.600 | 7.800 | 8.000 | 7.800 | 7.100 | 5.900 | 7.000 | 7.600 | 7.400 | 7.300 |
| Total Ammoniacal-N (mg/L) | <0.01 | 0.022 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.043 | <0.01 | <0.01 | <0.010 | 0.013 |
| Total Nitrogen (mg/L) | 7.10 | 7.20 | 7.20 | 7.50 | 7.50 | 7.00 | 6.60 | 7.60 | 7.10 | 6.60 | 8.30 | 7.00 |
| E. coli (MPN/100ml) | 109 | 114 | 276 | 248 | 192 | 687 | 579 | >2420 | 219 | 435 | 172 | 248 |
| Dissolved Reactive Phosphorus (mg/L) | 0.011 | 0.008 | 0.002 | 0.003 | 0.005 | 0.004 | 0.009 | 0.137 | <0.004 | <0.004 | 0.006 | 0.011 |
| Total Phosphorus (mg/L) | 0.017 | 0.015 | 0.019 | <0.004 | 0.008 | 0.011 | 0.011 | 0.181 | 0.011 | 0.015 | 0.048 | 0.031 |
| Electrical Conductivity (µS/cm) | 312 | 341 | 334 | 304 | 282 | 265 | 271 | 372 | 288 | 293 | 293 | 328 |
| Dissolved Oxygen (% Sat.) | 90.2 | 81.2 | 82.1 | 86.0 | 89.7 | 87.1 | 82.0 | 70.0 | 78.2 | 74.3 | 81.7 | 81.4 |
| pH | 7.4 | 7.5 | 7.4 | 7.4 | 7.6 | 7.6 | 7.5 | 7.3 | 7.4 | 7.9 | 7.6 | 7.3 |
| Temperature (DegC) | 10.7 | 9.6 | 11.4 | 11.4 | 12.6 | 13.1 | 14.0 | 12.6 | 13.1 | 12.0 | 10.7 | 11.3 |
| Turbidity (NTU) | 1.77 | 2.40 | 1.81 | 1.52 | 1.10 | 1.48 | 1.43 | 4.40 | 2.30 | 1.30 | 9.40 | 4.30 |
| Flow (cumec) | 0.587 | 0.598 | 0.644 | 0.667 | 0.686 | 0.707 | 0.746 | 0.792 | 0.705 | 0.704 | 0.710 | 0.723 |

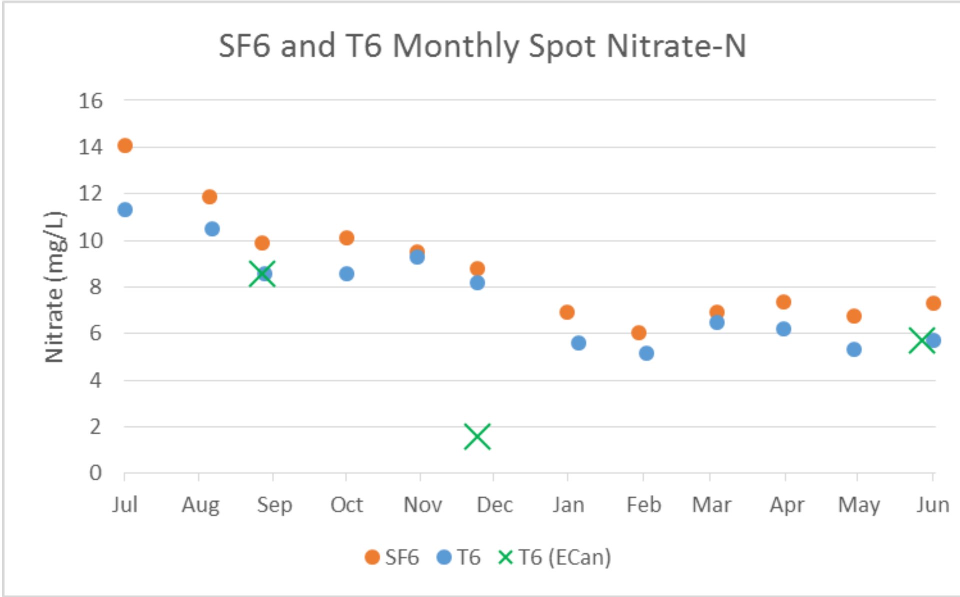

SF1 and T1 Monthly Spot Nitrate-N
Nitrate (mg/L)
0 0.5 1 1.5 2 2.5 3 3.5 4
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun
SF1 T1

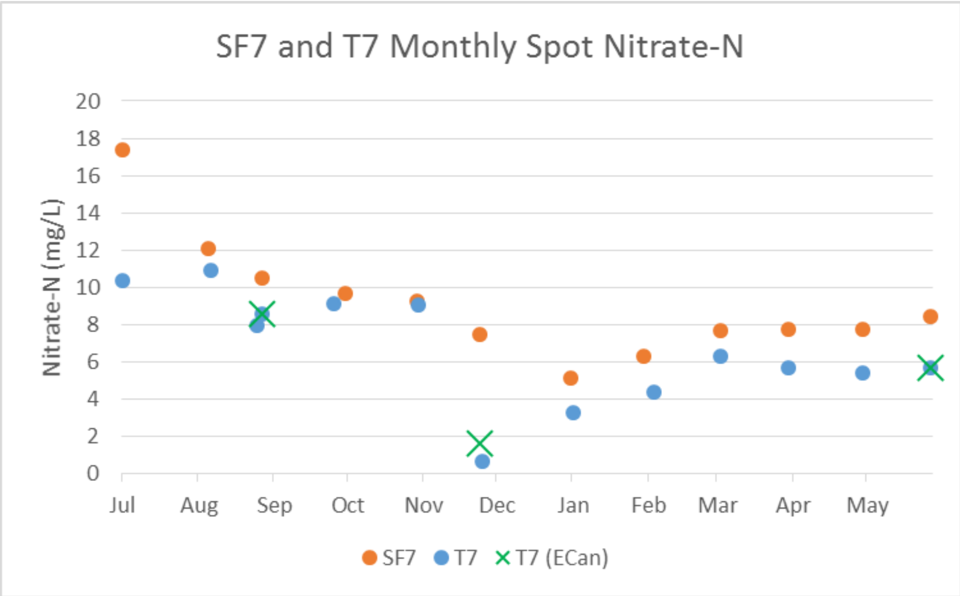

SF2 and T2 Monthly Spot Nitrate
Nitrate (mg/L)
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun
SF2 T2

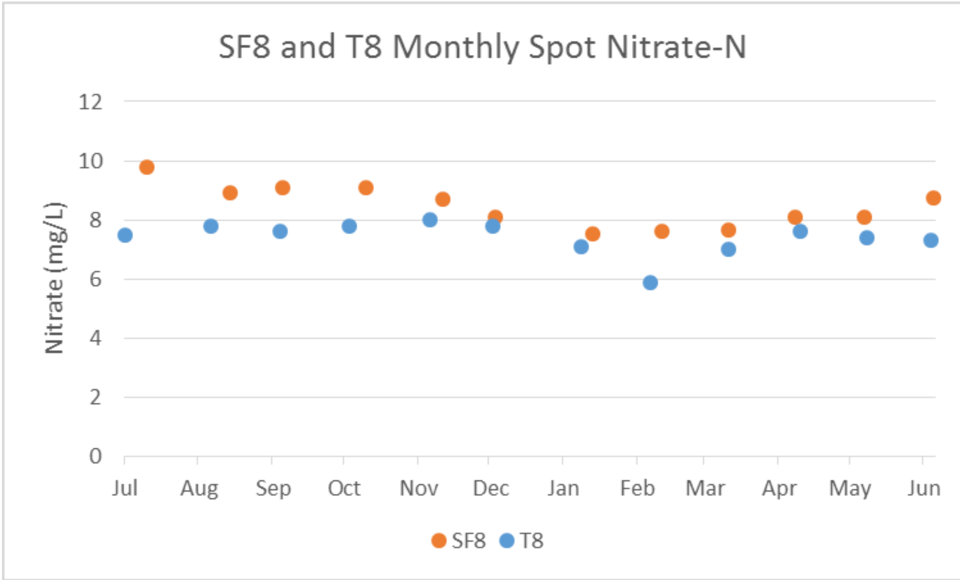

SF3 and T3 Monthly Spot Nitrate-N
Nitrate (mg/L)
0 1 2 3 4 5 6 7 8
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun
SF3 T3

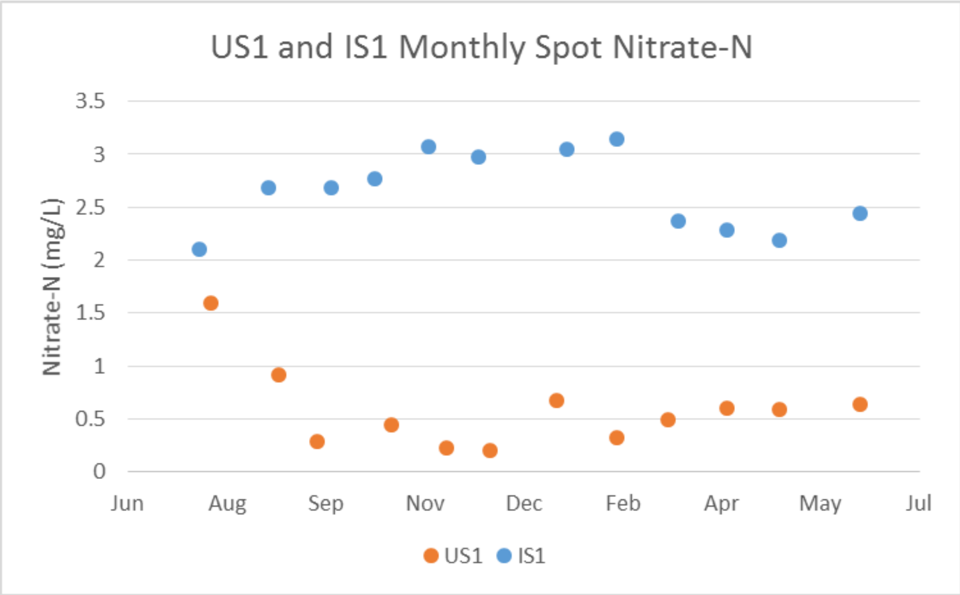

SF4 and T4 Monthly Spot Nitrate-N
Nitrate (mg/L)
0 1 2 3 4 5 6
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun
SF4 T4

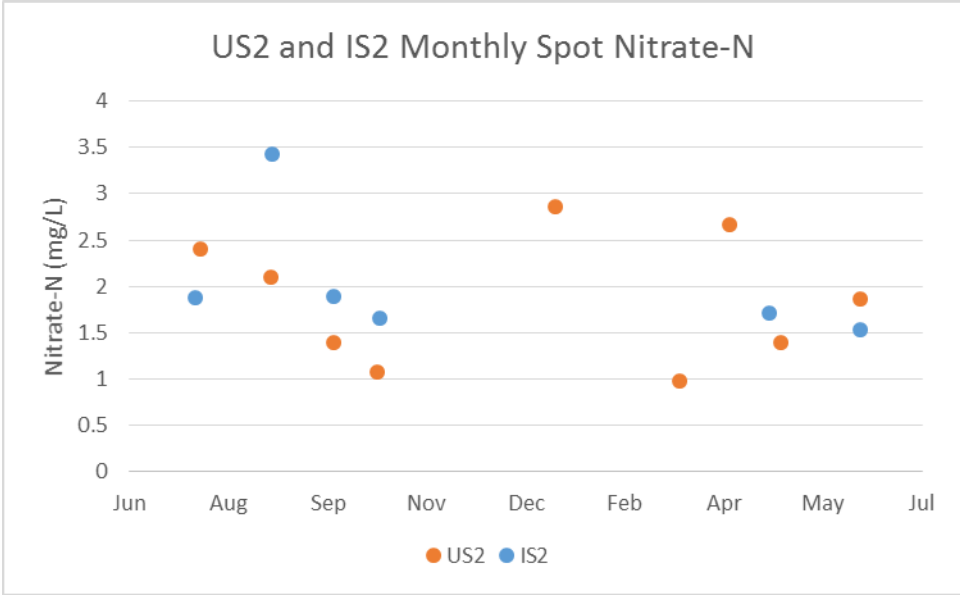

SF5 and T5 Monthly Spot Nitrate-N
Nitrate (mg/L)
0
1
2
3
4
5
6
7
8
9
10
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
SF5
T5

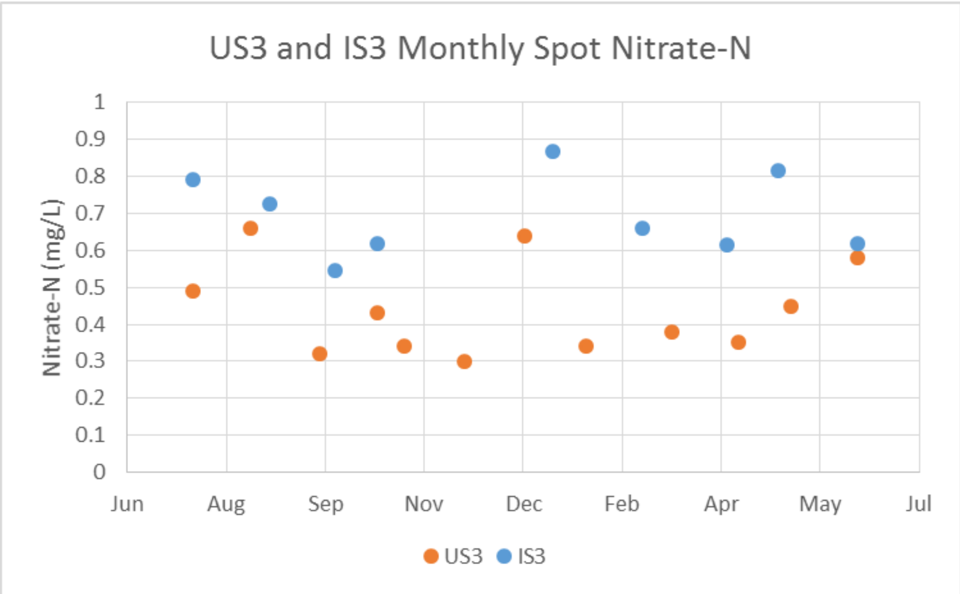

SF6 and T6 Monthly Spot Nitrate-N
Nitrate (mg/L)
0
2
4
6
8
10
12
14
16
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
SF6
T6
T6 (ECan)

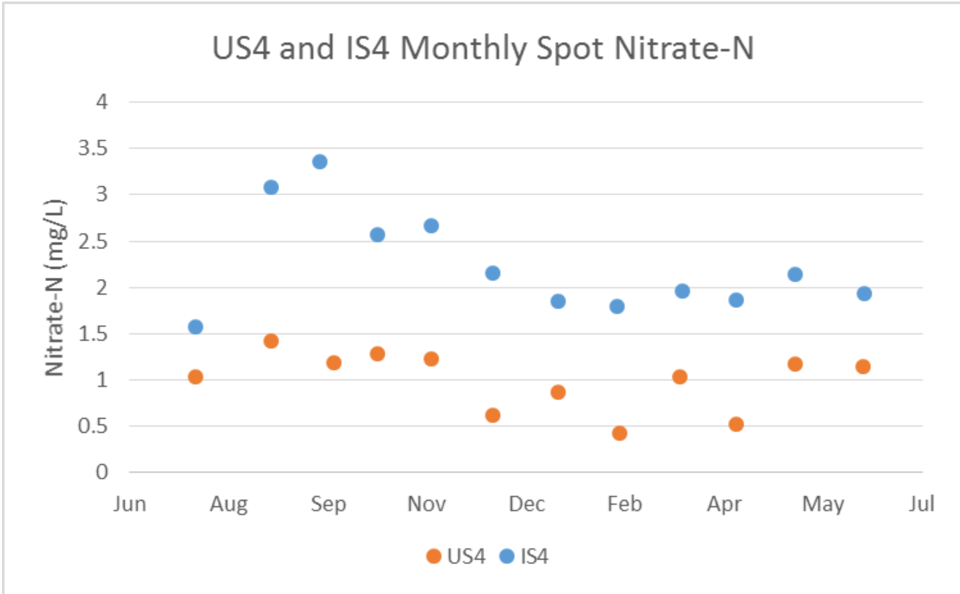

SF7 and T7 Monthly Spot Nitrate-N
Nitrate-N (mg/L)
0
2
4
6
8
10
12
14
16
18
20
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
SF7
T7
T7 (ECan)

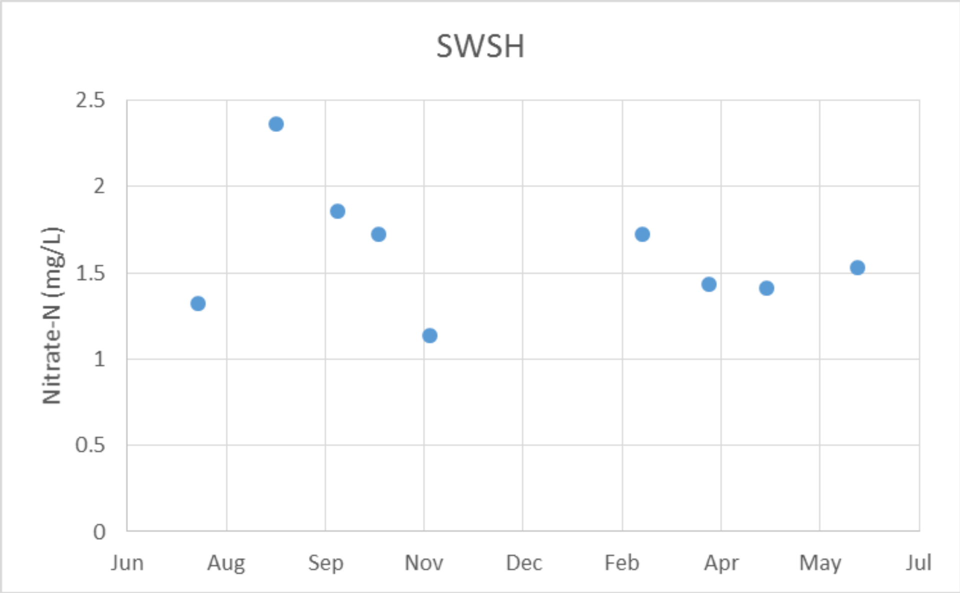

SF8 and T8 Monthly Spot Nitrate-N
Nitrate (mg/L)
0
2
4
6
8
10
12
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
SF8
T8

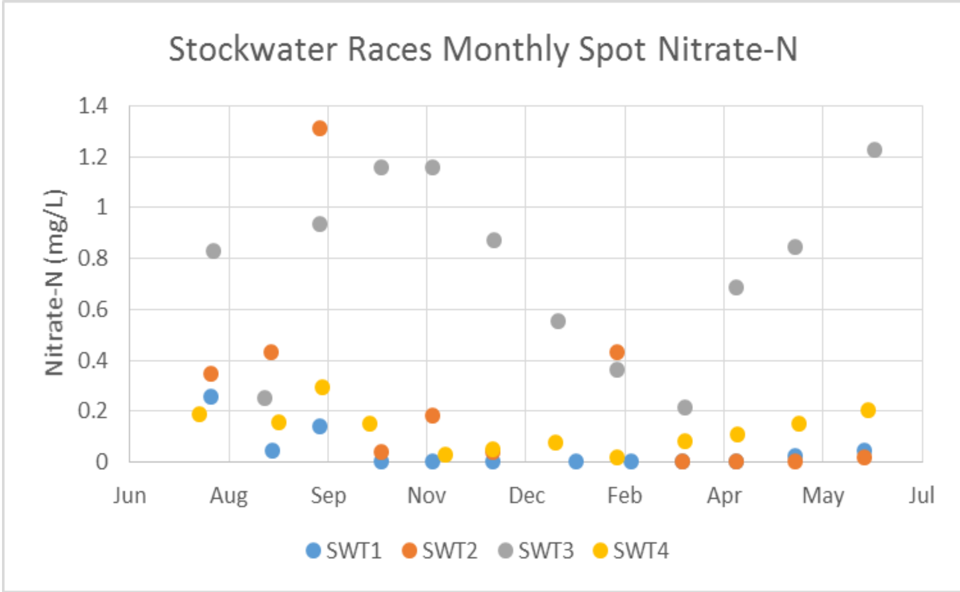

US1 and IS1 Monthly Spot Nitrate-N
Nitrate-N (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Jun
Aug
Sep
Nov
Dec
Feb
Apr
May
Jul
US1
IS1


US2 and IS2 Monthly Spot Nitrate-N
Nitrate-N (mg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
Jun
Aug
Sep
Nov
Dec
Feb
Apr
May
Jul
US2
IS2


US3 and IS3 Monthly Spot Nitrate-N
Nitrate-N (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jun
Aug
Sep
Nov
Dec
Feb
Apr
May
Jul
US3
IS3


US4 and IS4 Monthly Spot Nitrate-N
Nitrate-N (mg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
Jun
Aug
Sep
Nov
Dec
Feb
Apr
May
Jul
US4
IS4


SWSH
Nitrate-N (mg/L)
2.5
2
1.5
1
0.5
0
Jun
Aug
Sep
Nov
Dec
Feb
Apr
May
Jul


Stockwater Races Monthly Spot Nitrate-N
Nitrate-N (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jun
Aug
Sep
Nov
Dec
Feb
Apr
May
Jul
SWT1
SWT2
SWT3
SWT4

## 6.4. Lake Water Quality Monitoring Results (Ecan data)

| **Kaituna Lagoon** | 25/07/17 | 22/08/17 | 22/09/17 | 24/10/17 | 13/11/17 | 13/12/17 | 19/01/18 | 23/02/18 | 23/03/18 | 24/04/18 | 29/05/18 | 15/06/18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammoniacal-N (mg/L) | 0.037 | 0.016 | <0.010 | 0.085 | 0.013 | <0.005 | 0.009 | 0.007 | 0.019 | <0.005 | <0.011 | 0.011 |
| Nitrate + Nitrite-N (mg/L) | 0.480 | 0.340 | 0.191 | 0.099 | 0.094 | <0.001 | <0.001 | <0.001 | 0.380 | <0.001 | 0.110 | 0.110 |
| Total Nitrogen (mg/L) | 1.60 | 0.96 | 1.04 | 1.12 | 0.67 | 0.68 | 1.20 | 1.46 | 0.88 | 1.52 | 0.00 | 0.00 |
| Chlorphyll A (µg/L) | 6 | 1 | 7 | 4 | 4 | 7 | 57 | 26 | 2 | 30 | 21 | 35 |
| Dissolved Oxygen | 73.2 | 95.2 | 82.2 | 96.5 | 130.1 | 98.9 | 68.4 | 70.5 | 76.8 | 83.6 | 77.5 | 75.0 |
| Electrical Conductivity (mS/m) | 188.5 | 39.96 | 844.5 | 55 | 397.3 | 2324 | 903.5 | 1092.9 | 946.6 | 1046.1 | 4085 | 5622 |
| E coli (MPN/100ml) | 99 | 50 | 792 | 1046 | 110 | 867 | 1014 | 1483 | 2910 | 74 | 206 | 504 |
| Dissolved Reactive Phosphorus (mg/L) | 0.035 | 0.066 | 0.004 | 0.054 | 0.040 | 0.043 | 0.005 | 0.007 | 0.031 | 0.004 | 0.011 | 0.005 |
| Total Phosphorus (mg/L) | 0.189 | 0.136 | 0.065 | 0.260 | 0.102 | 0.092 | 0.158 | 0.138 | 0.068 | 0.137 | 0.140 | 0.170 |
| pH | 7.4 | 7.3 | 8.1 | 8.1 | 9.0 | 0.0 | 7.3 | 7.3 | 7.1 | 7.9 | 7.4 | 7.7 |
| Temperature (DegC) | 6.3 | 8.9 | 12.8 | 21.5 | 18.7 | 19.9 | 21.3 | 14.5 | 12.2 | 11.3 | 5.9 | 10.0 |
| Turbidity (NTU) | 52.0 | 13.5 | 22.0 | 70.0 | 29.0 | 61.0 | 47.0 | 44.0 | 7.2 | 27.0 | 35.0 | 32.0 |

| Off Selwyn River Mouth | 25/07/17 | 22/08/17 | 22/09/17 | 24/10/17 | 13/11/17 | 13/12/17 | 19/01/18 | 23/02/18 | 23/03/18 | 24/04/18 | 29/05/18 | 15/06/18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammoniacal-N (mg/L) | 0.022 | 0.018 | <0.01 | <0.01 | 0.03 | 0.009 | 0.014 | 0.009 | 0.006 | 0.022 | 0.038 | 0.011 |
| Nitrate + Nitrite-N (mg/L) | 0.49 | 1.86 | 1.59 | 0.72 | 0.071 | <0.001 | <0.001 | 0.5 | 0.002 | 0.003 | 0.002 | 0.79 |
| Total Nitrogen (mg/L) | 1.97 | 2.2 | 2.2 | 2 | 2 | 1.81 | 2.2 | 2.4 | 2.5 | 2.1 | 2.6 | 2.4 |
| Chlorphyll A (mg/L) | 53 | <2 | 23 | 45 | 76 | 43 | 59 | 46 | 70 | 81 | 74 | 64 |
| Dissolved Oxygen | 93.1 | 99.9 | 105.4 | 132.1 | 99.2 | 103.3 | 105.5 | 100.1 | 91.2 | 118.6 | 100.5 | 94.6 |
| Electrical Conductivity (mS/m) | 1168.2 | 1261.1 | 1030.8 | 1143 | 1397.1 | 1313.4 | 1343.8 | 900 | 1204.8 | 1050.5 | 1070.6 | 718.1 |
| E coli (MPN/100ml) | 187 | 295 | 132 | <10 | 10 | <10 | 41 | 2190 | 20 | 63 | <10 | 51 |
| Dissolved Reactive Phosphorus (mg/L) | 0.0066 | 0.0084 | 0.0035 | 0.004 | 0.0055 | 0.009 | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 | 0.0035 |
| Total Phosphorus (mg/L) | 0.129 | 0.077 | 0.072 | 0.077 | 0.186 | 0.167 | 0.22 | 0.2 | 0.26 | 0.171 | 0.27 | 0.13 |
| pH | 8.09 | 8.22 | 8.25 | 8.83 | 8.99 | 8.49 | 8.59 | 8.27 | 8.29 | 8.63 | 8.24 | 8.16 |
| Temperature (DegC) | 6.5 | 8 | 11.8 | 16.2 | 14.6 | 19.1 | 23.3 | 14.4 | 13.7 | 11.5 | 6.5 | 9.1 |
| Turbidity (NTU) | 59 | 78 | 49 | 63 | 143 | 81 | 113 | 118 | 181 | 72 | 193 | 46 |

| Mid Lake | 25/07/17 | 22/08/17 | 22/09/17 | 24/10/17 | 13/11/17 | 13/12/17 | 19/01/18 | 23/02/18 | 23/03/18 | 24/04/18 | 29/05/18 | 15/06/18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammoniacal-N (mg/L) | 0.016 | <0.01 | <0.01 | <0.01 | 0.015 | 0.009 | 0.013 | <0.005 | <0.005 | <0.005 | 0.023 | <0.005 |
| Nitrate + Nitrite-N (mg/L) | 0.53 | 0.54 | 0.68 | 0.093 | <0.001 | <0.001 | <0.001 | 0.037 | <0.001 | <0.001 | 0.001 | <0.001 |
| Total Nitrogen (mg/L) | 1.91 | 1.86 | 1.64 | 1.43 | 1.72 | 1.79 | 2 | 2.2 | 2.5 | 2.1 | 2.7 | 1.95 |
| Chlorphyll A (mg/L) | 43 | 62 | 50 | 55 | 51 | 49 | 50 | 60 | 89 | 68 | 62 | 100 |
| Dissolved Oxygen | 95.9 | 97.8 | 101.6 | 90.5 | 87 | 85.6 | 101.1 | 100.1 | 94 | 110.6 | 98 | 94.5 |
| Electrical Conductivity (mS/m) | 860.1 | 1081.7 | 1328.5 | 1406.3 | 1411.1 | 1461.4 | 1465.8 | 1331 | 1170.7 | 1160.3 | 1103.5 | 894.6 |
| E coli (MPN/100ml) | 5170 | <10 | <10 | <10 | <10 | <10 | 10 | 395 | <10 | <10 | <10 | 10 |
| Dissolved Reactive Phosphorus (mg/L) | 0.0058 | 0.0055 | 0.0038 | 0.0038 | 0.0038 | 0.009 | 0.006 | 0.005 | 0.005 | 0.005 | 0.007 | 0.004 |
| Total Phosphorus (mg/L) | 0.131 | 0.168 | 0.104 | 0.098 | 0.168 | 0.149 | 0.21 | 0.22 | 0.34 | 0.188 | 0.31 | 0.164 |
| pH | 8.13 | 7.99 | 8.26 | 8.57 | 8.39 | 7.98 | 8.31 | 8.24 | 8.06 | 8.5 | 8.14 | 8.29 |
| Temperature (DegC) | 6.5 | 7.9 | 11.8 | 15.4 | 14.6 | 18.7 | 22.8 | 14.7 | 13.2 | 11.6 | 6.5 | 8.6 |
| Turbidity (NTU) | 72 | 104 | 82 | 73 | 132 | 101 | 112 | 144 | 220 | 87 | 230 | 57 |

| South of Timber Yard | 25/07/17 | 22/08/17 | 22/09/17 | 24/10/17 | 13/11/17 | 13/12/17 | 19/01/18 | 23/02/18 | 23/03/18 | 24/04/18 | 29/05/18 | 15/06/18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammoniacal-N (mg/L) | 0.023 | 0.015 | <0.01 | <0.01 | 0.026 | 0.009 | 0.015 | 0.007 | 0.017 | 0.023 | 0.031 | 0.006 |
| Nitrate + Nitrite-N (mg/L) | 0.42 | 0.54 | 1.02 | 1.55 | 0.139 | <0.001 | <0.001 | <0.001 | 0.001 | 0.003 | 0.035 | 0.151 |
| Total Nitrogen (mg/L) | 2.1 | 1.94 | 2.1 | 2.5 | 1.95 | 1.93 | 1.9 | 2.3 | 2.2 | 2.1 | 2.5 | 2.3 |
| Chlorphyll A (mg/L) | 61 | 80 | 46 | 24 | 70 | 48 | 59 | 80 | 74 | 75 | 82 | 82 |
| Dissolved Oxygen | 103.7 | 86.4 | 100.6 | 107.4 | 99.2 | 101.2 | 110.7 | 128.5 | 102.1 | 118 | 99.1 | 97.3 |
| Electrical Conductivity (mS/m) | 1044.5 | 1229.7 | 1368.8 | 1074.1 | 13971 | 1413.4 | 1423.6 | 1154.8 | 1207.3 | 1103.3 | 976.1 | 872 |
| E coli (MPN/100ml) | 331 | <10 | 31 | 20 | 10 | 10 | <10 | 435 | 121 | <10 | 108 | 10 |
| Dissolved Reactive Phosphorus (mg/L) | 0.0068 | 0.0044 | 0.004 | 0.0044 | 0.0052 | 0.009 | 0.007 | 0.006 | 0.006 | 0.006 | 0.0061 | 0.0033 |
| Total Phosphorus (mg/L) | 0.151 | 0.165 | 0.142 | 0.048 | 0.124 | 0.112 | 0.176 | 0.26 | 0.2 | 0.171 | 0.2 | 0.146 |
| pH | 8.27 | 7.96 | 8.25 | 8.56 | 8.99 | 8.37 | 8.57 | 8.58 | 8.38 | 8.53 | 8.21 | 8.3 |
| Temperature (DegC) | 7.3 | 8.5 | 11.9 | 17.7 | 14.6 | 19.1 | 23.3 | 15.7 | 14 | 11.7 | 6.4 | 8.5 |
| Turbidity (NTU) | 56 | 141 | 128 | 48 | 87 | 103 | 88 | 113 | 123 | 74 | 119 | 46 |

| Taumutu | 25/07/17 | 22/08/17 | 22/09/17 | 24/10/17 | 13/11/17 | 13/12/17 | 19/01/18 | 23/02/18 | 23/03/18 | 24/04/18 | 29/05/18 | 15/06/18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammoniacal-N (mg/L) | 0.021 | 0.022 | <0.01 | 0.016 | 0.032 | 0.009 | 0.015 | 0.011 | 0.012 | 0.024 | 0.033 | 0.01 |
| Nitrate + Nitrite-N (mg/L) | 0.28 | 0.5 | 0.76 | 0.44 | 0.001 | <0.001 | <0.001 | <0.001 | 0.003 | 0.003 | 0.002 | 0.002 |
| Total Nitrogen (mg/L) | 1.94 | 1.66 | 1.7 | 1.37 | 1.61 | 1.9 | 2.2 | 2.1 | 2.2 | 2.3 | 2.4 | 1.98 |
| Chlorphyll A (mg/L) | 74 | 62 | 40 | 29 | 61 | 46 | 18 | 71 | 70 | 86 | 60 | 70 |
| Dissolved Oxygen | 109 | 101.1 | 100.5 | 99.2 | 93.2 | 106.5 | 119.6 | 116.7 | 103.3 | 117.6 | 99.5 | 99.7 |
| Electrical Conductivity (mS/m) | 1169.5 | 1792.4 | 1398.8 | 4608.8 | 1645.6 | 1494.3 | 1335.3 | 1304.6 | 1140.6 | 10612 | 983 | 942.9 |
| E coli (MPN/100ml) | 158 | <10 | 10 | <10 | <10 | 10 | <10 | 62 | <10 | <10 | <10 | 52 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.004 | 0.0044 | 0.0036 | 0.0051 | 0.009 | 0.006 | 0.005 | 0.006 | 0.005 | 0.0063 | 0.0035 |
| Total Phosphorus (mg/L) | 0.121 | 0.115 | 0.114 | 0.05 | 0.096 | 0.105 | 0.192 | 0.21 | 0.22 | 0.195 | 0.22 | 0.149 |
| pH | 8.39 | 8.13 | 8.18 | 8.19 | 8.85 | 8.3 | 8.65 | 8.47 | 8.38 | 8.69 | 8.23 | 8.41 |
| Temperature (DegC) | 6.8 | 8.3 | 12.1 | 13.4 | 13.7 | 18.9 | 20.3 | 15.2 | 13.4 | 11.6 | 6.3 | 8.8 |
| Turbidity (NTU) | 50 | 76 | 94 | 40 | 71 | 101 | 95 | 125 | 127 | 99 | 104 | 48 |

## 6.5. Groundwater Quality Monitoring Data

| BW22/0041 | 6/09/2017 | 7/12/2017 | 9/03/2018 | 14/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 5.965 | 6.685 | 6.070 | 5.720 |
| Alkalinity (mg/L) | 29[A] | 26 | 25 | 29 |
| Bromide (mg/L) | 0.04 | 0.03 | 0.03 | 0.03 |
| Chloride (mg/L) | 9.26 | 13.50 | 8.90 | 7.62 |
| Dissolved Oxygen (% Sat.) | 89.8 | 86.9 | 90.1 | 88.1 |
| Dissolved Reactive Phosphorus (mg/L) | 0.010 | 0.011 | 0.009 | 0.011 |
| Electrical Conductivity (mS/m) | 17.0 | 19.3 | 18.2 | 17.6 |
| E. coli (MPN/100ml) | <1 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 6.91 | 6.95 | 7.65 | 6.51 |
| Total Nitrogen (mg/L) | 6.68 | 7.26 | 7.32 | 6.28 |
| pH | 6.2 | 6.3 | 6.4 | 6.4 |
| Sulphate (mg/L) | 10.7 | 11.9 | 10.8 | 10.8 |
| Temperature (DegC) | 11.3 | 11.9 | 11.9 | 11.8 |

| BW22/0042 | 13/09/2017 | 4/12/2017 | 7/03/2018 | 8/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 13.925 | 17.095 | 14.535 | 17.460 |
| Alkalinity (mg/L) | 34 | 36 | 37 | 40 |
| Bromide (mg/L) | 0.04 | 0.04 | 0.04 | 0.04 |
| Chloride (mg/L) | 11.30 | 12.80 | 9.59 | 9.27 |
| Dissolved Oxygen (% Sat.) | 86.7 | 81.8 | 87.4 | 71.1 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.012 | 0.010 | 0.011 |
| Electrical Conductivity (mS/m) | 22.3 | 26.5 | 21.8 | 22.3 |
| E. coli (MPN/100ml) | 1 | 1 | 26 | <1 |
| Nitrate-N (mg/L) | 5.85 | 4.66 | 4.83 | 3.41 |
| Total Nitrogen (mg/L) | 5.91 | 4.77 | 4.81 | 3.35 |
| pH | 6.3 | 6.4 | 6.3 | 6.3 |
| Sulphate (mg/L) | 26.6 | 42.8 | 25.5 | 33.9 |
| Temperature (DegC) | 12.5 | 14.0 | 12.4 | 11.6 |

[A] Bicarbonate Alkalinity

| BX21/0017 | 7/09/2017 | 8/12/2017 | 9/03/2018 | 7/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 6.390 | 8.850 | 8.690 | 8.995 |
| Alkalinity (mg/L) | 21 | 26 | 26 | 29 |
| Bromide (mg/L) | 0.05 | 0.04 | 0.05 | 0.04 |
| Chloride (mg/L) | 21.80 | 16.50 | 17.90 | 14.30 |
| Dissolved Oxygen (% Sat.) | 88.3 | 79.7 | 82.7 | 80.3 |
| Dissolved Reactive Phosphorus (mg/L) | 0.013 | 0.016 | 0.014 | 0.020 |
| Electrical Conductivity (mS/m) | 29.8 | 26.9 | 29.1 | 26.0 |
| E. coli (MPN/100ml) | <4 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 17.30 | 14.40 | 16.70 | 13.00 |
| Total Nitrogen (mg/L) | 17.10 | 13.90 | 16.00 | 12.20 |
| pH | 6.4 | 6.3 | 6.2 | 6.2 |
| Sulphate (mg/L) | 10.9 | 13.5 | 12.9 | 13.2 |
| Temperature (DegC) | 11.2 | 12.1 | 11.7 | 11.8 |

| BX21/0018 | 7/09/2017 | 6/12/2017 | 5/03/2018 | 7/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 88.425 | 83.150 | 81.880 | 76.010 |
| Alkalinity (mg/L) | 67 | 63 | 62 | 56 |
| Bromide (mg/L) | 0.02 | <0.02 | 0.02 | 0.03 |
| Chloride (mg/L) | 10.60 | 11.40 | 10.20 | 11.20 |
| Dissolved Oxygen (% Sat.) | 101.5 | 99.5 | 98.1 | 93.1 |
| Dissolved Reactive Phosphorus (mg/L) | 0.016 | 0.016 | 0.015 | 0.014 |
| Electrical Conductivity (mS/m) | 22.0 | 22.3 | 22.5 | 22.7 |
| E. coli (MPN/100ml) | <4 | 2 | <1 | <1 |
| Nitrate-N (mg/L) | 3.79 | 4.22 | 4.04 | 4.98 |
| Total Nitrogen (mg/L) | 3.59 | 4.39 | 4.08 | 4.88 |
| pH | 8.0 | 8.0 | 8.0 | 7.9 |
| Sulphate (mg/L) | 7.5 | 8.2 | 9.4 | 9.5 |
| Temperature (DegC) | 11.3 | 12.6 | 12.5 | 11.2 |

| BX22/0041 | 7/09/2017 | 12/12/2017 | 9/03/2018 | 15/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 18.600 | 19.540 | 19.150 | 19.760 |
| Alkalinity (mg/L) | 57 | 53 | 55 | 51 |
| Bromide (mg/L) | 0.03 | 0.03 | 0.04 | 0.03 |
| Chloride (mg/L) | 9.68 | 10.20 | 10.70 | 9.95 |
| Dissolved Oxygen (% Sat.) | 83.0 | 70.9 | 80.5 | 63.6 |
| Dissolved Reactive Phosphorus (mg/L) | 0.006 | 0.007 | 0.006 | 0.010 |
| Electrical Conductivity (mS/m) | 24.1 | 22.8 | 24.1 | 21.1 |
| E. coli (MPN/100ml) | <4 | <1 | <1 | 68 |
| Nitrate-N (mg/L) | 6.77 | 6.31 | 6.97 | 5.02 |
| Total Nitrogen (mg/L) | 6.81 | 6.25 | 6.71 | 4.46 |
| pH | 7.3 | 7.0 | 7.1 | 7.0 |
| Sulphate (mg/L) | 10.6 | 10.1 | 11.0 | 8.3 |
| Temperature (DegC) | 11.8 | 12.8 | 12.2 | 11.4 |

| BX22/0042 | 14/09/2017 | 6/12/2017 | 12/03/2018 | 7/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 43.770 | 41.480 | 41.585 | 40.265 |
| Alkalinity (mg/L) | 56 | 54 | 50 | 49 |
| Bromide (mg/L) | 0.03 | 0.02 | 0.03 | 0.04 |
| Chloride (mg/L) | 8.97 | 9.87 | 9.35 | 11.00 |
| Dissolved Oxygen (% Sat.) | 90.9 | 84.2 | 92.5 | 94.1 |
| Dissolved Reactive Phosphorus (mg/L) | 0.010 | 0.013 | 0.006 | 0.010 |
| Electrical Conductivity (mS/m) | 20.5 | 18.8 | 18.6 | 20.2 |
| E. coli (MPN/100ml) | <1 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 4.18 | 2.86 | 2.42 | 4.76 |
| Total Nitrogen (mg/L) | 4.11 | 2.86 | 2.45 | 4.52 |
| pH | 7.8 | 7.8 | 7.9 | 7.4 |
| Sulphate (mg/L) | 9.8 | 8.0 | 9.0 | 6.8 |
| Temperature (DegC) | 11.8 | 13.7 | 12.5 | 11.7 |

| BX22/0043 | 14/09/2017 | 11/12/2017 | 5/03/2018 | 12/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 55.900 | 56.610 | 56.130 | 52.590 |
| Alkalinity (mg/L) | 80 | 66 | 75 | 76 |
| Bromide (mg/L) | 0.07 | 0.07 | 0.07 | 0.06 |
| Chloride (mg/L) | 16.20 | 23.10 | 17.10 | 16.90 |
| Dissolved Oxygen (% Sat.) | 95.2 | 94.4 | 99.0 | 88.3 |
| Dissolved Reactive Phosphorus (mg/L) | 0.006 | 0.007 | 0.009 | 0.010 |
| Electrical Conductivity (mS/m) | 34.6 | 37.8 | 34.7 | 35.1 |
| E. coli (MPN/100ml) | <1 | <1 | <1 | 1 |
| Nitrate-N (mg/L) | 11.00 | 14.90 | 11.20 | 11.20 |
| Total Nitrogen (mg/L) | 10.00 | 14.50 | 10.60 | 11.40 |
| pH | 7.8 | 7.8 | 7.9 | 7.7 |
| Sulphate (mg/L) | 17.8 | 20.4 | 17.7 | 17.7 |
| Temperature (DegC) | 12.1 | 13.3 | 13.0 | 11.2 |

| BX22/0044 | 14/09/2017 | 6/12/2017 | 12/03/2018 | 12/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 4.370 | 4.840 | 4.320 | 4.635 |
| Alkalinity (mg/L) | 40 | 44 | 43 | 42 |
| Bromide (mg/L) | 0.04 | 0.02 | 0.03 | 0.02 |
| Chloride (mg/L) | 15.00 | 10.60 | 10.10 | 9.14 |
| Dissolved Oxygen (% Sat.) | 74.2 | 73.0 | 85.2 | 74.1 |
| Dissolved Reactive Phosphorus (mg/L) | 0.009 | 0.012 | 0.010 | 0.014 |
| Electrical Conductivity (mS/m) | 28.6 | 22.4 | 23.3 | 20.6 |
| E. coli (MPN/100ml) | <1 | <1 | 2 | <1 |
| Nitrate-N (mg/L) | 12.60 | 6.46 | 7.19 | 5.46 |
| Total Nitrogen (mg/L) | 12.20 | 6.65 | 7.09 | 5.31 |
| pH | 6.5 | 6.6 | 6.3 | 6.4 |
| Sulphate (mg/L) | 19.2 | 16.4 | 16.9 | 13.9 |
| Temperature (DegC) | 11.6 | 12.9 | 14.5 | 12.6 |

| BX22/0046 | 14/09/2017 | 8/12/2017 | 9/03/2018 | 12/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 7.450 | 8.270 | 7.110 | 7.110 |
| Alkalinity (mg/L) | 90 | 85 | 87 | 80 |
| Bromide (mg/L) | 0.09 | 0.07 | 0.08 | 0.06 |
| Chloride (mg/L) | 22.10 | 20.10 | 19.80 | 15.50 |
| Dissolved Oxygen (% Sat.) | 86.6 | 79.3 | 74.2 | 73.8 |
| Dissolved Reactive Phosphorus (mg/L) | 0.008 | 0.010 | 0.010 | 0.014 |
| Electrical Conductivity (mS/m) | 47.0 | 44.3 | 44.1 | 40.9 |
| E. coli (MPN/100ml) | <1 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 22.20 | 19.20 | 18.90 | 16.80 |
| Total Nitrogen (mg/L) | 22.10 | 18.80 | 18.30 | 17.70 |
| pH | 6.6 | 6.7 | 6.6 | 6.4 |
| Sulphate (mg/L) | 13.9 | 18.2 | 16.7 | 19.1 |
| Temperature (DegC) | 12.5 | 13.6 | 12.8 | 12.5 |

| BX22/0053 | 14/09/2017 | 11/12/2017 | 5/03/2018 | 12/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 39.030 | 38.480 | 39.160 | 34.115 |
| Alkalinity (mg/L) | 61 | 68 | 50 | 48 |
| Bromide (mg/L) | 0.06 | 0.05 | 0.05 | 0.04 |
| Chloride (mg/L) | 15.30 | 15.00 | 13.10 | 11.30 |
| Dissolved Oxygen (% Sat.) | 90.5 | 86.7 | 94.3 | 81.4 |
| Dissolved Reactive Phosphorus (mg/L) | 0.006 | 0.005 | 0.010 | 0.012 |
| Electrical Conductivity (mS/m) | 32.5 | 31.8 | 27.4 | 25.8 |
| E. coli (MPN/100ml) | <1 | <1 | 1 | <1 |
| Nitrate-N (mg/L) | 13.30 | 10.50 | 10.70 | 9.35 |
| Total Nitrogen (mg/L) | 12.70 | 10.20 | 10.10 | 9.72 |
| pH | 7.6 | 7.6 | 7.5 | 7.4 |
| Sulphate (mg/L) | 16.7 | 15.6 | 13.2 | 13.6 |
| Temperature (DegC) | 13.0 | 13.9 | 13.2 | 11.7 |

| BX22/0065 | 12/09/2017 | 7/12/2017 | 2/03/2018 | 5/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 6.830 | 10.690 | 7.720 | 6.690 |
| Alkalinity (mg/L) | 33 | 35 | 32 | 37 |
| Bromide (mg/L) | 0.10 | 0.10 | 0.09 | 0.09 |
| Chloride (mg/L) | 45.60 | 35.70 | 34.20 | 30.50 |
| Dissolved Oxygen (% Sat.) | 80.0 | 76.1 | 77.1 | 77.3 |
| Dissolved Reactive Phosphorus (mg/L) | 0.009 | 0.010 | 0.011 | 0.012 |
| Electrical Conductivity (mS/m) | 48.9 | 38.0 | 39.9 | 36.9 |
| E. coli (MPN/100ml) | <1 | 12 | 4 | <1 |
| Nitrate-N (mg/L) | 21.30 | 14.10 | 15.50 | 13.50 |
| Total Nitrogen (mg/L) | 21.60 | 13.80 | 14.70 | 12.10 |
| pH | 6.3 | 6.3 | 6.1 | 6.2 |
| Sulphate (mg/L) | 39.1 | 31.6 | 36.1 | 32.5 |
| Temperature (DegC) | 12.1 | 13.3 | 14.9 | 13.0 |

| BX22/0066 | 15/09/2017 | 5/12/2017 | 12/03/2018 | 5/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 21.870 | 25.240 | 21.185 | 19.330 |
| Alkalinity (mg/L) | 36 | 34 | 40 | 39 |
| Bromide (mg/L) | 0.04 | 0.05 | 0.04 | 0.04 |
| Chloride (mg/L) | 13.20 | 9.70 | 12.70 | 12.30 |
| Dissolved Oxygen (% Sat.) | 79.8 | 77.6 | 81.0 | 76.9 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.008 | 0.008 | 0.009 |
| Electrical Conductivity (mS/m) | 21.2 | 16.8 | 21.7 | 20.2 |
| E. coli (MPN/100ml) | 2 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 6.54 | 3.88 | 5.87 | 5.21 |
| Total Nitrogen (mg/L) | 6.39 | 3.91 | 5.76 | 5.00 |
| pH | 6.7 | 6.8 | 6.6 | 6.6 |
| Sulphate (mg/L) | 13.3 | 9.9 | 14.1 | 13.0 |
| Temperature (DegC) | 13.2 | 13.3 | 13.4 | 12.1 |

| BX22/0067 | 12/09/2017 | 5/12/2017 | 13/03/2018 | 14/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 31.445 | 35.720 | 32.705 | 29.560 |
| Alkalinity (mg/L) | 41 | 44 | 43 | 44 |
| Bromide (mg/L) | 0.10 | 0.09 | 0.11 | 0.13 |
| Chloride (mg/L) | 34.20 | 24.30 | 30.70 | 32.00 |
| Dissolved Oxygen (% Sat.) | 74.1 | 70.1 | 87.5 | 76.1 |
| Dissolved Reactive Phosphorus (mg/L) | 0.005 | 0.010 | 0.009 | 0.017 |
| Electrical Conductivity (mS/m) | 41.0 | 36.1 | 38.4 | 41.1 |
| E. coli (MPN/100ml) | <1 | 29 | <1 | 16 |
| Nitrate-N (mg/L) | 18.50 | 16.10 | 16.90 | 17.40 |
| Total Nitrogen (mg/L) | 18.30 | 15.60 | 15.60 | 16.70 |
| pH | 6.6 | 6.7 | 6.4 | 6.3 |
| Sulphate (mg/L) | 21.2 | 19.5 | 23.1 | 24.7 |
| Temperature (DegC) | 12.4 | 13.9 | 13.2 | 12.0 |

| BX22/0068 | 8/09/2017 | 12/12/2017 | 8/03/2018 | 8/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 61.450 | 60.940 | 60.360 | 59.490 |
| Alkalinity (mg/L) | 26 | 35 | 35 | 24 |
| Bromide (mg/L) | 0.11 | 0.07 | 0.09 | 0.08 |
| Chloride (mg/L) | 59.10 | 22.20 | 31.10 | 28.20 |
| Dissolved Oxygen (% Sat.) | 83.7 | 83.7 | 89.9 | 87.6 |
| Dissolved Reactive Phosphorus (mg/L) | 0.008 | 0.005 | 0.009 | 0.009 |
| Electrical Conductivity (mS/m) | 48.9 | 31.4 | 32.0 | 36.0 |
| E. coli (MPN/100ml) | <4 | <1 | <1 | 18 |
| Nitrate-N (mg/L) | 24.80 | 15.70 | 17.70 | 15.70 |
| Total Nitrogen (mg/L) | 22.20 | 15.50 | 14.50 | 15.40 |
| pH | 7.1 | 7.3 | 7.5 | 7.2 |
| Sulphate (mg/L) | 18.6 | 7.2 | 9.5 | 36.0 |
| Temperature (DegC) | 11.5 | 12.0 | 12.1 | 12.0 |

| BX22/0069 | 6/09/2017 | 5/12/2017 | 13/03/2018 | 14/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 61.580 | 58.970 | 58.840 | 54.110 |
| Alkalinity (mg/L) | 45 | 38 | 35 | 29 |
| Bromide (mg/L) | 0.08 | 0.06 | 0.07 | 0.05 |
| Chloride (mg/L) | 25.90 | 20.80 | 24.40 | 12.60 |
| Dissolved Oxygen (% Sat.) | 92.8 | 84.9 | 93.6 | 113.1 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.007 | 0.006 | 0.008 |
| Electrical Conductivity (mS/m) | 34.8 | 27.4 | 29.0 | 20.4 |
| E. coli (MPN/100ml) | <1 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 15.70 | 11.70 | 13.50 | 9.76 |
| Total Nitrogen (mg/L) | 14.90 | 11.50 | 11.50 | 9.05 |
| pH | nt | 7.2 | 6.9 | 6.9 |
| Sulphate (mg/L) | 20.9 | 6.8 | 8.7 | 3.7 |
| Temperature (DegC) | 12.1 | 12.9 | 12.1 | 11.4 |

| BX22/0070 | 12/09/2017 | 5/12/2017 | 8/03/2018 | 8/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 97.175 | 91.150 | 82.245 | 80.710 |
| Alkalinity (mg/L) | 43 | 29 | 29 | 28 |
| Bromide (mg/L) | 0.06 | 0.04 | 0.05 | 0.05 |
| Chloride (mg/L) | 19.40 | 11.60 | 13.10 | 11.50 |
| Dissolved Oxygen (% Sat.) | 88.3 | 79.1 | 90.7 | 86.8 |
| Dissolved Reactive Phosphorus (mg/L) | 0.011 | 0.008 | 0.009 | 0.008 |
| Electrical Conductivity (mS/m) | 31.0 | 20.1 | 19.0 | 19.5 |
| E. coli (MPN/100ml) | 1 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 14.60 | 9.48 | 10.10 | 9.47 |
| Total Nitrogen (mg/L) | 14.00 | 9.41 | 8.71 | 8.59 |
| pH | 7.2 | 7.0 | 7.0 | 6.8 |
| Sulphate (mg/L) | 10.5 | 5.1 | 4.8 | 4.5 |
| Temperature (DegC) | 10.8 | 11.8 | 11.3 | 11.0 |

| BX22/0071 | 7/09/2017 | 4/12/2017 | 7/03/2018 | 5/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 47.080 | 46.690 | 62.170 | 53.910 |
| Alkalinity (mg/L) | 29 | 28 | 30 | 30 |
| Bromide (mg/L) | 0.02 | <0.02 | <0.02 | 0.02 |
| Chloride (mg/L) | 7.46 | 7.46 | 7.03 | 7.40 |
| Dissolved Oxygen (% Sat.) | 88.4 | 99.5 | 93.4 | 86.9 |
| Dissolved Reactive Phosphorus (mg/L) | 0.007 | 0.007 | 0.006 | 0.008 |
| Electrical Conductivity (mS/m) | 14.0 | 13.8 | 13.9 | 13.7 |
| E. coli (MPN/100ml) | <4 | <1 | <1 | 2 |
| Nitrate-N (mg/L) | 3.59 | 3.34 | 3.51 | 3.40 |
| Total Nitrogen (mg/L) | 3.67 | 3.43 | 3.65 | 3.31 |
| pH | 6.7 | 6.7 | 6.9 | 6.7 |
| Sulphate (mg/L) | 7.1 | 7.6 | 7.1 | 7.5 |
| Temperature (DegC) | 10.4 | 13.4 | 11.0 | 10.4 |

| BX22/0072 | 13/09/2017 | 6/12/2017 | 2/03/2018 | 5/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 6.730 | 9.295 | 9.575 | 9.350 |
| Alkalinity (mg/L) | 33 | 33 | 32 | 33 |
| Bromide (mg/L) | 0.04 | 0.05 | 0.03 | 0.04 |
| Chloride (mg/L) | 11.60 | 13.70 | 12.40 | 12.60 |
| Dissolved Oxygen (% Sat.) | 92.7 | 86.8 | 94.0 | 90.2 |
| Dissolved Reactive Phosphorus (mg/L) | <0.005 | 0.007 | 0.009 | 0.010 |
| Electrical Conductivity (mS/m) | 25.5 | 28.0 | 26.2 | 25.9 |
| E. coli (MPN/100ml) | <1 | <4 | <1 | 1 |
| Nitrate-N (mg/L) | 15.20 | 16.60 | 15.00 | 14.60 |
| Total Nitrogen (mg/L) | 15.10 | 15.80 | 0.01 | 13.20 |
| pH | 6.8 | 6.7 | 6.6 | 6.9 |
| Sulphate (mg/L) | 6.4 | 9.6 | 8.9 | 10.0 |
| Temperature (DegC) | 12.0 | 12.3 | 12.6 | 12.3 |

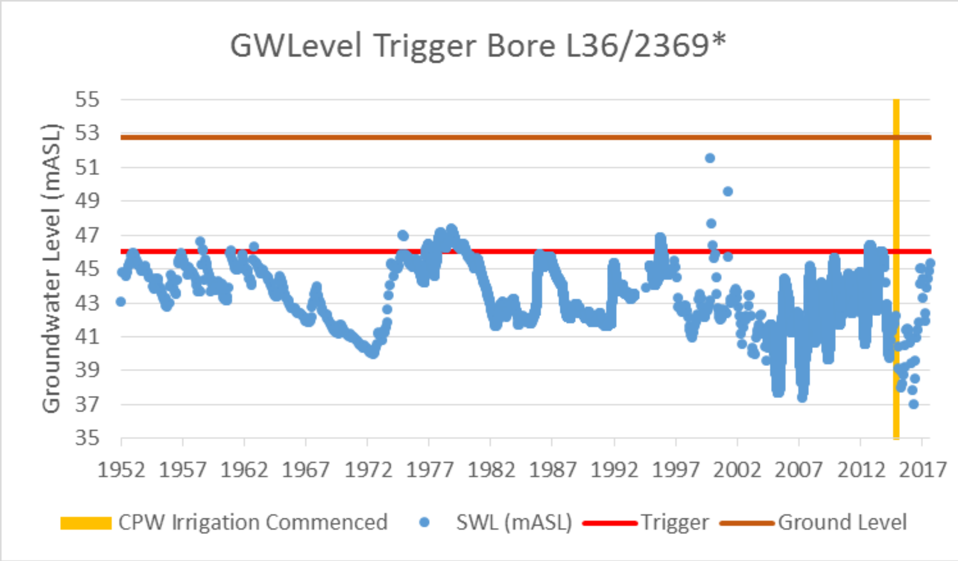
| BX23/0423 | 8/09/2017 | 12/12/2017 | 13/03/2018 | 14/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 26.920 | 36.580 | 32.880 | 28.930 |
| Alkalinity (mg/L) | 33 | 31 | 27 | 26 |
| Bromide (mg/L) | 0.08 | 0.08 | 0.10 | 0.10 |
| Chloride (mg/L) | 25.10 | 22.60 | 20.60 | 20.70 |
| Dissolved Oxygen (% Sat.) | 89.5 | 86.4 | 93.6 | 90.3 |
| Dissolved Reactive Phosphorus (mg/L) | 0.008 | 0.008 | 0.005 | 0.011 |
| Electrical Conductivity (mS/m) | 35.7 | 34.7 | 33.8 | 34.5 |
| E. coli (MPN/100ml) | <4 | <1 | <1 | 2 |
| Nitrate-N (mg/L) | 18.10 | 17.50 | 17.90 | 18.20 |
| Total Nitrogen (mg/L) | 17.30 | 17.20 | 16.70 | 17.10 |
| pH | 7.0 | 6.6 | 6.5 | 6.5 |
| Sulphate (mg/L) | 21.7 | 23.0 | 26.5 | 26.6 |
| Temperature (DegC) | 12.0 | 12.3 | 12.9 | 12.1 |

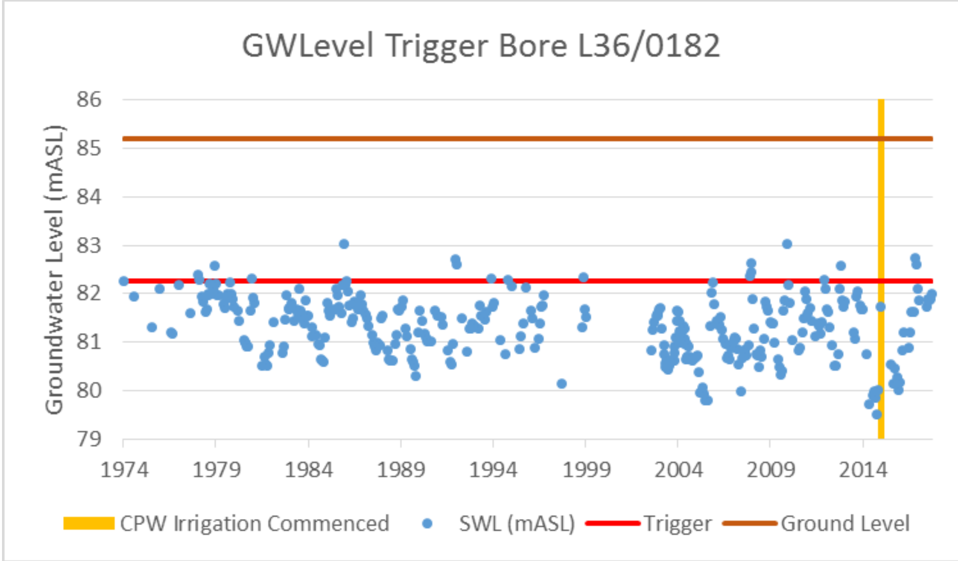
| BX23/0424 | 8/09/2017 | 8/12/2017 | 8/03/2018 | 15/06/2018 |
|---|---|---|---|---|
| Groundwater Level (mbgl) | 44.200 | 37.340 | 42.670 | 42.595 |
| Alkalinity (mg/L) | 45 | 45 | 41 | 51 |
| Bromide (mg/L) | 0.09 | 0.08 | 0.09 | 0.08 |
| Chloride (mg/L) | 26.70 | 23.20 | 25.30 | 19.70 |
| Dissolved Oxygen (% Sat.) | 71.7 | 67.4 | 88.3 | 62.8 |
| Dissolved Reactive Phosphorus (mg/L) | 0.008 | 0.006 | 0.007 | 0.011 |
| Electrical Conductivity (mS/m) | 34.2 | 32.9 | 32.0 | 30.6 |
| E. coli (MPN/100ml) | <4 | <1 | <1 | <1 |
| Nitrate-N (mg/L) | 13.00 | 13.10 | 16.00 | 10.70 |
| Total Nitrogen (mg/L) | 12.20 | 13.30 | 13.40 | 8.74 |
| pH | 7.4 | 7.1 | 7.1 | 6.9 |
| Sulphate (mg/L) | 19.1 | 18.8 | 18.8 | 23.1 |
| Temperature (DegC) | 12.3 | 14.6 | 13.0 | 12.0 |

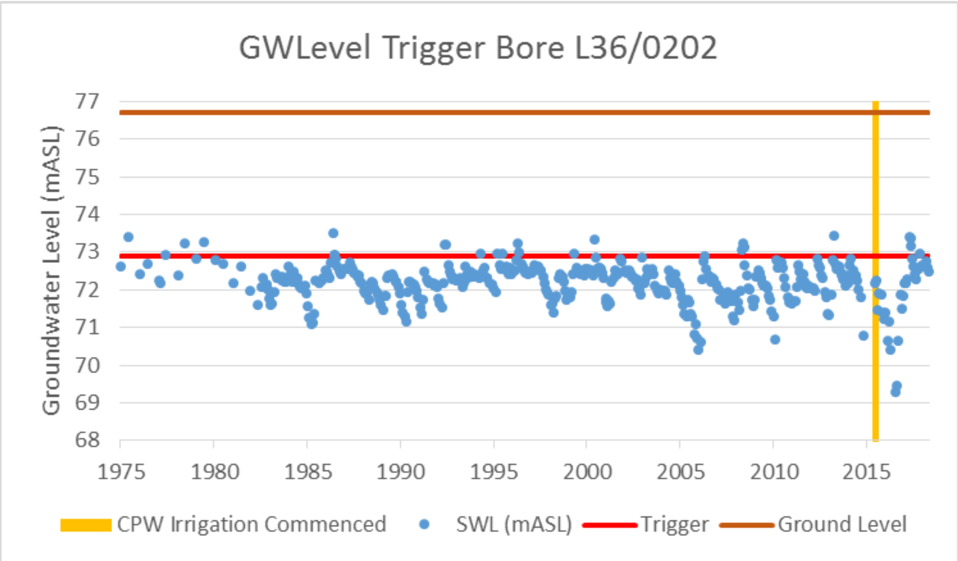
## 6.6. Lowland Groundwater Level Results (ECan Data)

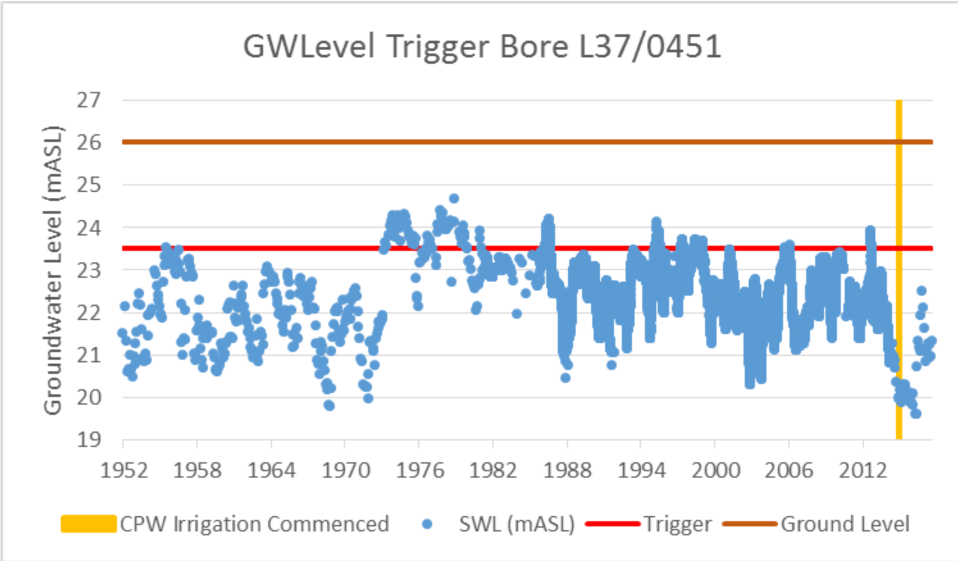
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L36/2369^ | Trigger | 27-Jul-17 | 24-Aug-17 | 20-Sep-17 | | 17-Oct-17 | 15-Nov-17 | 12-Dec-17 | 30-Jan-18 | 27-Feb-18 | 28-Mar-18 | 20-Apr-18 | 24-May-18 | | 27-Jun-18 |
| SWL (mASL) | >46.01 | 41.87 | 44.13 | 45.04 | | 45.06 | 44.45 | 43.32 | 41.96 | 42.41 | 43.94 | 44.41 | 44.88 | | 45.32 |
| L36/0182 | Trigger | 28-Jul-17 | 25-Aug-17 | 21-Sep-17 | | 19-Oct-17 | - | - | - | 28-Feb-18 | 29-Mar-18 | - | 01-May-18 | 25-May-18 | 28-Jun-18 |
| SWL (mASL) | >82.26 | 82.75 | 82.6 | 82.105 | | 81.87 | - | - | - | 81.735 | 81.88 | - | 81.87 | 81.88 | 82 |
| L36/0202 | Trigger | 27-Jul-17 | 24-Aug-17 | 01-Sep-17 | 20-Sep-17 | 17-Oct-17 | 15-Nov-17 | 12-Dec-17 | 30-Jan-18 | 27-Feb-18 | 28-Mar-18 | 20-Apr-18 | 24-May-18 | | 27-Jun-18 |
| SWL (mASL) | >72.88 | 73.395 | 73.355 | 73.161 | 72.827 | 72.625 | 72.42 | 72.29 | 72.55 | 72.95 | 72.63 | 72.65 | 72.64 | | 72.75 |
| L37/0451 | Trigger | 27-Jul-17 | 24-Aug-17 | 20-Sep-17 | | 17-Oct-17 | 15-Nov-17 | 12-Dec-17 | 30-Jan-18 | 27-Feb-18 | 28-Mar-18 | 20-Apr-18 | 24-May-18 | | 27-Jun-18 |
| SWL (mASL) | >23.5 | 21.942 | 22.527 | 22.119 | | 21.639 | 21.13 | 20.86 | 21.05 | 21.26 | 21.25 | 20.95 | 20.97 | | 21.33 |
| M36/0250 | Trigger | 26-Jul-17 | 23-Aug-17 | 19-Sep-17 | | 19-Oct-17 | 14-Nov-17 | 11-Dec-17 | 29-Jan-18 | 26-Feb-18 | 27-Mar-18 | 19-Apr-18 | 23-May-18 | | 26-Jun-18 |
| SWL (mASL) | >16.1 | 13.73 | 14.525 | 15.095 | | 15.477 | 15.55 | 15.01 | 14.71 | 14.69 | 14.78 | 14.83 | 14.96 | | 15.24 |
| M36/0255 | Trigger | 27-Jul-17 | 24-Aug-17 | 20-Sep-17 | | 17-Oct-17 | 14-Nov-17 | 12-Dec-17 | 29-Jan-18 | 27-Feb-18 | 27-Mar-18 | 19-Apr-18 | 23-May-18 | | 26-Jun-18 |
| SWL (mASL) | >36.25 | 35.235 | 35.965 | 35.685 | | 35.505 | 33.81 | 32.36 | 33.36 | 34.55 | 34.63 | 34.79 | 34.78 | | 35.64 |
| M36/0419 | Trigger | 27-Jul-17 | 24-Aug-17 | 20-Sep-17 | | 17-Oct-17 | 15-Nov-17 | 12-Dec-17 | 31-Jan-18 | 27-Feb-18 | 28-Mar-18 | 20-Apr-18 | 24-May-18 | | 27-Jun-18 |
| SWL (mASL) | >33.5 | 33.8 | 33.78 | 33.46 | | 33.28 | 32.78 | 32.24 | 32.44 | 32.85 | 32.97 | 33.12 | 33.17 | | 33.38 |
| M36/0424 | Trigger | 26-Jul-17 | 23-Aug-17 | 19-Sep-17 | | 19-Oct-17 | 14-Nov-17 | 11-Dec-17 | 29-Jan-18 | 26-Feb-18 | 27-Mar-18 | 19-Apr-18 | 23-May-18 | | 26-Jun-18 |
| SWL (mASL) | >21.02 | 21.005 | 20.873 | 20.981 | | 20.696 | 20.36 | 20.08 | 20.25 | 20.85 | 20.7 | 20.64 | 20.8 | | 20.87 |
| M36/0599 | Trigger | 26-Jul-17 | 23-Aug-17 | 19-Sep-17 | | 19-Oct-17 | 14-Nov-17 | 11-Dec-17 | 29-Jan-18 | 26-Feb-18 | 27-Mar-18 | 19-Apr-18 | 23-May-18 | | 26-Jun-18 |
| SWL (mASL) | >13.63 | 13.01 | 13.315 | 13.355 | | 13.193 | 12.98 | 12.61 | 12.47 | 12.53 | 12.61 | 12.81 | 13.15 | | 13.43 |
| M36/0693 | Trigger | 27-Jul-17 | 24-Aug-17 | 20-Sep-17 | | 17-Oct-17 | 15-Nov-17 | 12-Dec-17 | 30-Jan-18 | 27-Feb-18 | 28-Mar-18 | 20-Apr-18 | 24-May-18 | | 27-Jun-18 |
| SWL (mASL) | >21.53 | 19.105 | 20.03 | 20.4 | | 20.295 | 19.82 | 19.04 | 18.76 | 19 | 19.46 | 19.61 | 19.73 | | 20.06 |
| M36/7880 | Trigger | 27-Jul-17 | 24-Aug-17 | 20-Sep-17 | | 17-Oct-17 | 15-Nov-17 | 12-Dec-17 | 31-Jan-18 | 27-Feb-18 | 28-Mar-18 | 20-Apr-18 | 24-May-18 | | 27-Jun-18 |
| SWL (mASL) | >35.14 | 35.395 | 35.295 | 35.35 | | 35.295 | 35.09 | 34.82 | 34.59 | 35.04 | 35.09 | 35.08 | 35.12 | | 35.18 |
| M37/0010 | Trigger | 27-Jul-17 | 24-Aug-17 | 20-Sep-17 | | 17-Oct-17 | 15-Nov-17 | 12-Dec-17 | 30-Jan-18 | 27-Feb-18 | 28-Mar-18 | 20-Apr-18 | 24-May-18 | | 27-Jun-18 |
| SWL (mASL) | >6.21 | 6.18 | 6.615 | 6.515 | | 6.21 | 5.7 | 5.44 | 5.61 | 5.85 | 5.87 | 5.94 | 5.99 | | 6.04 |

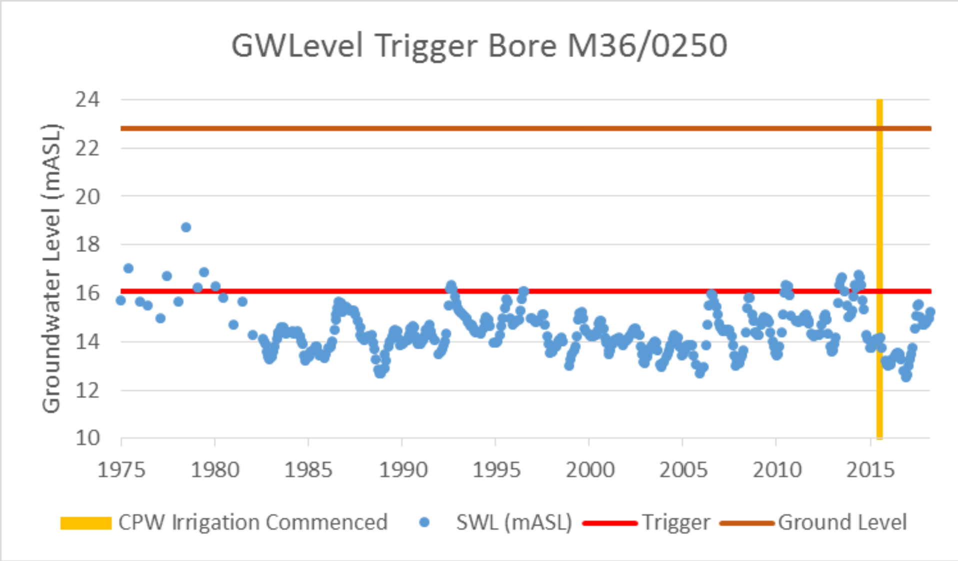
Lowland Groundwater Level post commencement of CPWL Supplied Irrigation

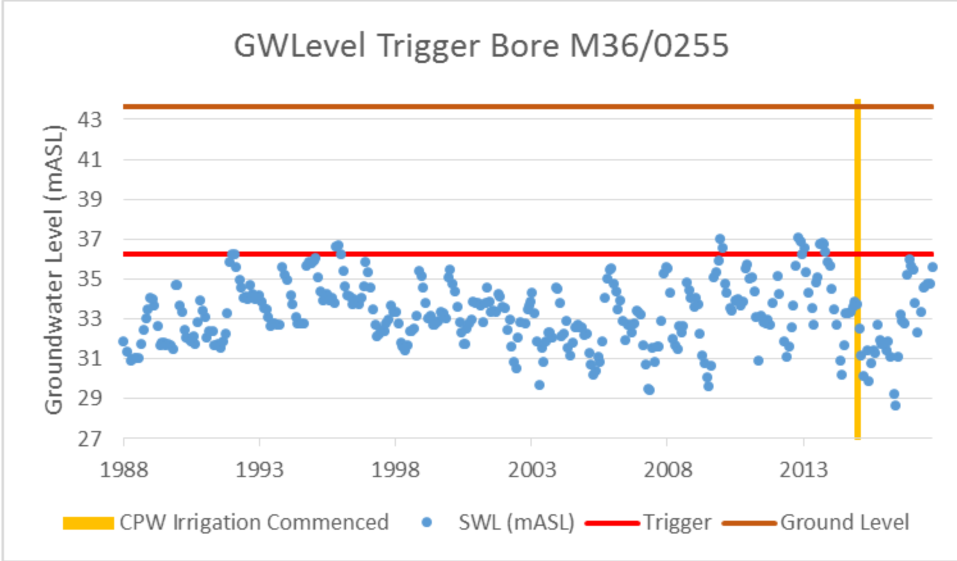


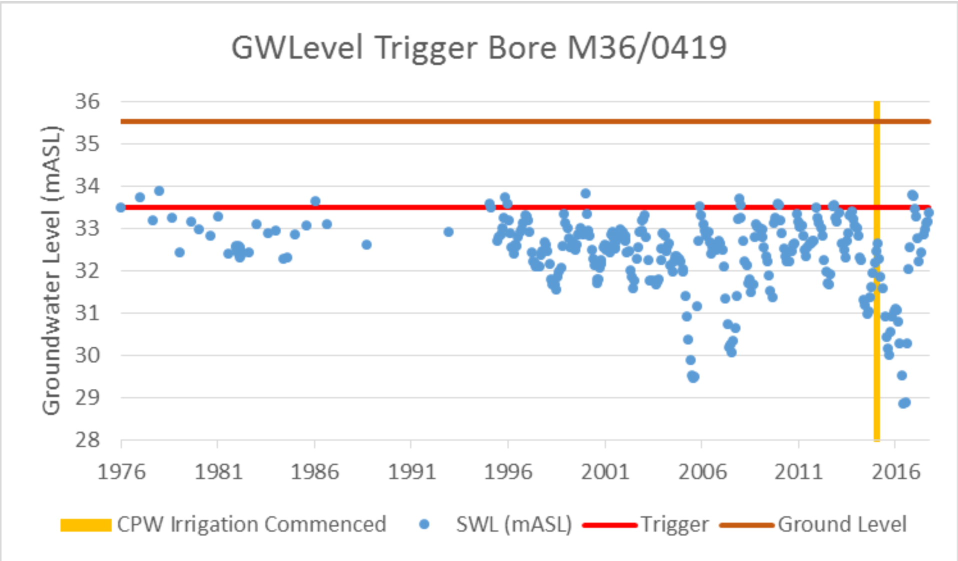



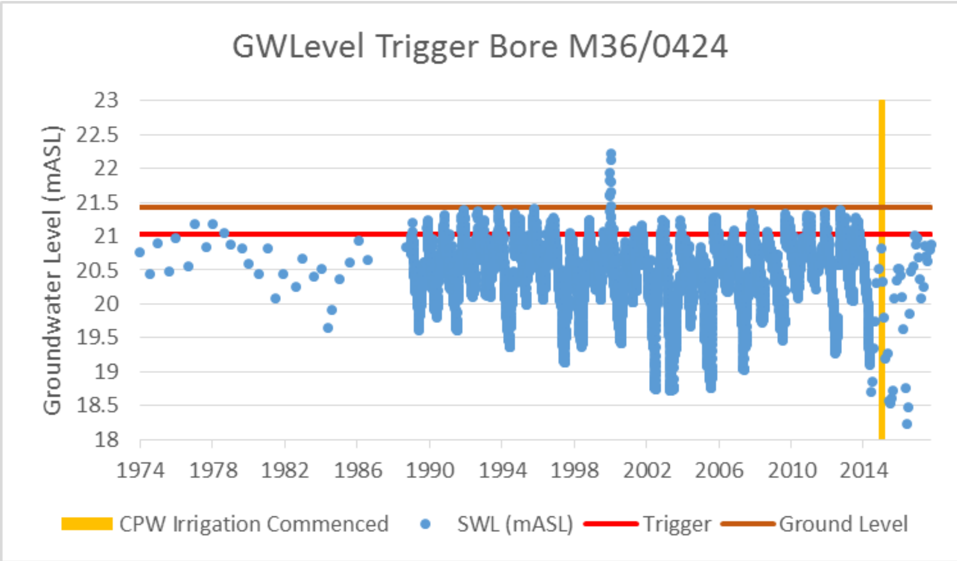



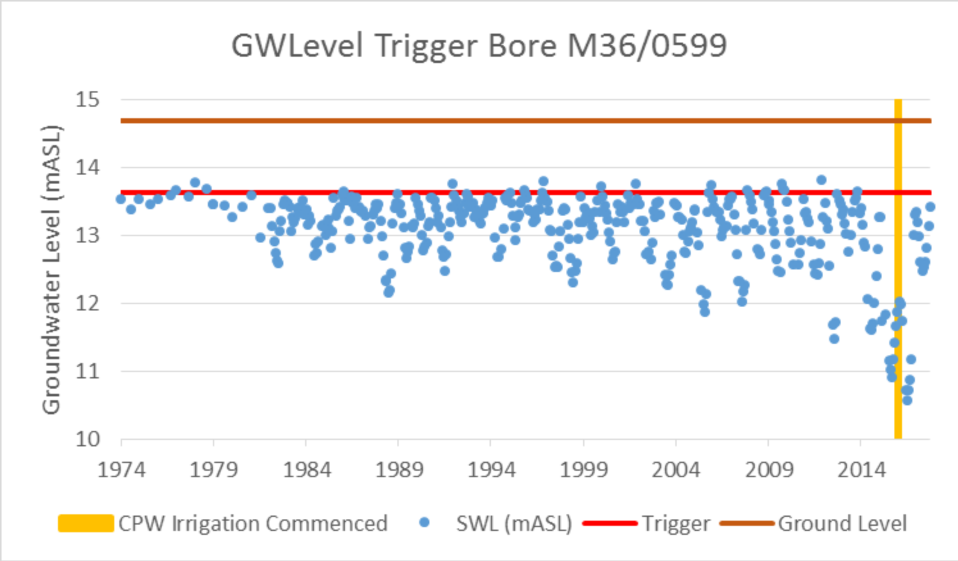



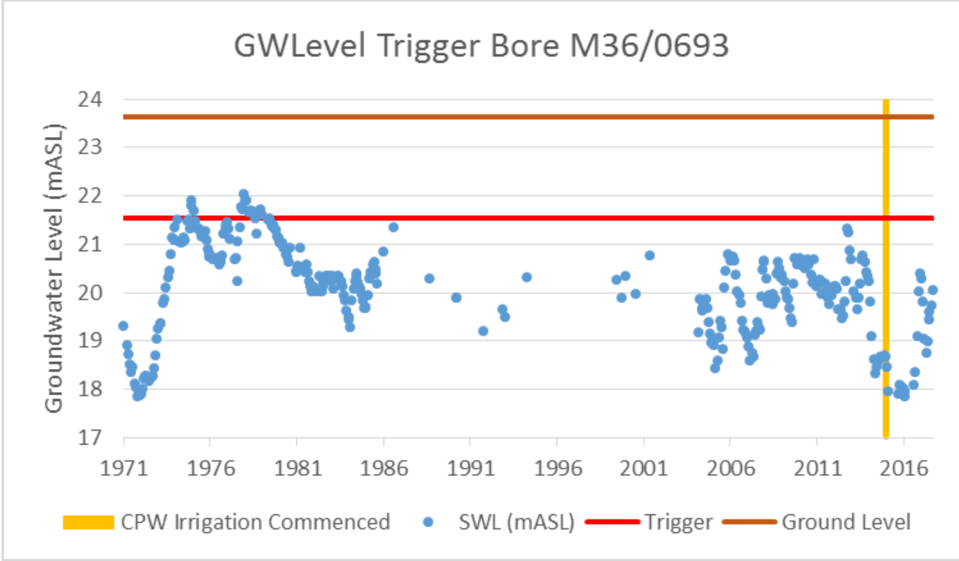

GWLevel Trigger Bore M36/0250
Groundwater Level (mASL)
24
22
20
18
16
14
12
10
1975
1980
1985
1990
1995
2000
2005
2010
2015
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level

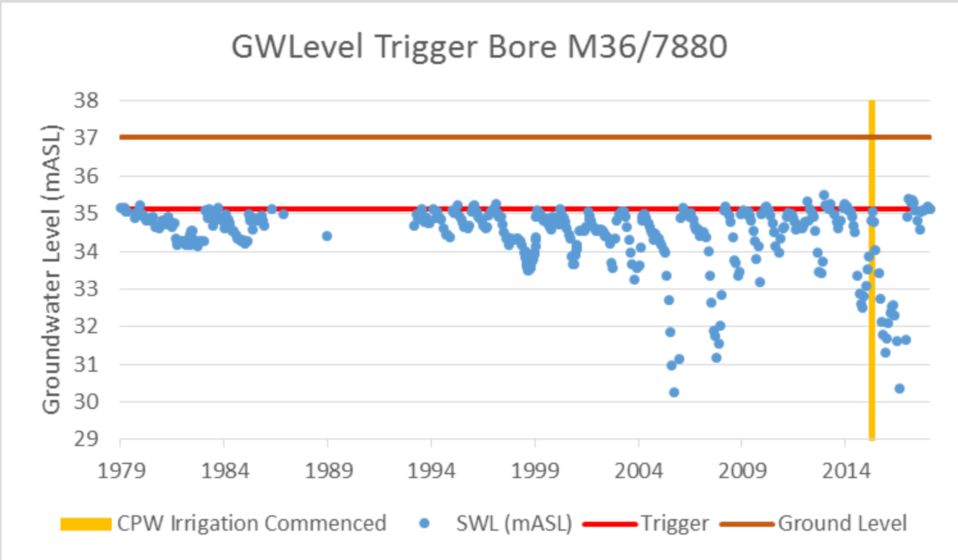

GWLevel Trigger Bore M36/0255
Groundwater Level (mASL)
43
41
39
37
35
33
31
29
27
1988
1993
1998
2003
2008
2013
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level

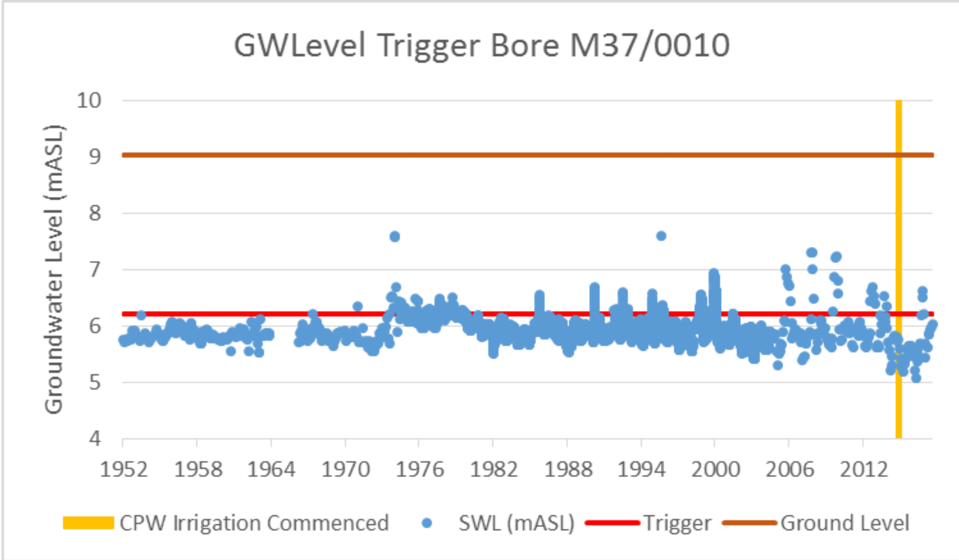

GWLevel Trigger Bore M36/0419
Groundwater Level (mASL)
36
35
34
33
32
31
30
29
28
1976
1981
1986
1991
1996
2001
2006
2011
2016
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/0424
Groundwater Level (mASL)
23
22.5
22
21.5
21
20.5
20
19.5
19
18.5
18
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/0599
Groundwater Level (mASL)
15
14
13
12
11
10
1974
1979
1984
1989
1994
1999
2004
2009
2014
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/0693
Groundwater Level (mASL)
24
23
22
21
20
19
18
17
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/7880
Groundwater Level (mASL)
38
37
36
35
34
33
32
31
30
29
1979
1984
1989
1994
1999
2004
2009
2014
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M37/0010
Groundwater Level (mASL)
10
9
8
7
6
5
4
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
2012
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level