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Report

Annual Waikanae Borefield Report 2015/16 (Consent WGN130103 [33759])

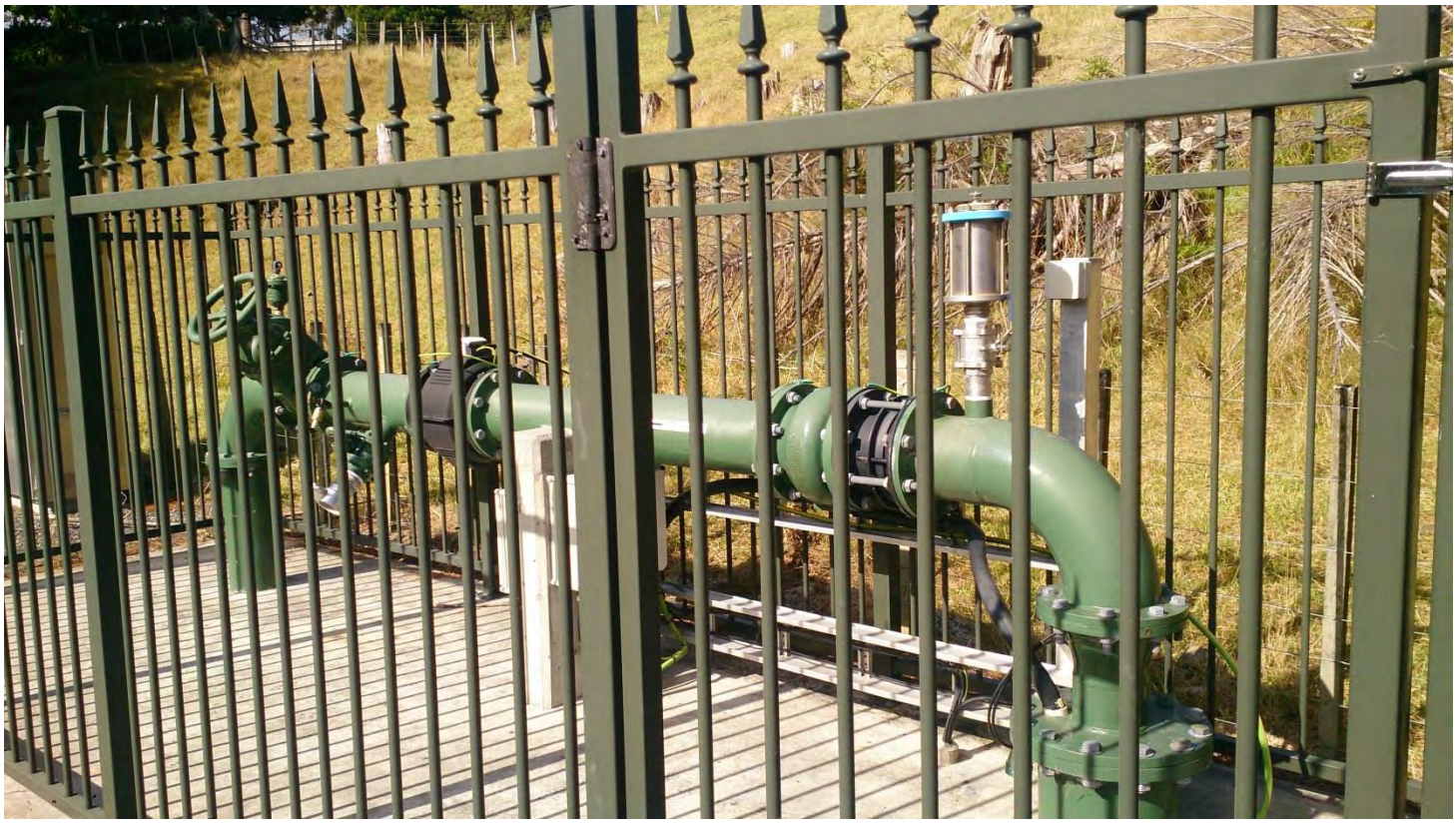
Prepared for Greater Wellington Regional Council

On behalf of Kāpiti Coast District Council

Prepared by CH2M Beca Ltd

22 September 2016

Kāpiti Coast DISTRICT COUNCIL
Me Huri Whakamuri, Ka Titiro Whakamua



Revision History

Revision Nº	Prepared By	Description	Date
1	Simon Newton, Dora Avanidou	Draft for Council review	18 July 2016
2	Tracy Clode	Draft for Adaptive Management Group	29 July 2016
3	Simon Newton	Final for Council Approval	15 September 2016
4	Tracy Clode	Final for Submission to Greater Wellington Regional Council	22 September 2016

Document Acceptance

Action			
Prepared by	**Simon Newton & Tracy Clode**		
Reviewed by	**Michael Goff** **Tracy Clode** **Malory Osmond**		
Approved by	**Andrew Watson**	**Signed:** 	**Date:** 22 September 2016
on behalf of	CH2M Beca Ltd		

Highlights

This 2015/16 annual report has been prepared for Kāpiti Coast District Council as part of the consenting requirements for the River Recharge with Groundwater scheme. It reports on operational aspects and monitoring undertaken in relation to the Council's groundwater take from the Waikanae Borefield during the year 1 July 2015 to 30 June 2016.

Greater Wellington Regional Council approved river recharge for year 2 of the baseline monitoring on 16 October 2015, which allows up to 20% river recharge of the downstream flow of the discharge point.

The Waikanae Borefield was used for river recharge on 14 days for 226 hours over five occasions during 2015/16 due to low river flows. Once starting on 16 October 2015 and four times within the summer monitoring period (1 December 15 to April 2016) between 12 March 2016 and 2 April 2016. The Borefield was not used for supplementary water supply this year. The Council's take from the Waikanae Borefield was within the requirements of the consent.

A comprehensive monitoring regime for the Borefield was undertaken for the 2015/16 monitoring period. The monitoring for the Borefield investigates groundwater levels and electrical conductivity to check that saline intrusion is not occurring. Similarly, there was a comprehensive programme for monitoring 5 small coastal stream sites and 13 wetlands during the months of December 2015 to April 2016.

This monitoring will continue for a further summer, and the data collected over the previous two years and the next summer (three years total) will be used to develop a longer term monitoring programme and on-going triggers with a series of actions in case of potential adverse effects from pumping groundwater from the Waikanae Borefield.

The Adaptive Management Group which comprises representatives of the Council, Greater Wellington Regional Council and Te Āti Awa ki Whakarongotai met in August 2016 to discuss this report, alongside representatives of the key stakeholder groups. The key recommendation from the Adaptive Management Group was the removal of one small coastal stream site (Ngarara) from the monitoring programme. Four sites will be continued to be monitored tis coming summer

Executive Summary

This annual report for the Waikanae Borefield has been prepared on behalf of Kāpiti Coast District Council (Council) in accordance with Condition 42 of consent WGN130103 [33759]. This is the third annual Waikanae Borefield report, and covers the period from 1 July 2015 through to 30 June 2016.

The consent authorises the abstraction of groundwater from eight wells within the Waikanae Borefield. Four of these wells (K4, K5, K6 and Kb4) were operable for recharge throughout the 2015/16 year. The remaining four wells (K10, Kb7, K12 and N2) were monitored throughout the 2015/16 period.

On 16 October 2015 Greater Wellington Regional Council approved river recharge for year 2 of the baseline monitoring, which allows up to 20% river recharge of the downstream flow at the discharge point.

The Waikanae Borefield was used on 14 days for a total of 226 hours for river recharge on five occasions during 2015/16 due to low river flows: 16 to 17 October 2015, 12 to 15 March 2016, 20 to 21 March 2016, 21 to 23 March 2016, 30 March 2016 to 02 April 2016. The other periods of the Borefield use were associated with operation and maintenance activities, or the commissioning of new infrastructure for the River Recharge with Groundwater scheme. Bore K4 has also been used for construction water supply for the Mackays to Peka Peka (M2PP) Expressway, although this use is under a separate consent. The maximum total daily take from the Borefield was 8,425 m^3/day on 23 March 2016. This is significantly less than 23,600 m^3/day which is the maximum take for Stage 1 of the River Recharge with Groundwater Scheme (RRwGW). The Borefield was not used for supplementary public water supply in the 2015/16 period.

Baseline monitoring of the aquifers, small coastal streams and wetlands was carried out in accordance with the relevant baseline monitoring plans. From the borefield monitoring results, none of the established interim trigger levels for groundwater levels (deep and shallow) or electrical conductivity have been exceeded. Similarly none of the interim triggers for wetlands or small coastal streams monitoring were exceeded.

The borefield is monitored all year round and further baseline monitoring for the small coastal streams and wetlands will be carried out over the 2016/17 summer. Boffa Miskell have recommended the removal of one Small Coastal Stream monitoring location due to difficulties in access and frequent changing bed conditions.

Any changes to the Borefield, Wetland and Streams baseline monitoring plans will be discussed with GWRC and agreed amendments will be incorporated in updated plans.

Council has identified, to the extent reasonably practicable, authorised existing wells within a one kilometre radius of each of the Waikanae Borefield production wells that may be a sole source of domestic or stock water. A website providing groundwater level monitoring information for these well users and the general public was launched in November 2015. Two queries relating to abstraction from the Borefield were received by Council during the 2015/16 period.

As required by Condition 15 of consent WGN050025 [33147]. Council confirms the back-up public water bores PW1 and PW5 were not used in the 2015/16 year for back up public water supply.

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1 Introduction

Kāpiti Coast District Council (Council) holds resource consent (WGN130103 [33759]) to take groundwater from bores within the Waikanae Borefield for the purpose of supplementary public water supply through river recharge or emergency public water supply.

The consent authorises the abstraction of groundwater from eight production wells within the Waikanae Borefield. All eight of these wells were operable throughout the 2015/16 year. However, only K4, KB4, K5 and K6 are approved and can be/ were used for supply and recharge in the 2015/16 year. The locations of the eight production wells and monitoring bores are shown in Figure 2.

An annual Waikanae Borefield report is required by Condition 42 of consent WGN130103 [33759]. This is the third annual Waikanae Borefield report, and covers the period from 1 July 2015 through to 30 June 2016. The requirements of Condition 42 are listed in Table 1below with cross-references to the relevant section in this report.

Table 1: Requirements for Annual Waikanae Borefield report

Condition 42 of consent WGN130103 [33759]	Section in this annual report
The consent holder shall, by 30th September each year, submit an annual Waikanae Borefield report to the Manager, or by another date as agreed with the Manager. The annual Waikanae Borefield report shall report on the year 1st July to 30th June inclusive, and include the following information:	
a) A copy of the records to demonstrate compliance with Condition 20 of this consent;	Sections 2.1 and 2.2
b) Details of the use (including daily and total volumes of groundwater abstracted) and reasons for that use of the water from the Borefield;	Section 2.1
c) A summary of Waikanae River flow gauging required by Condition 25 of this consent, if undertaken that year;	Section 3
d) Results of all monitoring undertaken that year required by conditions of this consent (if applicable), including a comprehensive analysis of the monitoring results, assessment against any relevant guidelines and comparison with previous years' results (i.e. trend analysis);	Sections 4, 5 and 6
e) Results or evidence to demonstrate compliance with Condition 7 of this consent	Section 8
f) Details of any trigger levels or compliance limits that were reached (if occurred that year) and specifically the findings of saline monitoring compared with the 'alert', 'action' or 'cease' triggers;	Sections 4 and 5
g) Details of any actions and/or mitigation/adaptive management taken in response to trigger levels or compliance limits being reached, including an assessment of the effectiveness of these actions and/or mitigation/adaptive management;	Sections 4, 5 and 6
h) Any recommendations for changes to the monitoring plan required by conditions of this consent, including triggers, compliance limits or actions and/or mitigation measures or changes to the operations and maintenance manual, required by Condition 19 of this consent, including any recommendations of the Adaptive Management Committee (referred to in Condition 43 of this consent);	Section 7, Section 2.3 and Section 11
i) A discussion on any mitigation/adaptive management that may be required in the coming year;	Section 10
j) A copy of the complaints record required by Condition 45 of this consent;	Section 9
k) Summary of any maintenance undertaken.	Section 2.2
The annual Waikanae Borefield report shall be made available to the public on the Kāpiti Coast District Council website by 30th September each year, or by another date as agreed with the Manager.	Refer www.kapiticoast.govt.nz

Condition 42 of consent WGN130103 [33759]	Section in this annual report
Note: The consent holder may request, with the Manager's approval, an extension of time to submit the annual report to the Manager and make it available to the public on the website, if the Adaptive Management Group requires more time to consider the draft annual report and provide their recommendations as required by part (h) of this condition.	

In addition to the above Council holds resource consent WGN050025 [33147] to abstract groundwater from two wells (PW1 and PW5) for the purpose of back up water supply for the communities of Waikanae , Paraparaumu and Raumati. Requirment of Condition 15 are discussed in section 4.6.

There are a number of plans and manuals required by the RRwGW suite of consents and various reports have been produced from the 2015/16 monitoring. These documents are set out in the following figure (Figure 1).

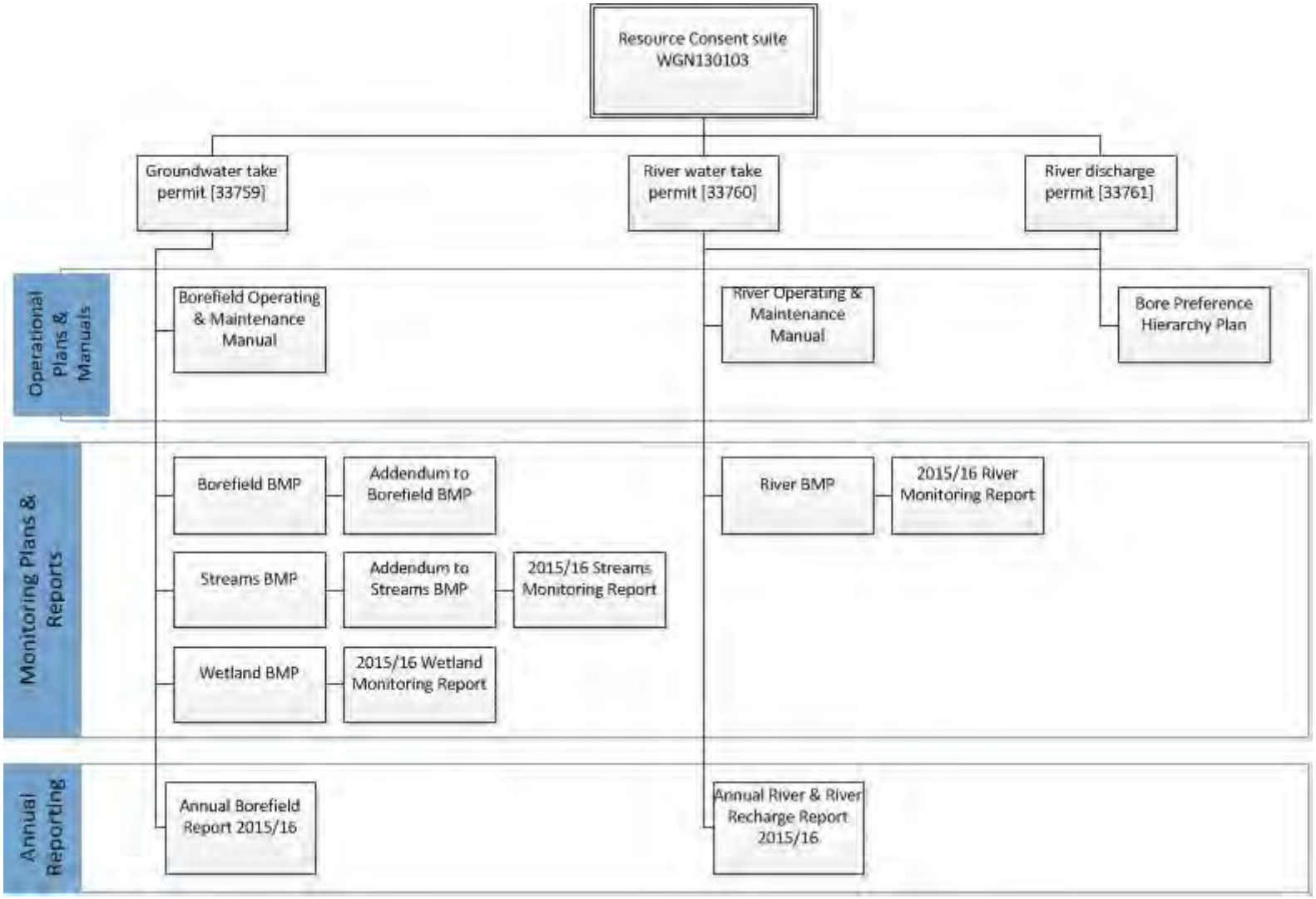

Figure 1: Key documents for RRwGW consents and 2015/16 monitoring

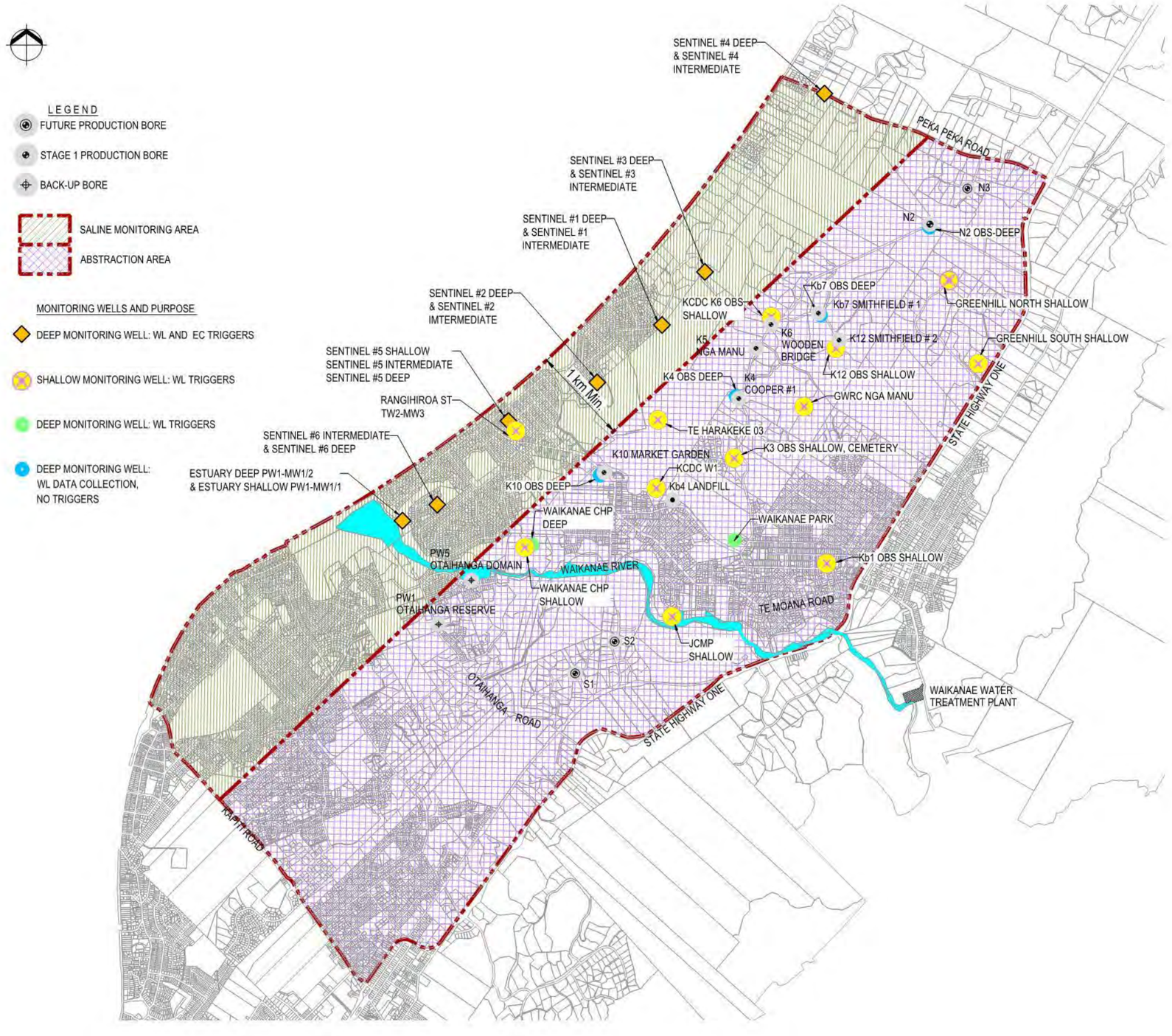

Figure 2: Location Plan – Waikanae Borefield Abstraction Wells and Monitoring Bores

2 Borefield Operation

2.1 Abstraction Volumes and Rates

Abstraction from each production well (L/s and m^3/day) is measured and recorded in accordance with Conditions 13,14 and 20 of consent WGN130103 [33759]. Council regularly submits full abstraction records to GWRC as required by Condition 18. A summary of the abstraction for this reporting period is provided below.

The total volume pumped from the production wells for the period 1 July 2015 to 30 June 2016 was 142,773 m^3, which is significantly less than the annual volume permitted by Condition 8 of the groundwater take consent (2,300,000 m^3/year). Of this volume, 83,187 m^3 was abstracted from bore K4 for construction water supply for the Mackays to Peka Peka (M2PP) Expressway. The use of bore K4 by the M2PP Alliance is outside the consent WGN130103 [33759] and is exercised under a separate consent.

The maximum total daily take was 8,425 m^3/day on 23 March 2016, which is also less the maximum daily take permitted by Condition 8.

On 16th October 2015 GWRC approved Condition 18(c) of WGN130103 [33761] River Recharge for year 2 of the baseline monitoring; which allows up to 20% river recharge of the downstream flow at the discharge point. There is a marked drop in the borefield abstraction compared to the 2014/15 period as a result of a slight fall in demand and higher river flows in the 2015/16 year allowing more abstraction from the river combined with the allowable 20% recharge.

River recharge occurred for 14 days during the 2015/16 year for a total of 226 hours The daily abstraction volumes for each production well during the reporting period are plotted in Figure 3. The Waikanae Borefield was used for river recharge on five occasions during 2015/16 due to low river flows: 16 to 17 October 2015 (2 days, 11 hours total), 12 to 15 March 2016 (4 days, 67 hours total), 20 to 21 March (1 day, 32 hours total), 21 to 23 March 2016 (3 days, 44 hours total), 30 March 2016 to 02 April 2016 (4 days, 71 hours total).

The other periods of Borefield use were associated with operation and maintenance activities or use by the M2PP Alliance. The production wells are generally pumped once per month (towards the end of the month) at maximum flow for a short period to flush the pipeline, check the operation of the bore pumps and collect water samples for water quality testing if required.

The total instantaneous abstraction rate is plotted in Figure 4. The maximum combined abstraction was 244 L/s, which occurred for 2.5 hours on 23 March (river recharging).

Summary graphs of the instantaneous rates for the individual wells is included in Appendix A. On two occasions the pumping rates for the production wells K4 and Kb4 was over the instantaneous abstraction rates given by Table 2 of Condition 8. In both cases the amount of flow that was over was in the order of 0.5% of the total flow, which is within the allowable flows as defined by Condition 8 of 15% for a maximum duration of 15 minutes.

None of the interim trigger levels for the deep and shallow aquifers were reached. During this reporting period, the total abstraction volume and duration of pumping were both much less than the scenario of borefield use presented during the consent hearing.

2.2 Operations Log and Maintenance Undertaken

Council has confirmed that its existing SCADA system together with the NCS system are an 'electronic data management system' which records and stores the information required by Condition 20 of consent WGN130103 [33759]. Council regularly emails borefield abstraction records to GWRC. Once HydroTel numbers have been issued by GWRC the borefield abstraction data will be supplied automatically from Council's SCADA system to GWRCs Water Use Data Management System. HydroTel numbers have been supplied for all but five sites. Council has implemented WaterOutlook as a system to store and report data and operational information relating to the Waikanae Borefield

A copy of the site logs for each production well is included in Appendix B. The following key events are noted:

- Well K10 experienced telemetry issues due to construction works (M2PP). On 27 October 2015 the telemetry central processing unit (CPU) was reset (attempted restart) but the CPU did not come back up. AFI was called to repair and AFI reloaded the PLC programme. It was noted that the memory's bank battery was low.
- An electrical short circuit was discovered at Well N2 on 28 October 2015 when taking water samples. The short circuit was fixed on 30 October 2015 by Proserve Electrical.
- Well N2's Pump refitted after new motor install on 30 November 2015.
- On 2 February 2016 the Virtual Private Network (VPN) link from Waikanae beach- K10 went down and was subsequently replaced by a tick router and telecom device. This was due to a large M2PP crane blocking the VPN from transmitting to the Waikanae Beach receiving tower.
- Water quality sampling for wells K10, N2, Kb7 and K12 completed in April 2016 for revised Bore PHP.
- Well K4 was used by the M2PP Alliance for construction water. The supply to M2PP was locked off as follows:
  - In June 2016 until M2PP confirmed consent queries. Valve turned on again 21 July 2016,
  - When the well was needed for river recharge due to low flows in the Waikanae River.
- The filter router for Well KB7 was reset on 11 April 2016. The main isolation switch (including the programmable logic controller (PLC)) was turned off so the communications could be fixed. The communications had to be reset on 23 May 2016, so the PLC had to be turned off once again.

2.3 Operation and Maintenance Manual

The Waikanae Borefield Operation and Maintenance Manual (BOMM) was submitted to GWRC, for approval, on 2 April 2015 in accordance with Condition 19 of consent WGN130103 [33759] and approved on 25 August 2015.

The recommended changes to the BOMM included:

- Inclusion of new interim triggers following approval from GWRC, submitted for approval on 08 June 2016
- Include the finalised Waikanae Borefield Operation and Maintenance document by Cardno
- Include the updated Bore Hierarchy Plan once approved by GWRC (which will include Kb7, K10, K12 and N2). This will be submitted to GWRC for approval shortly.

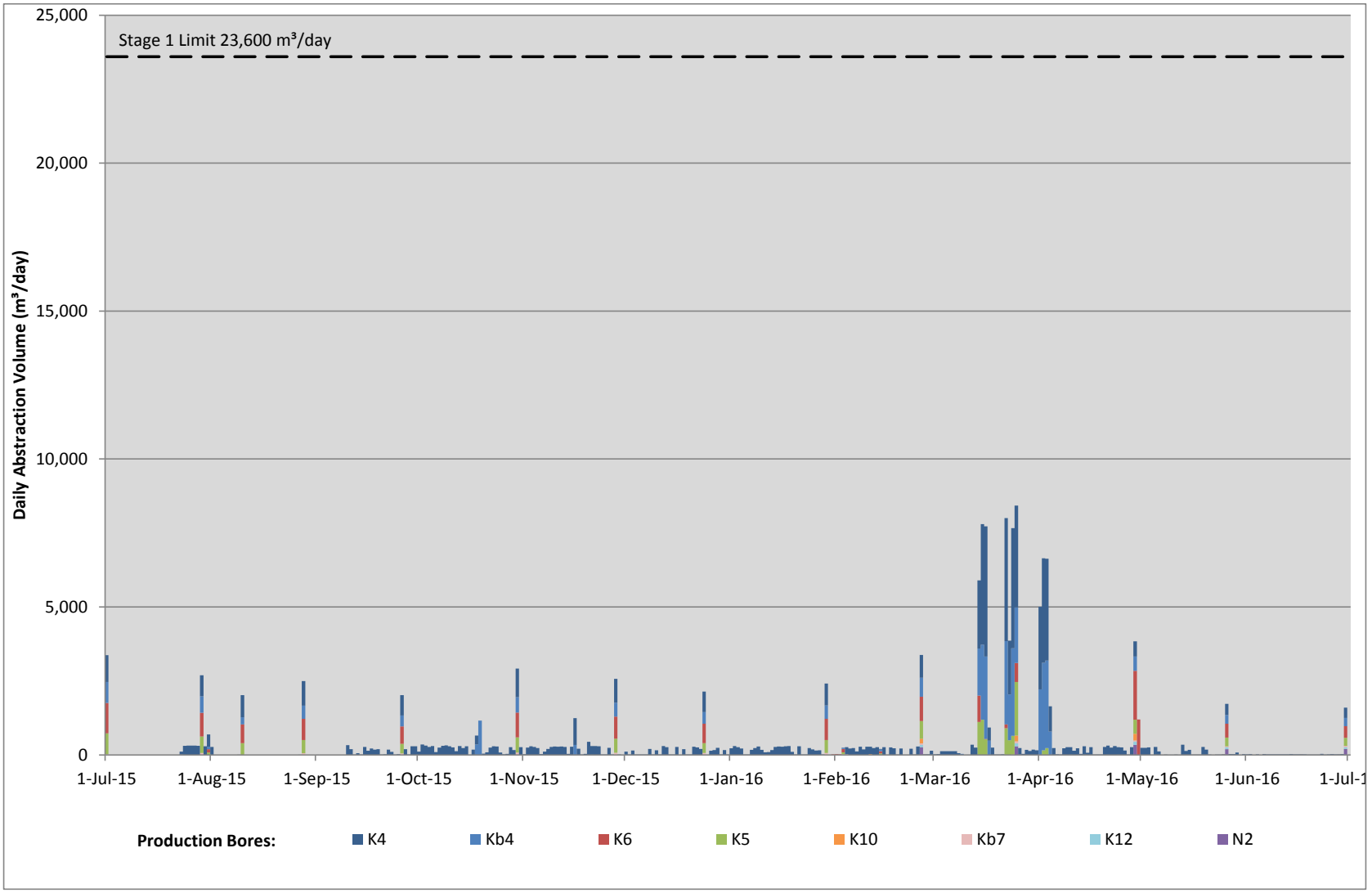

Figure 3: Daily Abstraction Volumes from Production Wells

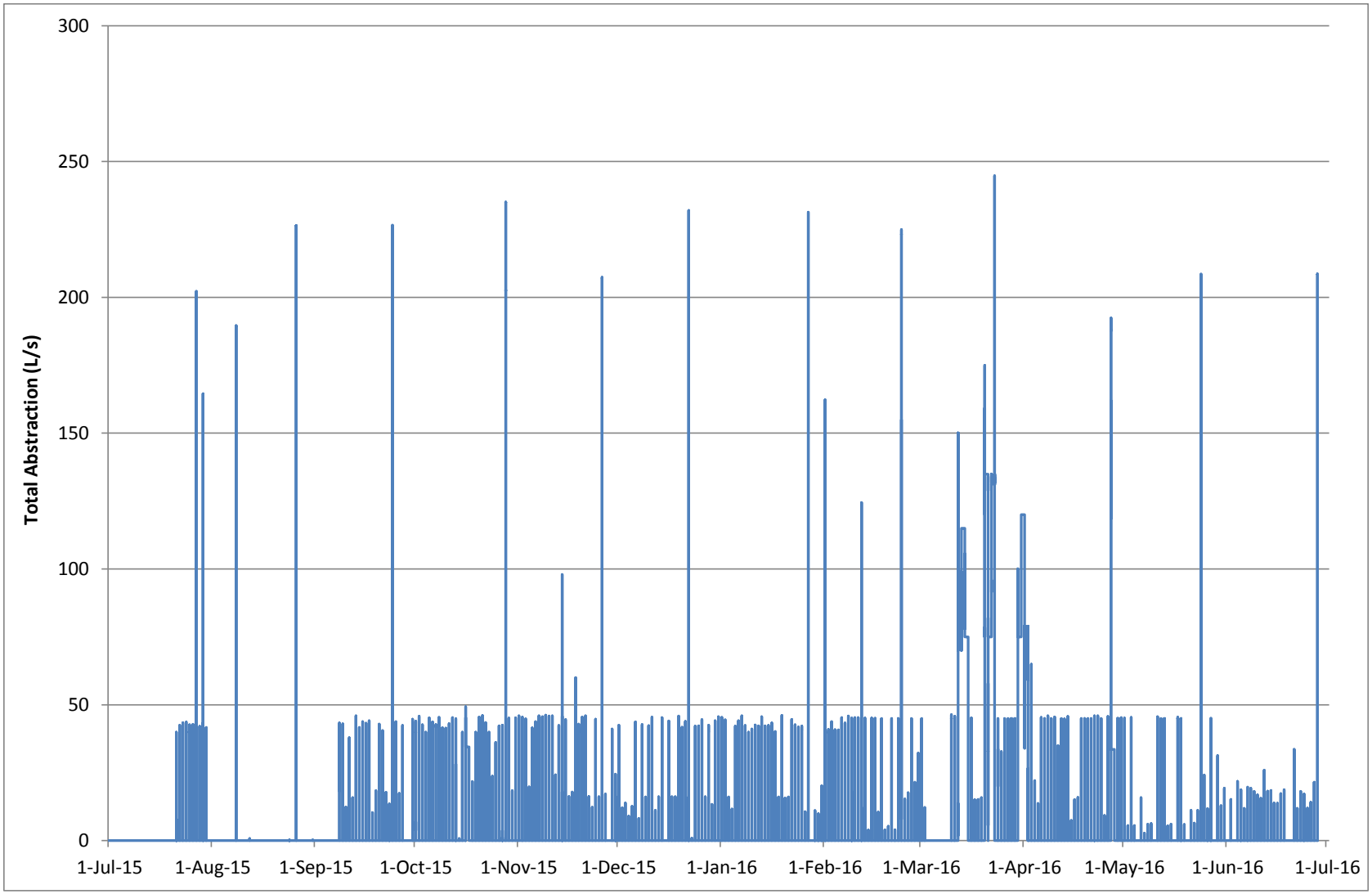

Figure 4: Total Instantaneous Abstraction from Production Wells

3 Waikanae River Flow Gauging

Flow gauging of the Waikanae River is required by Condition 25 of consent WGN130103 [33759]. One of the aims of this gauging is to determine whether a relationship between river flows, river abstraction rates and groundwater pumping can be identified by monitoring flows in the river downstream of the Waikanae WTP. Another reason for the hydrological monitoring is to confirm river flows at the periphyton and water quality monitoring locations to allow correlation of monitoring and effects. This is to establish whether additional groundwater pumping, from historic volumes abstracted, reduces flows in the Waikanae River downstream of the WTP due to increased losses through the bed of the river as a result of lowered groundwater levels.

Five sets of flow gauging were conducted by NIWA during the summer of 2015/2016 at the locations specified in River BMP; just downstream of SH1 and alongside Jim Cooke Park. The results are summarised in Table 2, along with the daily mean 'Flow' reported on the GWRC website and flow downstream of the WTP (calculated as the upstream flow minus the abstraction). The gaugings carried out by NIWA since baseline monitoring began are plotted in Figure 5 which also shows the results of 12 sets of gaugings carried out between 1993 and 2008 by GWRC at the same locations. The 2015-2016 gaugings are labelled.

Table 2: Gauging on the Waikanae River

Date	Water treatment plant			Site	Flow (L/s)	Area (m^2)	Velo-city (m/s)	Time (NZST)
	Upstream flow (L/s)	Abstraction (L/s)	Downstream flow (L/s)					
22 December 2015	2411	162	2249	Below SH1	2221	4.71	0.472	11:27
				Jim Cook Park	2258	3.94	0.573	12:54
22 January 2016	2136	157	1979	Below SH1	1674	4.11	0.408	08:11
				Jim Cook Park	1657	3.67	0.452	09:11
26 February 2016	1850	154	1696	Below SH1	1295	3.54	0.366	09:10
				Jim Cook Park	1192	2.21	0.639	10:08
18 March 2016	1831	151	1680	Below SH1	1113	3.01	0.370	14:26
				Jim Cook Park	968	2.31	0.42	13:24
22 April 2016	1211	146	1065	Below SH1	1037	4.43	0.234	11:07
				Jim Cook Park	713	1.69	0.424	12:53

Note: The upstream flow is the daily mean 'Flow', as published on the GWRC website.

The 2015/2016 gaugings undertaken by NIWA:

- Confirm the existing understanding that the Waikanae River loses about 300 L/s between SH1 and Jim Cooke Park, when flows at the WTP are lower than about 1,000 L/s.
- Extend the relationship between SH1 and Jim Cooke Park flows to include flows of more than 2000 L/s. Once flows get above about 1500 L/s, there is no net loss of flow between the two gauging points.

As per Condition 24 of consent WGN130103 [33759] the total abstraction from the borefield did not reach 23,000m^3/day throughout the 2015/16 monitoring period so Condition 24 (relating to Appendix 1D) of consent WGN130103 [33759] was not applicable.

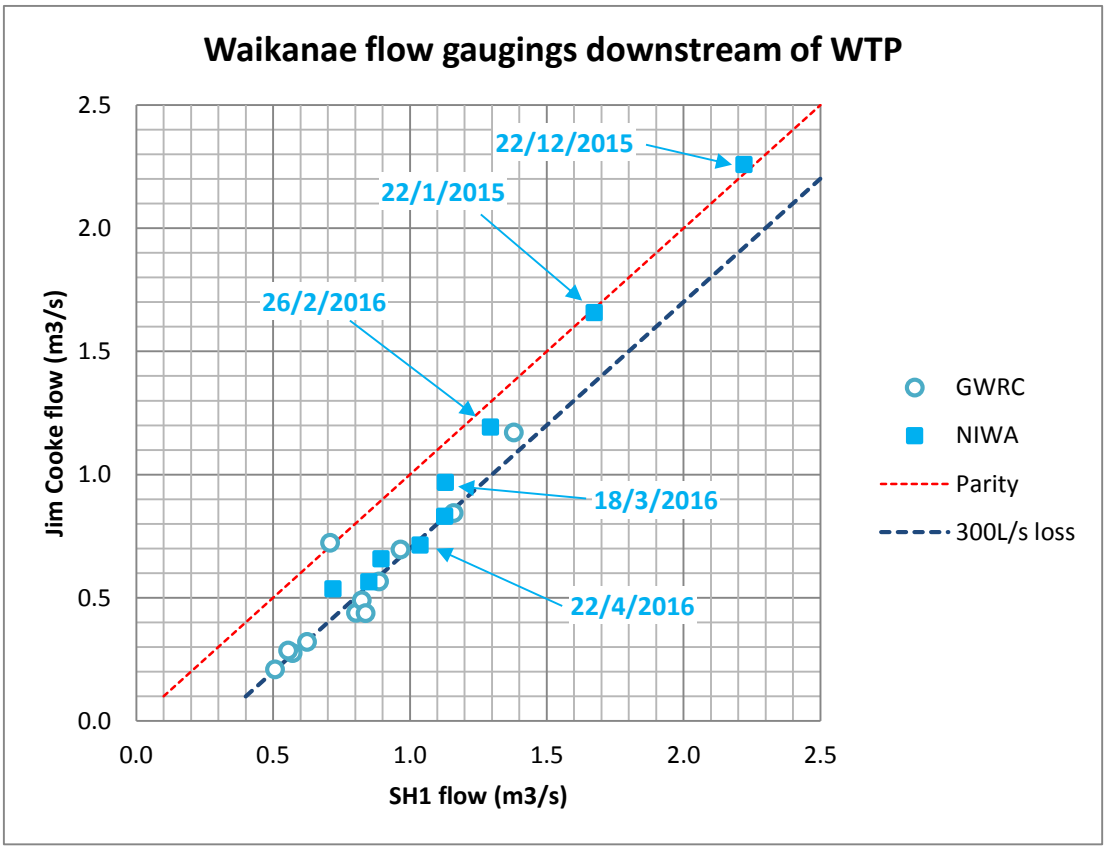

Figure 5: Waikanae River Flow Gaugings near SH1 and Jim Cooke Park

4 Borefield Monitoring

4.1 Borefield Baseline Monitoring

The Borefield Baseline Monitoring Plan (Borefield BMP) and addendum to the Borefield BMP describes the procedures for collecting and reporting water level data from shallow and deep monitoring wells within the Waikanae Borefield, as well as electrical conductivity monitoring from saline intrusion monitoring wells along the coast. The locations of these monitoring wells are shown in Figure 2.

An updated Borefield BMP that incorporates the addendum and accepted recommendations of the 2014/15 Adaptive Management Group (refer Section 11) was submitted on 3/11/2015 to GWRC for approval.

Some of the borefield monitoring sites are operated by GWRC. For these sites GWRC and Council's monitoring systems have been configured such that water level information is automatically transferred from GWRC to Council's SCADA system approximately every two hours.

The Council's SCADA system has been updated with the inclusion of the hydrotel numbers provided by GWRC to date. Hydrotel numbers are used as the basis of the link to automatically transmit data to the GWRC SCADA system. There remain five bores that require hydrotel numbers to be provided by GWRC. Where Hydrotel number are still required, data is sent to GWRC in excel format.

Interim trigger levels are in place for monitoring wells that were in existence at the commencement of the resource consent as detailed in the letter submitted to GWRC on 8 June 2016. New monitoring wells which now have 1 year of data have had interim trigger levels set and applied. There are three electrical conductivity sites where it is recommended that a further year of baseline monitoring takes place before interim triggers are set as detailed in the tables below. These interim trigger levels are summarised in the tables below. Ongoing triggers for the borefield will be set following the completion of 3 year baseline monitoring, as approved by GWRC on 12 April 2016. If interim trigger levels are exceeded, alarms are generated by Council's SCADA system and automatic notifications are emailed to Council, GWRC and CH2M Beca.

Abstractions from the borefield in the last period were used for maintenance and testing (Short term discharges) as well as river recharge.

4.2 Shallow Aquifer Drawdown Monitoring

Table 3: Shallow Aquifer Drawdown Monitoring Wells and Interim Trigger Levels below, lists the shallow aquifer monitoring sites, the applicable interim trigger levels and the minimum water level (daily average) recorded during this year's report period compared to last year. Graphs of the shallow aquifer monitoring data for this reporting period are presented in Appendix C.

None of the interim alert trigger levels for the shallow monitoring bores were exceeded during the reporting period.

The following issues or unusual events are noted:

- KCDC W1 - Operations and maintenance caused Alert, Action and Cease on the 28 January 2016
- Te Harakeke 03 – GWRC replaced the logger and caused Alert, Action and Cease on the 15 April 2016

Table 3: Shallow Aquifer Drawdown Monitoring Wells and Interim Trigger Levels

Well Name	GWRC Bore Number	Interim Trigger Level			Status	Min level this reporting period 2015/16 (mm AMSL)	Min level last reporting period 2014/15 (mm AMSL)
		Alert (mm AMSL)	Action (mm AMSL)	Cease (mm AMSL)			
KCDC K6 Obs Shallow	R26/6992	2180	1980	1580	Existing well previously monitored by GWRC, now monitored by KCDC.	3087	2943
GWRC Nga Manu	R26/6991	7460	7260	6860	Existing well operated by GWRC	7862	7472
KCDC W1	R26/7025	4440	4240	3840	Existing well operated by GWRC	4144	4905
Rangihiroa St TW2-MW3	R26/6287	1340	1140	740	Existing well operated by GWRC	1828	1797
Te Harakeke 03	R26/6886	2760	2560	2160	Existing well operated by GWRC	3654	3370
Waikanae CHP Shallow	R26/6916	1740	1540	1140	Existing well operated by GWRC	2032	1967

Well Name	GWRC Bore Number	Interim Trigger Level			Status	Min level this reporting period 2015/16 (mm AMSL)	Min level last reporting period 2014/15 (mm AMSL)
		Alert (mm AMSL)	Action (mm AMSL)	Cease (mm AMSL)			
K12 Obs Shallow, Smithfield Road	R26/6300	5184	4984	4784	Online monitoring since May 2015.	5542	5596
JCMP Shallow, Jim Cooke Memorial Park	To be advised by GWRC	6681	6481	6281	Monitored since Dec 2014	7299	7220
Kb1 Obs Shallow, Ngaio Road	R26/6304	Water level naturally falls below well bottom - sensor dry – this well excluded from analysis– removed from interim trigger and on-going triggers programme as agreed with GWRC					
K3A Obs Shallow, Cemetery	R26/6290	6964	6764	6564	Online monitoring since Dec 2014	7862	7544
Greenhill North Shallow, Greenhill Road North	To be advised by GWRC	6387	6187	5987	Monitored since Dec 2014	7084	6987
Greenhill South Shallow, Greenhill Road South	To be advised by GWRC	11846	11646	11446	Monitored since Dec 2014	12564	12381

4.3 Deep Aquifer Drawdown Monitoring

Table 4: Deep Aquifer Drawdown Monitoring Wells and Interim Trigger Levels lists the deep aquifer monitoring sites, the applicable interim trigger levels and the minimum water level (daily average) recorded during this year's reporting period compared to last year. Graphs of the deep aquifer monitoring data for this reporting period are presented in Appendix C.

None of the interim alert trigger levels for the deep monitoring bores were exceeded during the reporting period.

The following issues or unusual events are noted:

- Sentinel 1 – Operations and maintenance caused Alert, Action and Cease on the 02 December 2015
- Sentinel 2 - Operator error when configuring the new alarms caused Alert, Action and Cease on the 26 May 2016

Table 4: Deep Aquifer Drawdown Monitoring Wells and Interim Trigger Levels

Well Name	GWRC Bore Number	Interim Trigger Level			Status	Min level this reporting period 2015/16 (mm AMSL)	Min level last reporting period 2014/15 (mm AMSL)
		Alert [mm AMSL]	Action [mm AMSL]	Cease [mm AMSL]			
Sentinel #1 Deep, Rutherford Drive	R26/6378	-1537	-3787	-5475	Existing well. Equipment replaced and monitoring re-started Dec 2014	2588	988
Sentinel #1 Intermediate, Rutherford Drive	To be advised by GWRC	-2526	-4776	-6463	Monitored since Dec 2014	1328	1373
Sentinel #2 Deep, Hodgkins Rd	To be advised by GWRC	-898	-2698	-4048	Monitored since Dec 2014	2293	1899
Sentinel #2 Intermediate, Hodgkins Rd	To be advised by GWRC	-1757	-3557	-4907	Monitored since Dec 2014	1239	1398
Sentinel #3 Deep, Old WWTP	R26/6776	-2090	-4490	-6290	Manually measured weekly since 03/10/2013 Online monitoring since Dec 2014	2199	481
Sentinel #3 Intermediate, Old WWTP	To be advised by GWRC	-2547	-4947	-6747	Monitored since Dec 2014	1781	1752
Sentinel #4 Deep, Peka Peka Road	To be advised by GWRC	1832	932	257	Monitored since Dec 2014	3566	2958
Sentinel #4 Intermediate, Peka Peka Road	To be advised by GWRC	284	-616	-1291	Monitored since Dec 2014	1991	2003
Sentinel #5 Shallow, Taiata Street	R26/6673	-404	-1454	-2242	Existing well previously monitored by GWRC, now monitored by KCDC. Equipment replaced and monitoring re-started Dec 2014	1372	1415
Sentinel #5 Intermediate, Taiata Street	R26/6955	-393	-1443	-2231	Existing well previously monitored by GWRC, now monitored by KCDC. Equipment replaced and monitoring re-started Dec 2014	1353	1418
Sentinel #5 Deep, Taiata Street	To be advised by GWRC	19	-1031	-1819	Monitored since Dec 2014	1679	1781

Well Name	GWRC Bore Number	Interim Trigger Level			Status	Min level this reporting period 2015/16 (mm AMSL)	Min level last reporting period 2014/15 (mm AMSL)
		Alert [mm AMSL]	Action [mm AMSL]	Cease [mm AMSL]			
Sentinel #6 Deep, Tamati Place	To be advised by GWRC	560	-190	-752	Monitored since Dec 2014	2011	1874
Sentinel #6 Intermediate, Tamati Place	To be advised by GWRC	599	-151	-714	Monitored since Dec 2014	1746	1981
Waikanae CHP Deep	R26/6594	540	-510	-1298	Existing well operated by GWRC	2267	2154
Waikanae Park	R26/6284	4611	2511	936	Existing well operated by GWRC	8650	8455

Note: Old Estuary Shallow PW1-MW1/1 and Old Estuary Deep PW1-MW1/2 no longer report as they have been replaced by Sentinel #6 Intermediate, Tamati Place and Sentinel #6 Deep, Tamati Place respectively as detailed in Appendix A to consent WGN130103 [33759] table 2.

4.4 Saline Intrusion Monitoring

Table 5: Saline Intrusion Monitoring Wells Electrical Conductivity Interim Trigger Levels lists the saline intrusion monitoring sites, the applicable interim trigger levels and the maximum electrical conductivity (daily average) recorded during this year's reporting period compared to last year. Graphs of the electrical conductivity (EC) monitoring data for this reporting period are presented in Appendix C.

The interim EC trigger levels for previously existing monitoring wells (i.e. in existence and monitored for EC at the commencement of the consent) are a continuation of the already established triggers from the previous abstraction consent.

It was noted in the 2014/15 Borefield Annual Report that EC measurement equipment and sensor placement within the existing saline intrusion monitoring wells may have changed over time such that the existing EC trigger values based on data collected over the period 2005 - 2009 may no longer be representative of current conditions. The interim trigger levels for the existing wells were reviewed, when the new well interim triggers were calculated, and it was found that the magnitude of difference with the inclusion of recent data did not justify changing the existing interim triggers. Ongoing triggers will be set for the wells following the completion of the final year of baseline monitoring.

None of the interim alert trigger levels for electrical conductivity were exceeded during the reporting period.

The following issues or unusual events are noted

- Sentinel #2 Deep Hodgkins Rd sensor replaced in November 2015,
- Sentinel #3 Deep Old WWTP sensor removed and repaired mid-August to early November 2015,
- Sentinel #5 Deep Taiata St isolated peak December 2015 related to calibration work.
- Sentinel #6 Deep Tamati Place sensor failed and was replaced mid November to December 2015
- Sentinel #6 Intermediate Tamati Place failed and was replaced June to July 2015.

EC monitoring data collection is proceeding according to plan. Council is continuing to investigate noted issues with the EC monitoring equipment and data and is liaising with GWRC on matters as they arise. Development of trends used to set trigger levels is the goal of current monitoring and not the determination of absolute values. Discussions with GWRC staff indicate that previous EC monitoring experienced similar anomalies and the data is useful for trend identification but not absolute values of EC.

The yearly check of conductivity measurement equipment against standard solutions was completed in November 2015. The depth of the EC sensor was also checked and adjusted as necessary to ensure that the setting was within the screened section of the well.

Table 5: Saline Intrusion Monitoring Wells Electrical Conductivity Interim Trigger Levels

Well Name	GWRC Bore Number	Interim Trigger Level			Status	Max this reporting period 2015/16 (µS/cm)	Max last reporting period 2014/15 (µS/cm)
		Alert (µS/cm)	Action (µS/cm)	Cease (µS/cm)			
Sentinel #1 Deep, Rutherford Drive	R26/6378	1500	1875	2188	Existing well repaired. Equipment replaced and monitoring re-started Dec 2014	1006	1024
Sentinel #1 Intermediate, Rutherford Drive	To be advised by GWRC	TBD	TBD	TBD	Monitored since Dec 2014 additional year of data required to set interim triggers	1555	4253
Sentinel #2 Deep, Hodgkins Rd	To be advised by GWRC	1532	1915	2234	Monitored since Dec 2014	1257	1339
Sentinel #2 Intermediate, Hodgkins Rd	To be advised by GWRC	1671	2089	2437	Monitored since Dec 2014	1420	1398
Sentinel #3 Deep, Old WWTP	R26/6776	1342	1677	1956	Monitored since Dec 2014	1124	1064
Sentinel #3 Intermediate, Old WWTP	To be advised by GWRC	2422	3027	3531	Monitored since Dec 2014	1324	2351
Sentinel #4 Deep, Peka Peka Road	To be advised by GWRC	866	1082	1262	Monitored since Dec 2014	726	804
Sentinel #4 Intermediate, Peka Peka Road	To be advised by GWRC	738	923	1077	Monitored since Dec 2014	583	648
Sentinel #5 Shallow, Taiata Street	R26/6673	430	537	627	Equipment replaced and monitoring re-started Dec 2014	325	271

Well Name	GWRC Bore Number	Interim Trigger Level			Status	Max this reporting period 2015/16 (µS/cm)	Max last reporting period 2014/15 (µS/cm)
		Alert (µS/cm)	Action (µS/cm)	Cease (µS/cm)			
Sentinel #5 Intermediate, Taiata Street	R26/6955	3079	3849	4491	Existing well previously monitored by GWRC, now monitored by KCDC. Equipment replaced and monitoring re-started Dec 2014	2837	2943
Sentinel #5 Deep, Taiata Street	To be advised by GWRC	6119	7648	8923	Monitored since Dec 2014	4955	5193
Sentinel #6 Deep, Tamati Place	To be advised by GWRC	TBD	TBD	TBD	Monitored since Dec 2014 additional year of data required to set interim triggers	7965	7817
Sentinel #6 Intermediate, Tamati Place	To be advised by GWRC	TBD	TBD	TBD	Monitored since Dec 2014 additional year of data required to set interim triggers	1396	967

Note: Old Estuary Shallow PW1-MW1/1 and Old Estuary Deep PW1-MW1/2 no longer report as they have been replaced by Sentinel #6 Intermediate, Tamati Place and Sentinel #6 Deep, Tamati Place respectively as detailed in Appendix A to consent WGN130103 table 3.

4.5 Bore Water Quality Monitoring

The Bore Preference Hierarchy Plan, which is required by Condition 16 of consent WGN130103 [33761], was approved by GWRC on 13 October 2015. This plan included full water quality results for the production bores Kb4, K4, K5 and K6 from monthly sampling carried out between October 2013 and January 2015.

Sampling for the remaining production bores, K10, Kb7, K12 and N2, commenced in May 2015 following the installation of bore pumps and headworks piping. A year of sampling for these bores was completed in April 2016. The next revision of the Bore Preference Hierarchy Plan was submitted to GWRC on 20 July 2016. This includes full water quality results for all production bores.

Bore water quality samples were taken from production bores approved for use as defined in the bore Preference Hierarchy Plan (dated 26/03/2015), if the bore had been used for more than one day, and prior to turning off if the bore had been used for three days or more. K4 and Kb4 were the only bores that were required to be sampled due to pumping for a period of 3 days. This sampling aligns with Condition 27 of consent WGN130130 [33759].

Blended bore water was sampled as per the minimum requirements under [33761] condition 21 at the same frequency as is required by [33759] condition 27 (j). This will allow for comparison of the individual bore water quality sampling with the blended bore water sampled if necessary. GWRC has yet to confirm the clarification of blended bore water sampling, email sent on the 15 December 2015.

A summary of the bore water quality sampling results obtained during the 2015/16 reporting period is included in Appendix D.

4.6 PW1 and PW5 Well Abstraction

Consent WGN050025 [33147] allows for a combined total of 7000m³/day to be abstracted from wells PW1 and PW5 for back up public water supply to the surrounding communities. The wells were not used for back up water supply in the 2015/16 year. Hence a summary of monitoring results is not required in addition to the information provided in this report.

5 Wetlands Monitoring

The results of the 2015/16 baseline monitoring are documented in the report "Wetland Baseline Monitoring Annual Report" by Boffa Miskell, which is included as Appendix E. Wetland interim trigger levels are applicable to wetlands that are less than 2 km from Council's operable production wells.

Monitoring of changes to water levels in the wetlands (specified in parts 1F and 1G of Appendix A of the [33759] resource consent) is accomplished by recording groundwater levels in piezometers installed in close proximity to these wetlands. The "alert" and "action" trigger levels do not apply to the monitored wetlands located greater than 2 kilometres from any well in the Waikanae Borefield actively being pumped for water supply or river recharge. Graphs presenting the wetland groundwater levels for the monitoring period (July 2015-June 2016) are presented in the report in Appendix E.

For the 2015/16 reporting period the following wetlands were within 2 km from the Waikanae Borefield production wells: Nga Manu Wetland, El Rancho Wetland, Te Harakeke Wetland, Ngarara Rd Wetland, Ngarara Bush Wetland, Otaihanga Wetland, and Peka Peka Rd Swamp. These wetlands were checked against trigger levels. Water levels measured were within expected levels. No approved trigger levels have been exceeded. An overall decline of water levels was observed in most monitoring sites during the summer months (January - April 2016). This was also observed in the late summer/early autumn period in previous years.

Whilst no trigger levels were exceeded, some alarm notifications have been received and communicated to GWRC. These were all due to maintenance.

6 Small Coastal Streams Monitoring

Baseline monitoring for small coastal streams commenced in December 2015 in accordance with the certified Small Coastal Streams Baseline Monitoring Plan (Streams BMP) and addendum to the Streams BMP as approved by GWRC. The results of the 2015/16 baseline monitoring are documented in the report "Small Coastal Streams Baseline Aquatic Monitoring Annual Report" by Boffa Miskell, which is included as Appendix F.

There are five small coastal stream monitoring sites. Following the findings of the 2014/2015 small coastal streams monitoring, two small stream sites were removed from the monitoring programme going forward as agreed with GWRC. The removed sites were Kowhai Stream and Paetawa. The small coastal streams baseline monitoring generally involved recording shallow groundwater level adjacent to each stream, instream water depth, and instream dissolved oxygen and temperature.

The data collected over the 3 year baseline monitoring period will be used to develop an on-going monitoring regime for the streams and inform the development of management triggers as part of the On-going Mitigation Plan for the Small Coastal Streams. Despite some data gaps due to equipment failure, the data collected from the small coastal streams between 1 December 2015 and 1 May 2016 is adequate in providing the second of three years of baseline monitoring measures of relevant instream habitat parameters and potentially associated ground water levels.

When comparing the shallow groundwater level changes with the instream water depth changes we have observed that there are roughly parallel responses of groundwater level and instream water depth to rain. The stream water depth increase response is ahead of the increase in groundwater level (responding first to rain fall) at almost all sites.

Due to very high bed movement we suggest removal of the Ngarara site for the 2016/17 monitoring period, as the probes instream were often buried and the amount of data gained was marginal. Also, access to the in stream sensor can be restricted by high water levels. The Kakariki monitoring site is not far up stream on the same water body and captures sufficient data for baseline monitoring to provide an indication of potential effects on this small coastal stream going forward. The Kakariki monitoring site is a better potential indicator of potential effects going forward.

There has been no detailed analysis of the relationship between stream depth and shallow groundwater level at this stage. This analysis will be carried out by hydrologists and hydrogeologists once the 3 year baseline monitoring period is complete.

No interim trigger levels for the small coastal streams as per Condition 23 of consent WGN130103 [33759] were exceeded. The maximum daily abstraction from the borefield was 8,425m³/day well under the trigger level of 23,000m³/day for three or more consecutive days.

7 Changes to Monitoring Plans

7.1 Borefield Baseline Monitoring Plan

An updated Borefield BMP that incorporates the approved addendum and accepted recommendations of the Adaptive Management Group (refer Section 11) was submitted on 3 November 2015 and approved by GWRC on 3 August 2016.

The new site interim trigger letter, issued to GWRC 8 June 2016 and dated 11 May 2016 forms a new addendum to the Borefield BMP. GWRC confirmed the approach to the interim triggers on 19 August 2016.

No further changes to the Borefield BMP are proposed at this stage.

7.2 Wetlands Baseline Monitoring Plan

No further changes to the Wetland BMP are proposed at this stage.

7.3 Small Coastal Streams Baseline Monitoring Plan

The Small Coastal Streams Baseline Monitoring Plan (Streams BMP) and approved addendum included the removal of two Small Costal Stream monitoring sites for year 2 of the Baseline monitoring.

The Small Coastal Streams monitoring report for 2014/15 had the following recommendations that were approved by GWRC on 30 November 2015:

1. No further fish sampling for the rest of the baseline monitoring present due to the low numbers of fish present in the streams.

2. No further aquatic macroinvertebrate monitoring because the communities present are not generally sensitive to water depth or habitat quality changes.

An updated Stream BMP was submitted to GWRC in November 2015 and was put on hold following the issue of annual review comments from GWRC on the 2014/2015 Annual Reports. The 2014/15 recommendations will be incorporated in an updated stream BMP now to be submitted after 2015/16 annual reporting round as agreed with GWRC.

The Small Coastal Streams monitoring report for 2015/16 (Appendix F) includes recommendations relating to changes to the baseline monitoring programme. These are summarised below; refer to Appendix F for further detail.

- Recommendation to remove Ngarara Stream from the baseline monitoring.

This recommendation will be discussed and agreed between Council's and GWRC's ecologists, and any changes will be incorporated into a revised BMP that will be submitted to GWRC for approval prior to the commencement of next summer's monitoring. The changes to the monitoring from the 2014/15 period will also be combined with the recommendations from this year. The revised BMP will also incorporate the addendum of changes and accepted recommendations of the Adaptive Management Group (refer Section 11).

8 Potentially Affected Existing Private Wells

Condition 7 of consent [33759] requires work to be undertaken to identify potentially affected existing authorised wells (and also actions (b)-(d) listed in the condition) prior to implementing each stage of the project as referenced in Condition 6. Condition 6 outlines the staging plan for the Waikanae Borefield extension and abstraction. The Stage One construction works were completed and commissioned in early 2015, but abstraction from the extended borefield (i.e. the new bores Kb7, K12 and N2) was only for testing and maintenance i.e. not recharge or supply for the 2015/16 reporting period. As such, Stage One will be implemented when abstraction from bores Kb7, K12 or N2 for either water supply or river recharge commences. Before this can take place GWRC need to be satisfied that Council has met all requirements of condition 7.

Private properties that are within a one kilometre radius of each of the Waikanae Borefield production wells and may be solely reliant on an existing well for domestic or stock water have been identified and contacted by the Council to provide details of wells on the property and the use of the groundwater abstracted from these wells. The information received have been assessed to confirm that the locations of Council's monitoring bores and interim trigger levels are adequate and appropriate for representing and detecting potential drawdown effects in potentially-affected existing authorised wells as submitted to GWRC on 20 November 2015.

A website has also been developed that provides groundwater level monitoring information as well as contact details if well users wish to discuss issues arising or make complaints. This website was launched to the public in November 2015.

The full requirements for condition 7 of WGN130103 [33761] were submitted to GWRC on 13 May 2016 for approval. GWRC certification that condition 7 has been met was received on 21 July 2016. Now approval has been received Kb7, K12, N2 and K10 can be used for supply and Stage One will be complete. Stage One will also be complete if recharge is used as long as the Bore Preference Hierarchy Plan (including Kb7, K10,K12 and N2) is approved by GWRC before recharge from these bores takes place .

9 Complaints Record

Condition 45 requires Council to maintain an on-going record of any complaints received alleging adverse effects from, or related to, abstraction from the Waikanae Borefield, including complaints of any adverse effects on private bores. During the reporting period Council received two queries that were related to Borefield pumping. They both related to drawdown of private bores. One query was dismissed after investigations revealed no pumping from Council's borefield occurred, and the other complaint was external to the zone of influence (located south of the Waikanae River).

10 Mitigation/Adaptive Management in the Coming Year

Looking ahead to the coming year (2016/17), it is proposed that the Small Coastal Streams monitoring site Ngarara Stream is removed. There is no additional mitigation or adaptive management that is anticipated at this stage other than the proposed changes to the BMPs, outlined in Section 7 above.

Further baseline monitoring will be carried out over the coming year in accordance with the certified Waikanae Borefield, Wetland and Small Coastal Streams BMPs.

The Waikanae Borefield may be used for river recharge next summer (2016/17) if required due to low flows in the Waikanae River. River Recharge is limited to no more than 20% of the downstream river flow in accordance with Condition 18 of consent WGN130103 [33761]. The recharge will be undertaken in accordance with the approved Bore Preference Hierarchy Plan.

11 Recommendations of the Adaptive Management Group

The Adaptive Management Group (AMG) for the RRwGW scheme comprises three members who are representatives of GWRC, Council and Te Āti Awa ki Whakarongotai. Figure 6 shows the stages of AMG and key stakeholder involvement in the lead up to the submission of this annual report to GWRC.

Council held a briefing session with the AMG and key stakeholders on 26 May 2016. Representatives of Wellington Fish and Game Council, The Kapiti Fly Fishing Club and Regional Public Health were present at the briefing. The purpose of this briefing session was to discuss the observations from the baseline monitoring undertaken to date as well as any observations of the AMG and key stakeholders during the

2015/16 period, and to make an early start in the process of considering the potential for adaptive management in regards to these observations ahead of the AMG meeting in August 2016 on the annual reports.

The AMG met on 31 August 2016 to discuss the draft version of this annual report, as well as the draft version of the annual River and River Recharge report. Representatives from the following key stakeholders also attended this meeting: Wellington Fish and Game Council, The Kapiti Fly Fishing Club, Friends of the Waikanae River and Regional Public Health.

Recommendations received from the AMG are set out in the table below.

Table 6: Recommendations of the Adaptive Management Group

Adaptive Management Observations and Opportunities	Consideration with AMG Recommendations
Small Coastal Streams ■ Ngarara Small Coastal stream site was challenging to maintain due to high sediment movement which buried the instruments on a number of occasions. The Kakariki site is on the same stream also provides data on the stream health and is considered a better indicator of potential effects.	■ Remove Ngarara SCSs monitoring site from further monitoring AMG Agreed

Recommendations made by the AMG and included in the final annual reports still require the approval of GWRC before implementation.

Figure 6: AMG activities associated with this year's annual report

Appendix A

Borefield Abstraction Summary Graphs

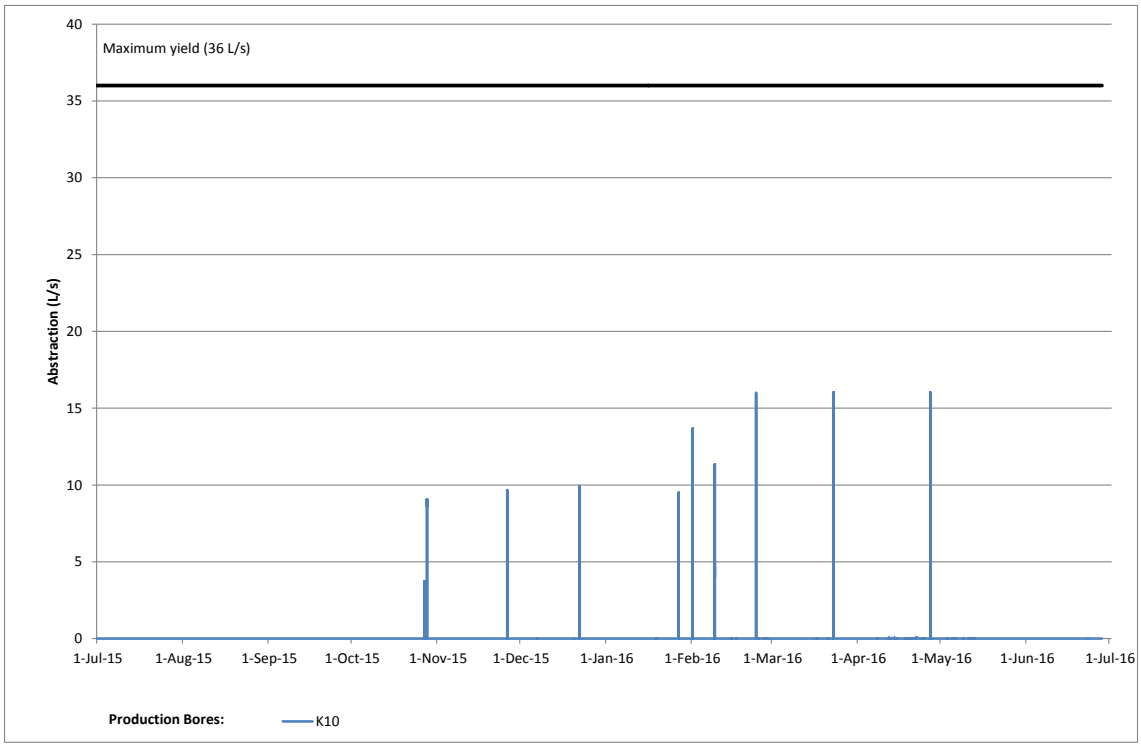

Figure A1: Instantaneous Abstraction for K10

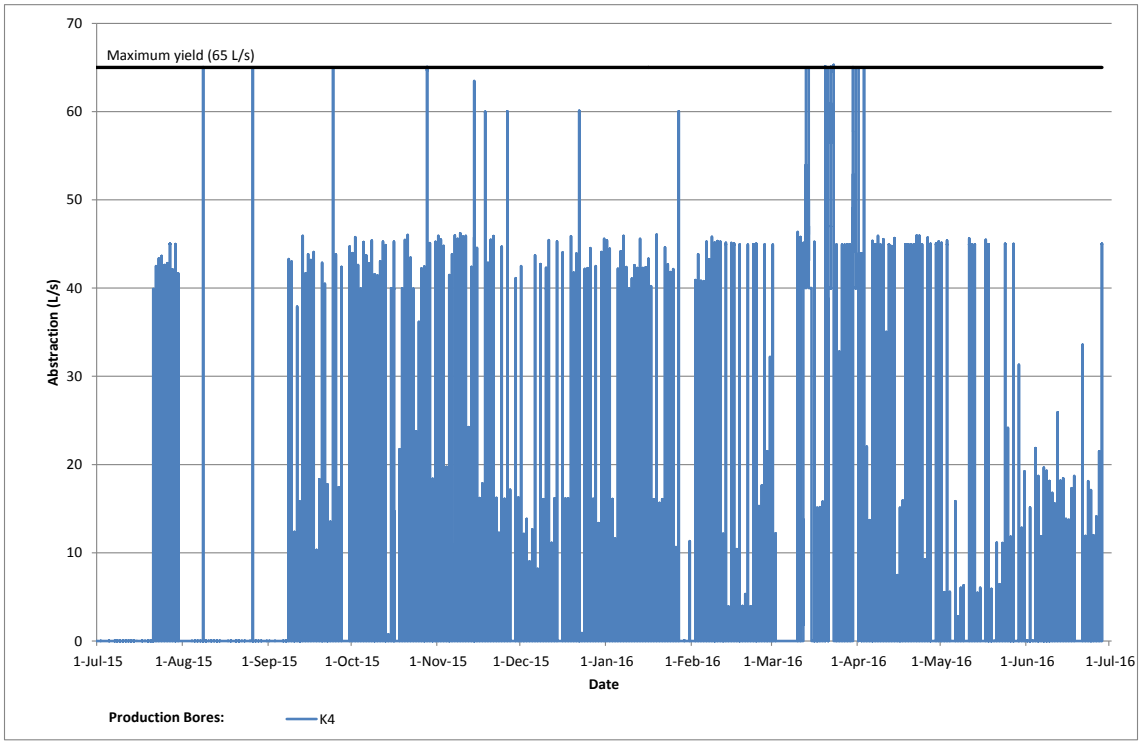

Figure A2: Instantaneous Abstraction for K4

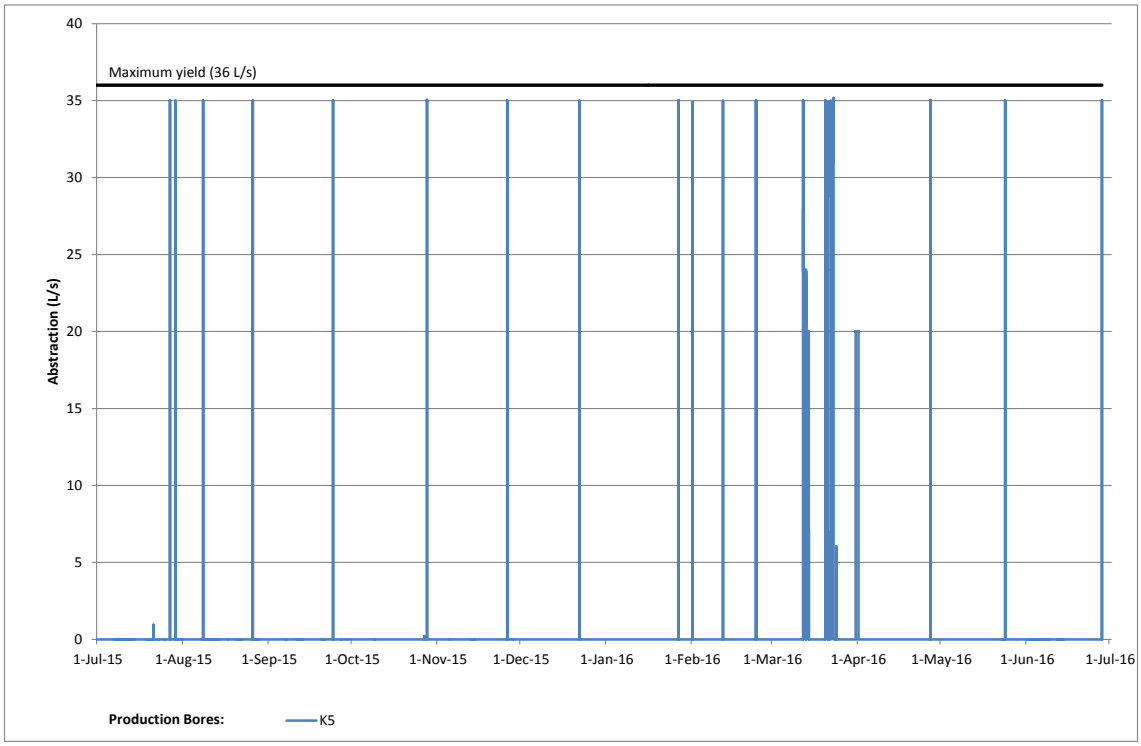

Figure A3: Instantaneous Abstraction for K5

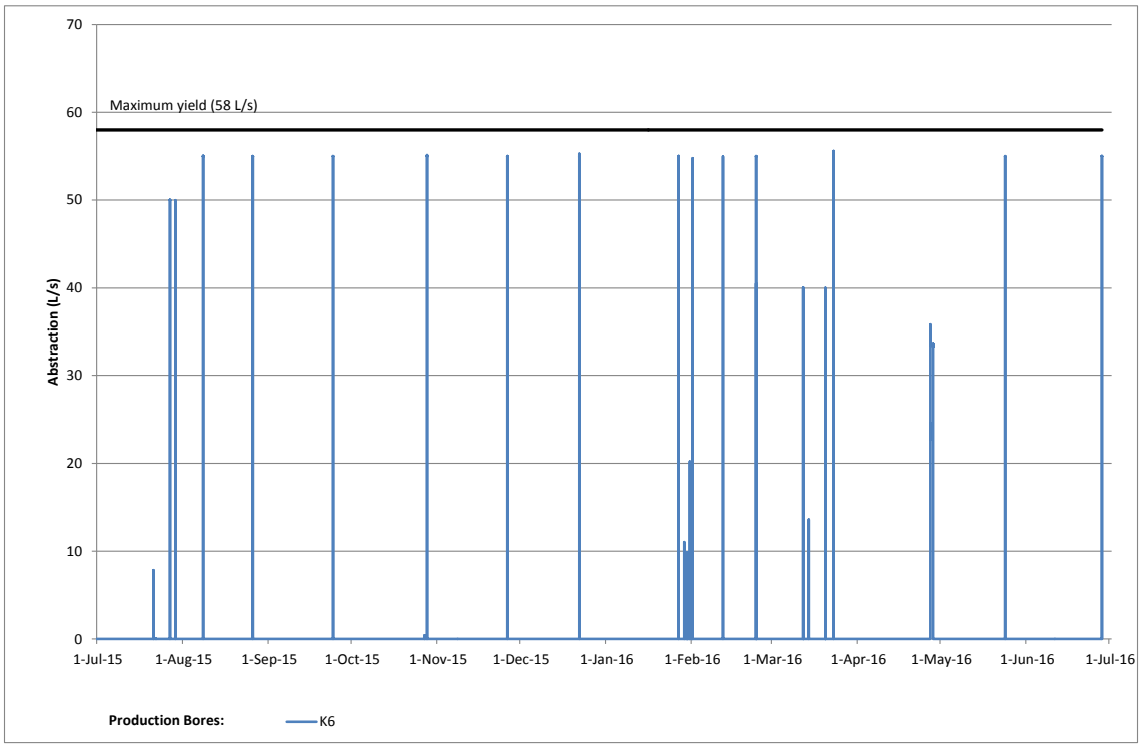

Figure A4: Instantaneous Abstraction for K6

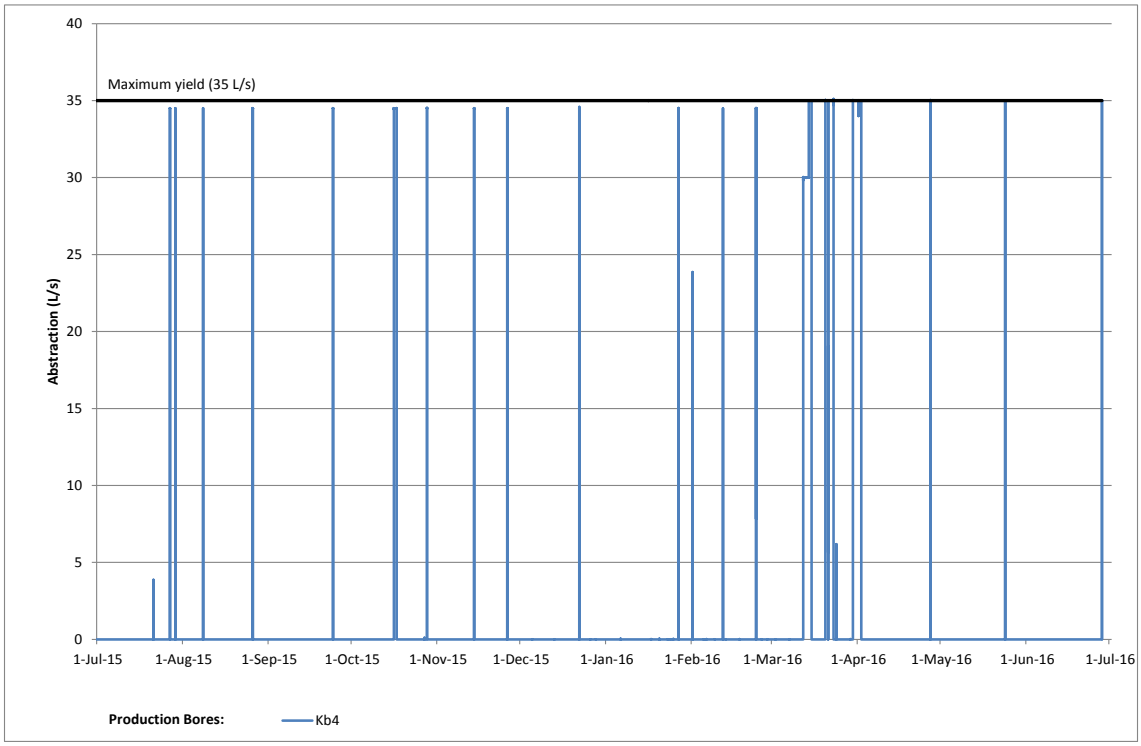

Figure A5: Instantaneous Abstraction for KB4

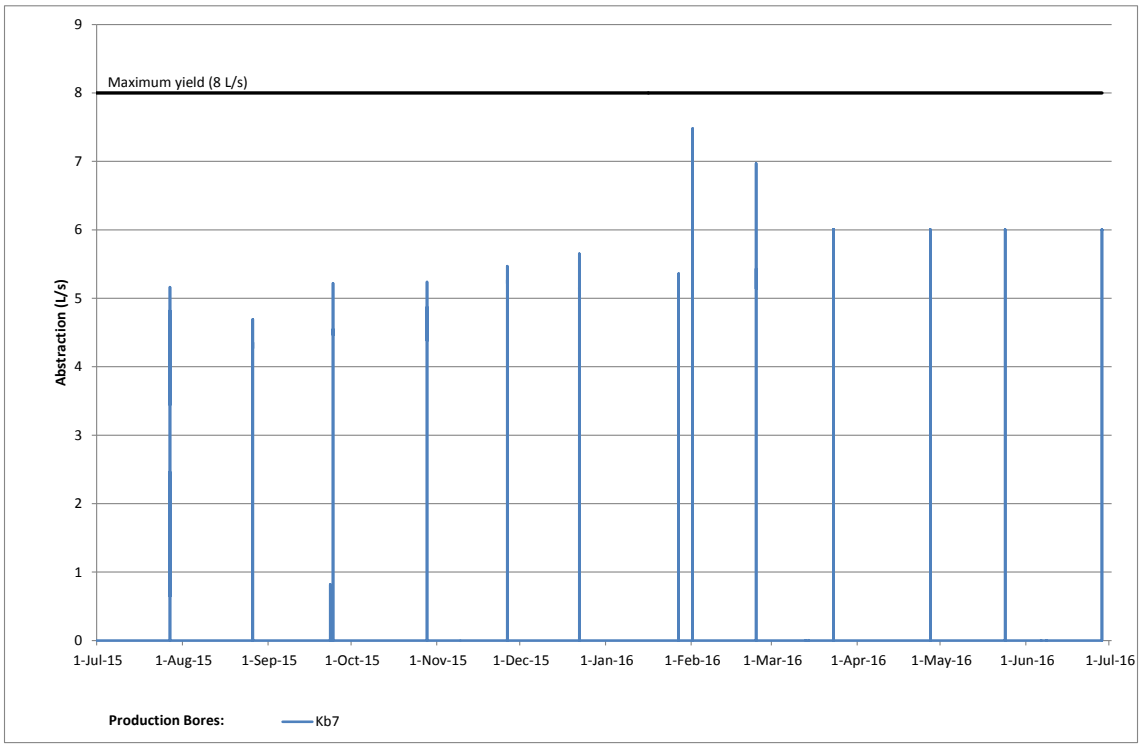

Figure A6: Instantaneous Abstraction for KB7

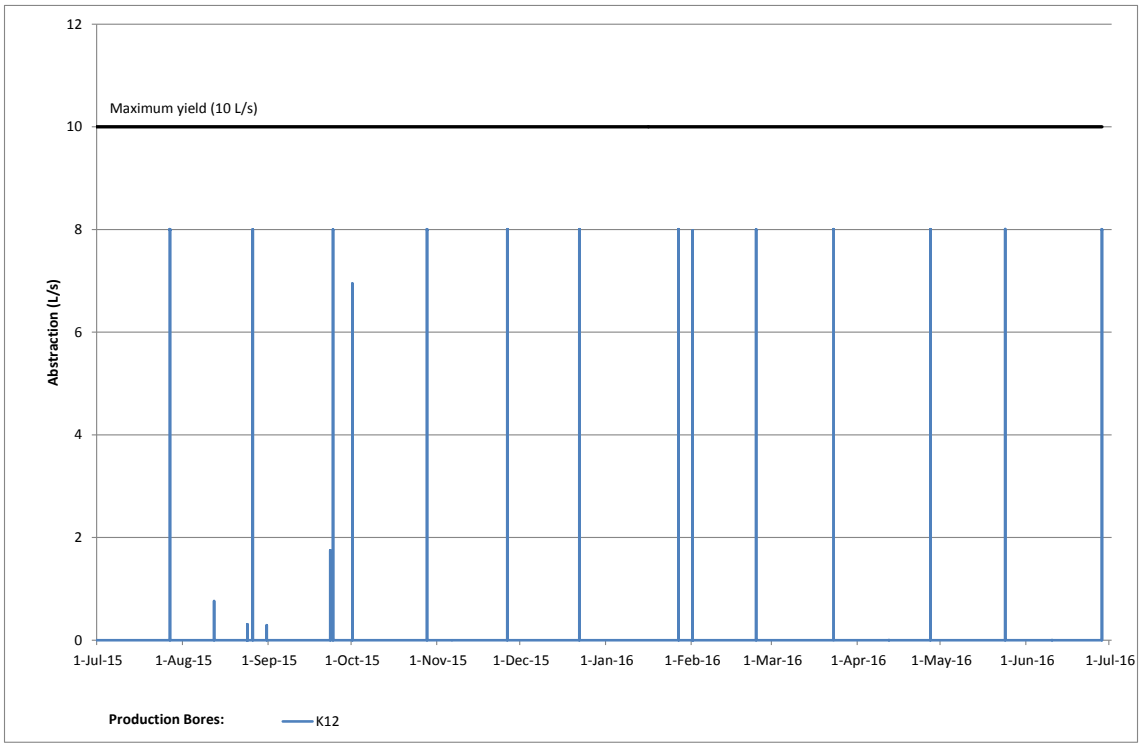

Figure A7: Instantaneous Abstraction for K12

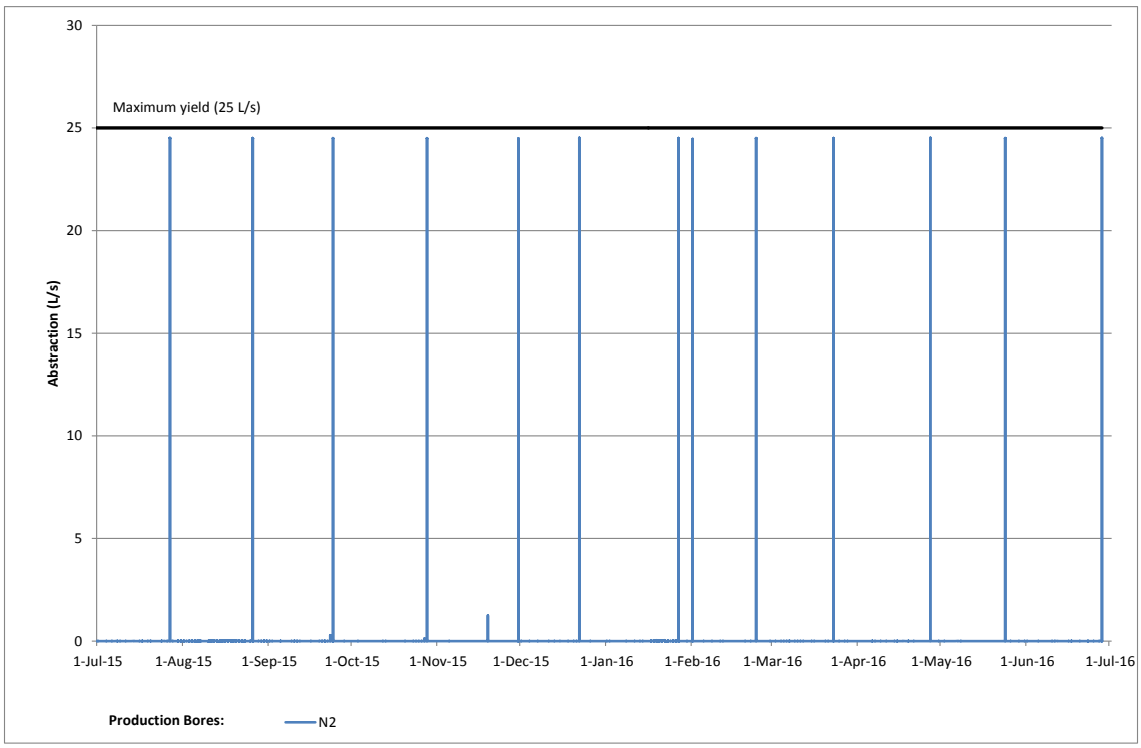

Figure A8: Instantaneous Abstraction for N2

Appendix B

Borefield Log Books

K4

Date	Comments – K4
23/04/15	Read meters - BB
28/04/15	Take Bore Sample - TA
30/04/15	Read Meters - CG
7/05/15	Read Meters - BB
15/05/15	Read meters - CG
20/05/15	Take Sample - BB
28/05/15	Read meters - TA
3/06/15	Place bulk water padlock on M2PP Take off valve from bore, until consent issues (M2PP to take water) has been sorted - TA
4/06/15	Read meters - BB
6/06/15	Read meters - CG
8/06/15	Meter read - CK
25/06/15	Meter Readings - TA
29/06/16	Meter Readings - CK
2/07/15	Meter Reading - BB
9/07/15	Read meters - BB
16/07/15	Read meters - CK
21/07/15	Turn on valve for M2PP - BB
21/07/15	Flow meter verification - CG
23/07/15	Meter Readings - TA
27/07/15	Bore sample - CK
30/07/15	Read meters - BB
6/08/15	Read meters - CG
13/08/15	Read meters - CG
20/08/15	Read meters site visit - TA
26/08/15	Bore samples - CK + DB + BN
27/08/15	Meter readings site visit - TA
3/09/15	Read meters - CG
10/09/15	Meter read - CK
17/09/15	Meter read - TY
1/10/15	Read meter - CG
8/10/15	Meter read - CK
15/10/15	Meter readings - TA
23/10/15	Read meters - BB
28/10/15	Take sample - BB
29/10/15	Read meters - CG
5/11/15	Read meters - CK
12/11/15	Meter Readings - TA
19/11/15	Read meters - BB
26/11/15	Take sample - BB
26/11/15	Read meters - CG
3/12/15	Meter read - CK

Date	Comments – K4
10/12/15	Meter read change cabinet filter - TA
17/12/15	Meter read - CK
22/12/15	Take bore sample - TA
23/12/15	Read meters - CG
21/12/15	Meter read - CG
7/01/16	Meter readings - TA
4/01/16	Read meters - BB
21/01/16	Read meters - CG
26/01/16	Lock VSD & shot valve - CG
28/01/16	Opened valve to drain surge vessel. Back through M2PP supply - CA
29/01/16	Take readings - BN
1/02/16	Turned VSD isolator on repowered radio for coms fault - CA
2/02/16	Reset VSD driver - BN
4/02/16	Meter read, site check - TA
7/02/16	Read meters - BB
8/02/16	Read meters - CG
9/02/16	Read meters & take sample - CG
3/03/16	Meter readings clean cabinet filter - TA
10/03/16	Reset the drive, unable to start from plant in auto - now ok - TA 0914hrs
10/03/16	Read meters - BB
12/03/16	Lock out M2PP supply starting RRWGW (meter) 54081 - BN
13/03/16	24Hr samples - BN & DB
15/03/16	Unlock M2PP valve recharge off - meter (54081 M2PP) - BN
17/03/16	Read meters - CG
20/03/16	1.26am - lock out M2PP (54330) - BN
20/03/16	Replace alarm 2.30pm to stop overheating - BN
21/03/16	Take 24hr sample - BN
23/03/16	Take 24hr /monthly samples - BN + DB + BB
24/03/16	Read meters - BB
30/03/16	Lock out M2PP (5533-9) - BN
31/03/16	24hr sample - BN + DB
31/03/16	Meter Readings - BN + DB
2/04/16	Recharge off turn on M2PP valve - BN
7/04/16	Read Meters - BB
14/04/16	Read Meters - BB
21/04/16	Read Meters - BB
27/04/16	Take sample - CG
28/04/16	Meter read clean filter - TA
6/05/16	Read meters - BB
12/05/16	Meter Readings - TA
19/05/16	Read Meters - BB
24/05/16	Bore water sample - TA
26/05/16	Read meters - CG
2/06/16	Read meters - BB

Date	Comments – K4
9/06/16	Read meters and check filter - TA
16/06/16	Read meters - BB
21/06/16	Read meters - TA
30/06/16	Samples taken - BB

Kb4

Date	Comments – KB4
2/06/2015	Read Meters - BB
10/06/2015	Read Meters - CG
18/06/2015	Meter Read - CK
25/06/2015	Meter readings remove lock out of VSD drive turn on VSD & set pump to auto - TA
29/06/2015	Bore sample - CK
2/07/2015	Read meters - BB
9/07/2015	Read meters - BB
16/07/2015	Read meters - CK
21/07/2016	Flow meter verification - CG + SG
23/07/2015	Meter readings - TA
27/07/2015	Bore sample - CK
30/07/2015	Read meters - BB
6/08/2015	Read meters - CG
15/08/2015	Read meters - CG
20/18/15	Meter readings - TA
26/18/2015	Bore samples - CK + BN + DB
27/08/2015	Meter read - TA
3/09/2015	Read meters - CG
10/09/2015	Meter read - CK
17/10/2015	Meter readings - TA
24/09/2015	Bore sample taken - TA
24/09/2015	Meter readings - BB
1/10/2015	Read meters - CG
8/10/2015	Meter read - CK
15/10/2015	Meter readings - TA
22/10/2015	Read meters - BB
28/10/2015	Take sample - BB
29/10/2015	Read meters - CG
5/11/2015	Meter read - CK
12/11/2015	Meter read - TA
13/11/2015	Check door security - alarm activated - came ajar at top. - TA
19/11/2015	Read meters - BB
25/11/2015	Read meters - CG
26/11/2015	Take sample - BB
3/12/2015	Meter read - CK
10/12/2015	Meter read change cabinet filter - TA
17/12/2015	Meter read - Ck
22/12/2015	Take bore sample - TA
23/12/2015	Read meters - CG
7/01/2016	Read meters - TA
14/01/2016	Read meters - BB
20/01/2016	Read meters - CG

Date	Comments – KB4
26/01/2016	Lock VSD, shut valve - CG
29/01/2016	Read meters open valve and start VSD - BN
4/02/2016	Meter readings - TA
11/02/2016	read meters replace air filter - BB
18/02/2016	Read meters - CG
24/02/2016	Read meters & take Sample - CG
3/03/2016	Meter reading cleaned cabinet filter - TA
10/03/2016	Read meters - BB
13/03/2016	Samples taken 24hr bore samples - BN + DB
17/03/2016	Read meters - CG
21/03/2016	Take 24hr samples - BN
23/03/2016	Take monthly samples - BN + DB + BB
24/03/2016	Read meters - BB
31/03/2016	24hr samples - BN + DB
31/03/2016	Meter reads, clean cabinet filter - TA
7/04/2016	Read meter - BB
14/04/2016	Read meter - BB
21/04/2016	Read meters - BB
27/04/2016	Take sample - CG
28/04/2016	Read meters - TA
6/05/2016	Read meters - BB
12/05/2016	Meter Readings - TA
19/05/2016	Read meters - BB
24/05/2016	Bore water sample - TA
2/06/2016	Read meters - BB
9/06/2016	Read meters, cleaned filter - TA
16/06/2016	Read meters - BB
21/06/2016	Read meters - TA

K5

Date	Comments – K5
2/04/15	Read Meters - CG
4/04/15	0700 reset drive fault PCT EXT 22 - CG
6/04/15	Take sample bore 1740 - CK
9/04/15	Read Meters - CG
16/04/15	Read meters clean cabinet filter - TA
23/04/15	Read meters - BB
28/04/15	Take bore sample - TA
30/04/15	Read meters - CG
7/05/15	Read meters - BB
15/05/15	Read meters - CG
20/05/15	Take sample - BB
28/05/15	Read meters - TA
10/06/15	Read meters - CG
18/06/15	Meter read - CG
25/06/15	Meter readings - TA
29/06/15	Bore sample - CK
2/07/15	Meter reading - BB
9/07/15	Read meters - BB
16/07/15	Read meters - CK
21/07/15	Flow meter verification - CG
23/07/15	Meter readings - TA
27/07/15	Bore samples - CK
30/07/15	Read meters - BB
6/08/15	Read meters - CG
13/08/15	Read meters - CG
20/08/15	Read meters site visit - TA
26/08/15	Bore samples - CK + CB + BN
27/08/15	Meter readings - TA
3/09/15	Read meters - CG
11/09/15	Meter read - CK
17/09/15	Meter Reading - TA
24/09/15	Reset Pump drive - TA
24/092015	Bore water sample - TA
24/09/15	Read meters - BB
1/10/15	Read meters - CG
3/10/15	Meter read - CK
5/10/15	Meter readings, site visit - TA
22/10/15	Read meters - BB
28/10/15	Take sample - BB
29/10/15	Read meters - CG
5/11/15	Read meters - CK
12/11/15	Meter readings - TA

Date	Comments – K5
19/11/15	Read meters - BB
26/11/15	Take sample - BB
26/11/16	Read meters - CG
3/12/15	Meter read - CK
10/12/15	Meter read – replace cabinet filter - TA
17/12/15	Meter Read - BB
22/12/15	Reset the drive to run the bore in auto. Take Sample - TA
23/12/15	Read Meters - CG
31/12/15	Meter Read - CK
7/01/16	Meter read - Ta
14/01/16	Read meters - BB
21/01/16	Read meters - CG
26/01/16	Lock VSD and Shut Valve - CG
29/01/16	Bore water sample - BB
1/02/16	Open Valve and Turned on VSD - CA
4/02/16	Read meters - BN
11/02/16	Read meters - CA
18/02/16	Read meters - TA
24/02/16	Read meters - BB
3/03/16	Read meters - Clean cabinet filter - CG
10/03/16	Read meters - BB
13/03/16	2Hr bore Sample - BB
17/03/16	Bore Samples - CG
23/03/16	Monthly Samples - BN & DB & BB
24/03/16	Read meters - BB
31/03/16	Read meters - Clean cabinet filter - TA
7/04/16	Read meters - BB
14/04/16	Read meters - BB
21/04/16	Read meters - BB
27/04/16	Take sample - CG
28/04/16	Meter read clean filter - TA
6/05/16	Read meters - BB
12/05/16	Meter readings - TA
19/05/16	Read meters - BB
24/05/16	Bore water sample - TA
26/05/16	Read meters - CG
2/06/16	Read meters - BB
9/06/16	Read meters - TA
16/06/16	Read meters - BB
21/06/16	Read meters - TA
30/06/16	Samples taken - BB

K6

Date	Comments – K6
12/02/15	Meter read and dip - TA
19/02/15	Meter read + dip - TA
23/02/15	Sample - BN + DB
26/02/15	Read meters - BB
6/03/15	Read + Dip - CG
12/03/15	Meter read & change filter - CK
19/03/15	Meter read - TA
24/03/15	Check out comms fail no power to readouts - BB
26/03/15	Samples - BN + DB
26/03/15	Read meters - BB
31/03/15	Turned off compressor tank reading 100%, bleed air out of system - CK
2/04/15	Read meters - CG
9/04/15	Read meters - CG
13/04/15	Put compressor control onto manual. Transducers playing up for level ctrl - CK
14/04/15	Checked tank level @ 13 on gauge. - CK + DB
16/04/15	Meter Readings clean cabinet filter - TA
23/04/15	Read meters - BB
22/04/16	Fitted new level transducer - CK
28/04/16	Take bore sample - TA
28/04/15	Check surge tank, level stuck @ 80% after bores shut down, tank empty and air valves releasing air, turned off compressor and powered down transducer, powered up and reset ok, put compressor back to auto after removing excess air from tank. - CK
30/04/15	Read meters - CG
7/05/15	Read meters - BB
15/05/15	Read power meter rest is flooded and shut down. - CG
18/05/15	Check flood damage - UPS had been submerged and is now dead and gone. No other damage anywhere pump station running on mains power until new UPS arrives. - BB
20/05/15	Take same - BB
28/05/15	Meter Readings - TA
4/06/15	Read meters - BB
10/06/15	Read meters - CG
18/06/15	Meter read - CK
25/06/15	Meter readings, site check - TA
29/06/15	Bore sample - CK
2/07/15	Read meters - BB
9/07/15	Read meters - BB
16/07/15	Read meters - CK
21/07/15	Flow meter verification - CG
23/07/15	Meter readings - TA
27/07/15	Bore samples - CK
30/07/15	Read meters - BB
6/08/15	Read meters - CG
13/08/15	Read meters - CG

Date	Comments – K6
20/08/15	Read meters, site visit - TA
26/08/15	Bore Samples - CK + BN + DB
27/08/15	Meter readings - TA
31/08/15	Fitted up new pipework valves and drain to surge tank - CK
3/09/15	Read meters - CK
11/09/15	Meter read - CK
17/09/15	Meter readings - TA
24/09/15	Bore water sample - TA
24/09/15	Meter reading - BB
1/10/15	Read meters - CG
15/10/15	Read meters site visit - TA
23/10/15	Read meters - BB
28/10/15	Take sample - BB
29/10/15	Read meters - CG
5/11/15	Meter read - CK
13/11/15	Meter read - TA
19/11/15	Read meters - BB
26/11/15	Take sample - BB
26/11/15	Read meters - CG
3/12/15	Meter read - CK
10/12/15	Meter read site check - change cabinet filter - TA
17/12/15	Meter read - CK
22/12/15	Take raw sample - TA
23/12/15	Read meters - CG
31/12/15	Meter read - CK
7/01/16	Meter readings - TA
8/01/16	Reset compressor fault - CK
14/01/16	Read meters - BB
21/01/16	read meters - CG
26/01/16	Lock VSD & shut valve - CG
29/01/16	Read meters - BN
1/02/16	Open valve and turned USD on - CK
4/02/16	Meter Readings - TA
11/02/16	Read meters - BB
18/02/16	Read meters - CK
24/02/16	Read meters & take sample - CG
2/03/16	Read meters clean cabinet filter - TA
3/03/16	Check compressor all ok - SD
3/03/16	Compressed air controls had isolated main valve from compressor to surge tank - reopened valve so it works - automatically as designed. - TA
9/03/16	Repaired door hinge - CK
10/03/16	Read meters - BB
17/03/16	Read meters - CG
19/03/16	9:30am reset compressor - BN

Date	Comments – K6
22/03/16	Reset compressor - BN
23/03/16	Monthly samples - BN + DB + BB
24/03/16	Read meters - BB
30/03/16	Can't reset compressor - BN
31/03/16	Meter readings, clean cabinet filter, change surge chamber PR valve. - TA
5/04/16	Inspect surge vessel - Roger SGS + BN
8/04/16	Read meters - BB
14/04/16	Read meters - BB
19/04/16	Read meters - BB
25/04/16	Reset comms - BN
27/04/16	Take sample - CG
28/04/16	Check PLC controls are in auto. Plant saying we are in manual. - BN
28/04/15	Meter readings change cabinet filter - BB
12/05/16	Meter readings - TA
16/05/16	Reset drive & Comms - CG + BN
19/05/16	Read Meters - BB
24/05/16	Bore water sample - TA
26/05/16	Read meters - CG
30/05/16	Switch off and on UPS output - BB
2/06/16	Read meters - BB
9/06/16	Read meters check site - check filter element ok - TA
16/06/16	Read meters - BB
21/06/16	Site visit - meter read - TA
21/06/16	Service/replaced pressure switch. Jason Crawford Cal - compressed air controls. - Ricky
30/06/16	Samples taken - BB

K10

Date	Comments – K10
28/04/15	Start bore - then take sample - TA
1/05/15	Read Meters - CG
20/05/15	Take Sample - BB
22/05/15	PLC back plane changed observation bore hooked up - Bill B
23/05/15	Check high level in pressure vessel, compressor off? - CK
28/05/15	Site visit meter readings - TA
3/06/15	Site visit check on status of surge vessel. Everything setup to auto - although no water in surge vessel. Valve supply must be shut will check with Bruce - Correct Mills Albert. Have watermain redirection work going on. Locked out VSD to bore pump - till watermain back on line - TA
3/06/15	Read meters - BB
10/06/15	Read meters - CG
18/06/15	Weekly plant check bore hole buried & covered with pipes - CG
25/06/15	Weekly plant visit remove isolation lock from USD supply torn on usd - put switch to auto record meter readings - TA
29/06/15	Bore sample - CK
2/07/16	Read meters - BB
9/07/15	Read meters - BB
15/07/15	Read meters - CK
18/07/15	Flow meter verification - CK +Shane Gunn
23/07/15	Meter readings site inspection - bore cabinet & ground area under massive vibration due to construction process next to bore. Cabinet vibrating wildly! - TA
27/07/15	Started pump for monthly sampling returned & took sample - CK
27/07/15	Samples - BN + DB
30/07/15	Read meters - CG
6/08/15	Read meters - BB
13/08/15	Read meters - CG
20/08/15	Read meters site visit - TA
26/08/15	Bore sample started pump in manual and compressor for surge tank. - CA
26/08/15	Take sample - BN + DB
27/08/15	Site visit meter readings - TA
3/09/15	Read meters - CG
3/09/15	Finished plumbing new surge tank compressor pipework & drain. - CK
10/09/15	Meter read - CK
17/09/15	Meter readings site check - TA
24/09/15	0810 start K10 bore in manual as there are no comms back to Waikanae plant and take bore sample - BN + DB
24/09/15	Read meters - BB
1/10/15	Read meters - CG
3/10/15	Meter read - CK
5/10/15	Meter read check site - TA
12/10/15	Read meters - BB
27/10/15	Repower CPU did not come Back up. Called AFI to repair - AFI Reloaded PLC programme. Memory Card battery low -

Date	Comments – K10
28/10/15	Take samples - BN + DB
29/10/15	Read meters - CK
5/11/15	Meter read - CK
19/11/15	Take samples - BN + DB
26/11/15	Read meters - CG
26/11/15	Meter read - CK
3/12/15	Meter readings - must sign into Mills Albert job site or else wear long pants & PPE or they'll write you up . - TA
10/12/15	Meter read - CK
17/12/15	Turn bore on manually - sample day - TA
22/12/15	Take samples - BN + CB
23/12/15	Read meters - CG
30/12/15	Security check - site intruder alarm activation - all secure - TA
31/12/15	Meter read - CK
7/01/16	Start bore - then take sample - TA
14/01/16	Read meters - BB
20/01/16	Read meters - CG
27/01/16	Take samples - BN + DB
26/01/16	Lock VSD & shut valve - CG
28/01/16	Meter readings - BN
1/02/16	Unlock VSD and bore valve - BN
2/02/16	VPN link from WBCH - K10 down - TA
2/02/16	Troubleshoot this end of VPN link 10:30am - Simon Fraser
2/02/16	16:30hrs replace > tick router + telecom device - Simon Fraser
18/02/16	Read meters - CG
24/02/16	Take samples - BN + DB
24/02/16	Read meters and take sample - TA
10/03/16	Read meters - BB
17/03/16	Read meters - CG
23/03/16	Take samples - BB
23/03/16	Take monthly samples - BN + DB
24/03/16	Read meters - BB
31/03/16	Replace surge vessel relief valve - meter readings. Clean cabinet filter element - TA
7/04/16	Read meters - BB
5/04/16	Inspect surge vessel - BN + Roger
14/04/16	Read meters - BB
21/04/16	Read meters - BB
27/04/16	Take samples - BN + DB
27/04/16	Take sample - CG
28/04/16	Meter readings - TA
6/05/16	Read meters - BB
12/05/16	Read meters - TA
19/05/16	Read meters - BB
24/05/16	Bore sample - TA

Date	Comments – K10
26/05/16	Read meters - CG
2/06/16	Read meters - BB
9/06/16	Meter readings - clean dust filter - TA
16/06/16	Read meters - BB
21/06/16	Read meters - TA
30/06/16	Samples taken - BB

Kb7

Date	Comments – Kb7
2/07/15	Read meters - BB
9/07/15	Read meters - BB
16/07/15	Read meters - CK
21/07/15	Flow meter Verification - CG + Shane Gunn
27/07/15	Bore samples, put bore into manual, not achieving flow set. - CK
30/07/15	Read meters - BB
5/08/15	Locked out pump - CK
6/08/15	Read meters - CG + Shane Gunn
20/08/15	Read meter visit site - TA
24/08/15	Unlock pump - CK
26/08/15	Bore samples - CK + BN + DB
10/12/15	Meter readings site check change cabinet filter - TA
17/12/15	Meter readings site check change cabinet filter - CK
22/12/15	Raw water sample - TA
22/12/15	Samples - BN + DB
23/12/15	Read Meters - CG + Shane Gunn
31/12/15	Meter readings site check change cabinet filter - CK
7/01/16	Meter read, site visit - CK
14/01/16	Read meters - BB
21/01/16	Read meters - CG
26/01/16	Take sample - BN + DB
26/01/16	Lock VSD and shut valve - CG
29/01/16	Take readings - BN + DB
1/02/16	Open valve and turned VSD on - CK
4/02/16	Meter read - TA
11/02/16	Read meters - BB
23/02/16	Take sample - BN + DB
24/02/16	Read Meters & take sample - CG
25/12/16	Paul K Elec filter install/power - Kapiti Electrical
3/03/16	Meter readings clean cabinet filter - TA
10/03/16	Read meters - BB
17/03/16	Read meters - CG
22/03/16	Kapiti Ele install filters - Kapiti Electrical
23/03/16	Take monthly samples - BN + DB + BB
24/03/16	Read meters - BB
29/03/16	Fit filter guards Kapiti Elec - Kapiti Electrical
31/03/16	Meter read clean cabinet filter - TA
7/04/16	Read meters - BB
11/04/16	Reset filter router turned off main isolated under PLC inside PLC fixed comms (Main ISOL) - BN + DB
14/04/16	Read meters - BB

Date	Comments – Kb7
25/04/16	Reset coms - DB
27/04/16	Take sample - CG
27/04/16	Take samples - Reset Drive - BN + DB
28/04/16	Meter read, clean filter - TA
12/05/16	Meter read clean filter - TA
19/05/16	Read meters - BB
23/05/16	Reset PCL Comms - see BN comment on 11 April 16. Cycle "Main ISOL' switch off then on again - Signed
24/05/16	reset PLC comms - reset VSD drive - cycle power take sample bore water - TA
26/05/16	Read meters - CG
2/06/16	Read Meters - BB
8/06/16	Reset comms turn off and on main ISOL switch behind PLC controls board - BB
9/06/16	Meter readings clean cabinet filter - TA
16/06/16	Read meters - BB
21/06/16	Read meters - TA

K12

Date	Comments – K12
2/07/15	Read meters - BB
9/07/15	Read meters - BB
16/07/15	Read meters - CK
21/07/15	Flow meter verification - CG + Shane Gunn
23/07/15	Meter readings - TA
27/07/15	Bore samples - CK
27/07/15	Samples - BN + DB
30/07/15	Read meters - BB
5/08/15	Locked out pump - CK
6/08/15	Read meters - CG
13/08/15	Read meters - CG
20/08/15	Read meter site visit - TA
26/08/15	Bore samples - BN + CG + CK
27/08/15	Meter readings - TA
3/09/15	Read meters - CG
11/09/15	Meter readings - CK
17/09/15	Site visit meter read - TA
24/09/15	Bore water sample - TA
24/09/15	Removed door to power meter cabinet at request of meter reader. - TA
1/10/15	Read meters - CG
8/10/15	Meter read - CK
15/10/15	Meter readings - TA
23/10/15	Take sample - BB
28/10/15	Take sample - BB
28/10/15	Takes samples - BN + DB
29/10/15	Read meters - CG
5/11/15	Read meters - TA
13/11/15	Meter Read - TA
26/11/15	Take sample - BB
26/11/15	Take samples - BN + DB
3/12/15	Meter Read - TA
10/12/15	Site check, meter read, change cabinet filter - Tony A
17/12/15	Meter read - CK
22/12/15	Raw bore sample - TA
22/12/15	Take Samples - BN + DB
23/12/15	Read meters - CK
7/01/16	Site visit meter readings - TA
14/01/16	Read meters - BB
21/01/16	Read meters - CG
26/01/16	Take samples - BN + DB

Date	Comments – K12
26/01/16	Lock VSD + Shut valve - CG
29/01/16	Took readings - BN + DB
3/02/16	Open valve & turned VSD on - CA
4/02/16	Meter readings - TA
11/02/16	Read meters - BB
18/02/16	Read meters - CG
23/02/16	Take samples - BN + DB
24/02/16	Read meters & take sample - CG
25/02/16	Paul KE site check for filters - CG
3/03/16	Read meters - BB
15/03/16	Kapiti Elec Paul filters - DG
17/03/16	Read meters - CG
23/03/16	Monthly samples - BN + CB + BB
24/03/16	Read meters - BB
29/03/16	Fit filter guards Kapiti Elec - Kapiti Electrical
31/03/16	Meter read clean cabinet filters - TA
7/04/16	Read Meters - BB
11/04/16	Smoke alarm 1.30am - false alarm - BN
11/04/16	Top UPS has switch on side to reboot PLC. Located in drive door next to charger. - BN
14/04/16	Read meters - BB
27/04/16	read meters - BB
27/04/16	Take sample - CG
27/04/16	Takes samples - BN + DB
28/04/16	Meter read clean filter - TA
6/05/16	Read meters - BB
12/05/16	Meter read clean filter - TA
19/05/16	Read meters - BB
24/05/16	Bore water sample - TA
26/05/16	Read meters - CG
9/06/16	Read meters - TA
16/06/16	Read meters - BB
21/06/16	Meter readings - TA
30/06/16	Samples taken - BB

N2

Date	Comments – N2
3/07/15	25 kgs of grass seed deposited around bore area and gate entrances - Tony A
9/07/15	Read meters - BB
16/07/15	Read meters - CK
21/07/15	Flow meter calibration - Shane Gunn + CG
23/07/15	Plant visit, meter readings check on progress of grass seed complete failure, farmer has had stock in each area, completely ruined all effort to grow seed. - Tony A
27/07/15	Bore samples - CK
27/07/15	Samples - BN + DB
5/08/15	Lock out pump - CK
6/08/15	Read meters - CG
13/08/15	Read meters Didn't feed birds - CG
20/08/15	Meter readings site visit - ?
24/08/15	Unlocked pump - CK
26/08/15	Bore samples - CK + DB + BN
27/08/15	Site visit meter readings - TA
3/09/15	Read meters - CG
11/09/15	Meter readings site visit - CK
17/09/15	Meter readings site visit - TA
24/09/15	Take bore water sample - TA
24/09/15	Take samples - BN + DB
24/09/15	Removed meter (power) cabinet door to give meter reader visual access. - TA
1/10/15	Read meters - CG
8/10/15	Meter read and spread grass seed - CK + BB
15/10/15	Meter read site visit - TA
23/10/15	read meters - BB
28/10/15	Take Samples. Ground Short circuit. Power off drive then re power. Same fault. - BN + DB
29/10/15	Read meters - CG
30/10/15	Proserve to address electrical fault issues "ground short circuit" - Craig + Wayne
5/11/15	Meter read - CK
19/11/15	Read meters - BB
30/11/15	take samples - BN + DB
30/11/15	Pump refitted after new motor install - TA
3/12/15	Meter read - CK
10/12/15	Meter read change cabinet filter - TA
17/12/15	Meter Read - TA
22/12/15	Samples - BN + DB
30/12/15	Check intruder alarm all ok - CK
31/12/15	Meter read - CK
14/01/16	read meters - BB

Date	Comments – N2
21/01/16	read meters - CG
26/01/16	take samples - BN + DB
26/01/16	Lock VSD & shut valve - TA
1/02/16	Open valve turn on VSD - BN + DB
4/02/16	Meter readings - TA
11/02/16	read meters - BB
18/02/16	Read meters - CG
23/02/16	take samples - BN + DB
24/02/16	Read meters and take samples - CG
23/02/16	Power filter install - signature
3/05/16	Power filter install - signature
10/03/16	read meters - BB
17/03/16	Read meters - CG
23/03/16	Monthly samples - BN + DB + BB
24/03/16	read meters - BB
29/03/16	Fit filter guard - Signature Kapiti Elec
31/03/16	Meter readings clean cabinet filter - TA
7/04/16	Meter read - BB
14/04/16	read meters - BB
21/04/16	read meters - BB
27/04/16	take samples - CG
27/04/16	Take samples - BN + DB
28/04/16	Meter readings - ?
6/05/16	read meters - BB
12/05/16	Meter readings clean filter - TA
19/05/16	Read meters - BB
26/05/16	Read meters - CG
2/06/16	Read meters - BB
9/06/16	Meter readings - TA

Appendix C

Groundwater Level and Electrical Conductivity Monitoring Results

C.1 Shallow Aquifer Water Level Monitoring

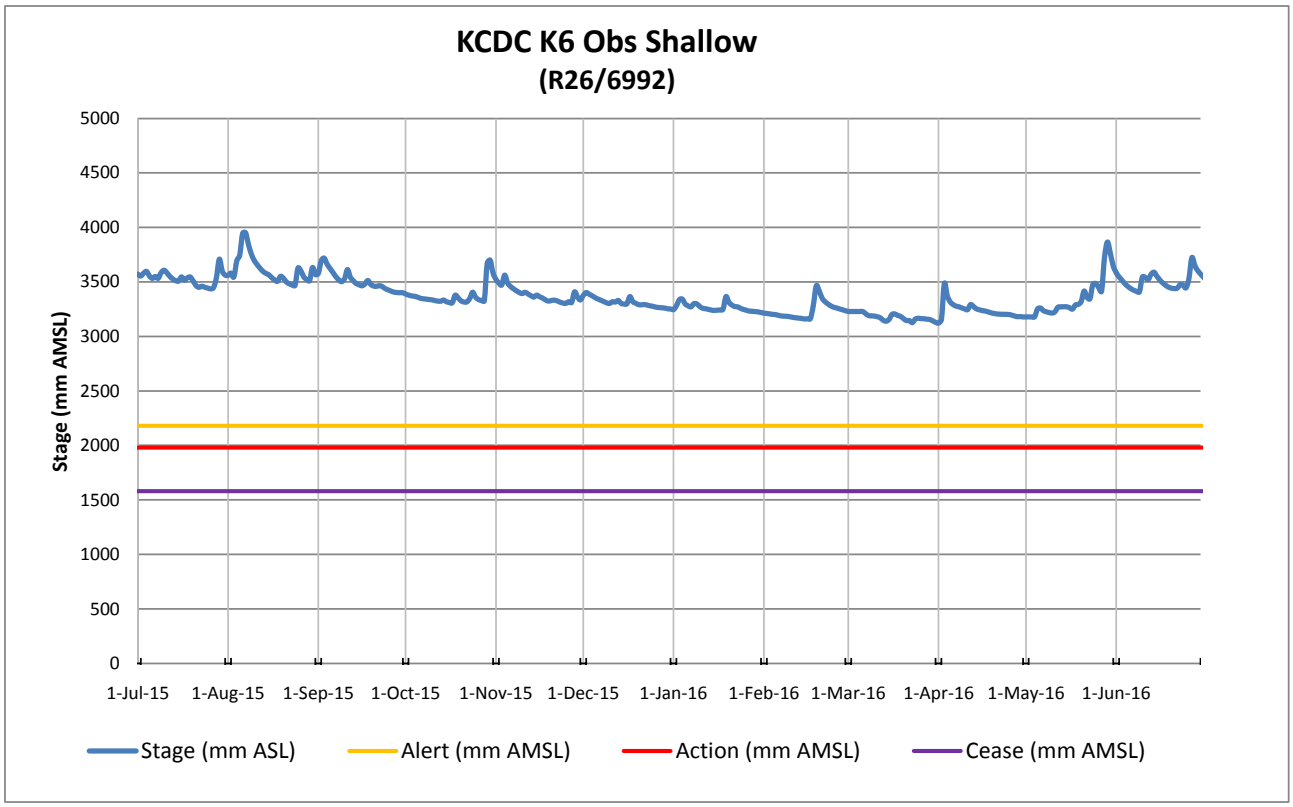

Figure C1.1: Water Levels at KCDC K6 Observation Shallow Monitoring Bore (R26/6992)

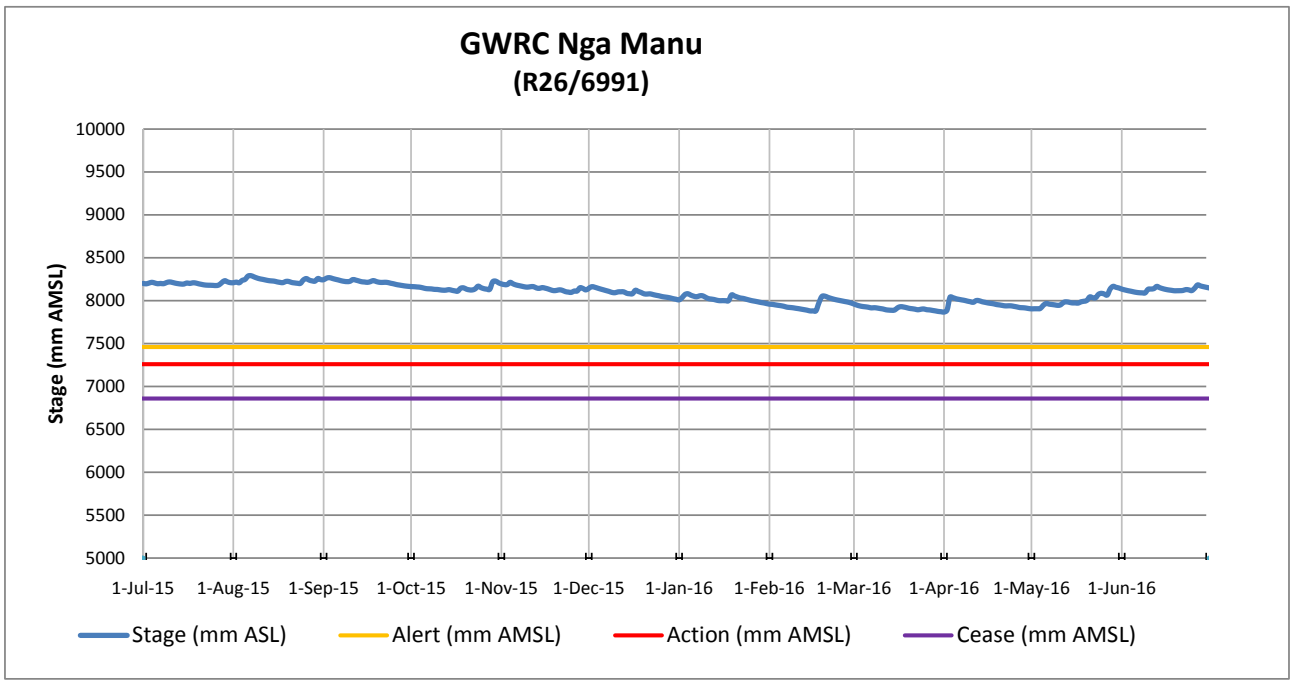

Figure C1.2: Water Levels at GWRC Nga Manu Monitoring Bore (R26/6991)

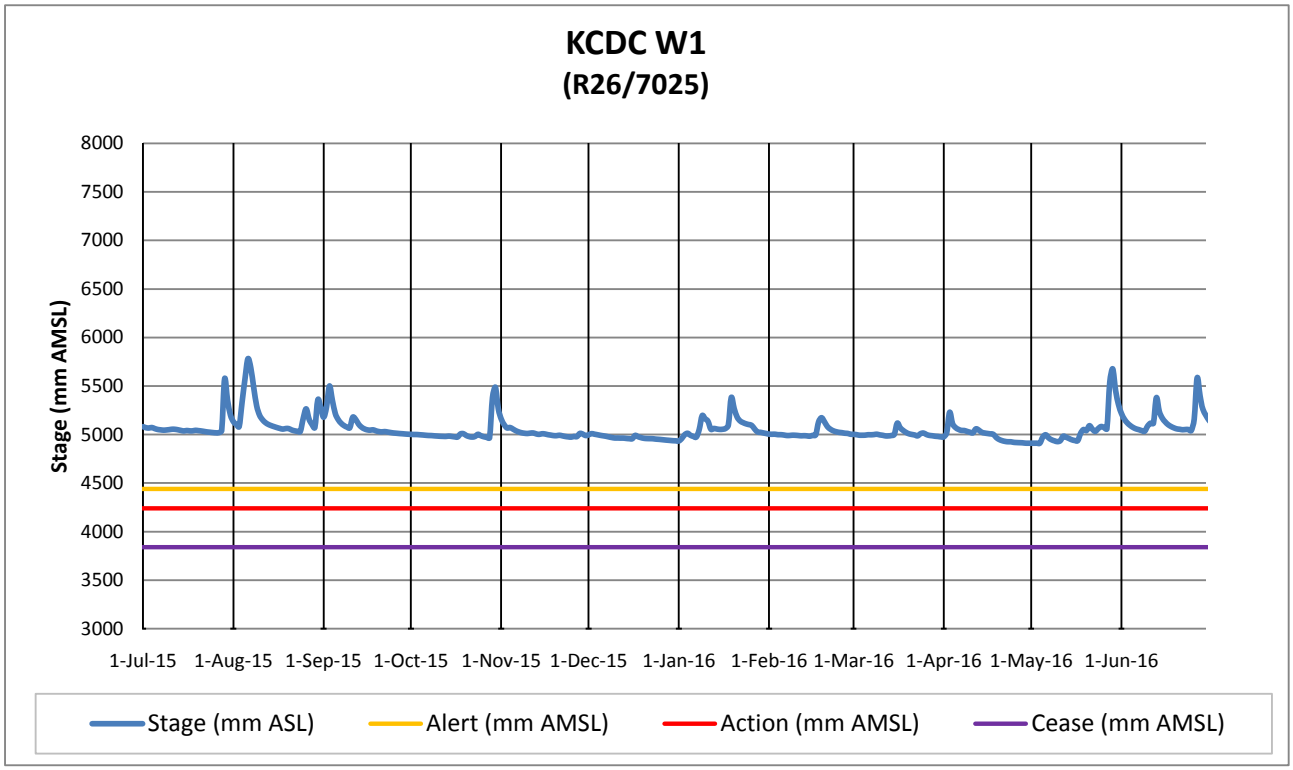

Figure C1.3: Water Levels at KCDC W1 Monitoring Bore (R26/7025)

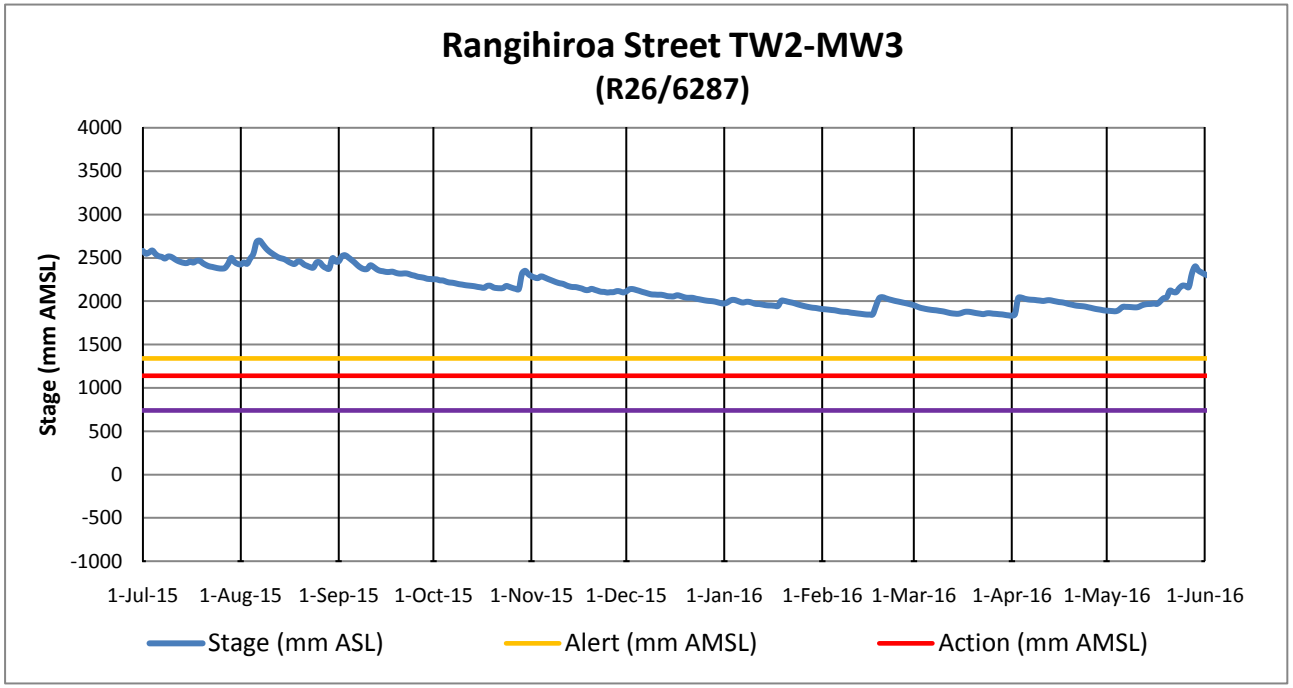

Figure C1.4: Water Levels at Rangihiroa St Monitoring Bore (R26/6287)

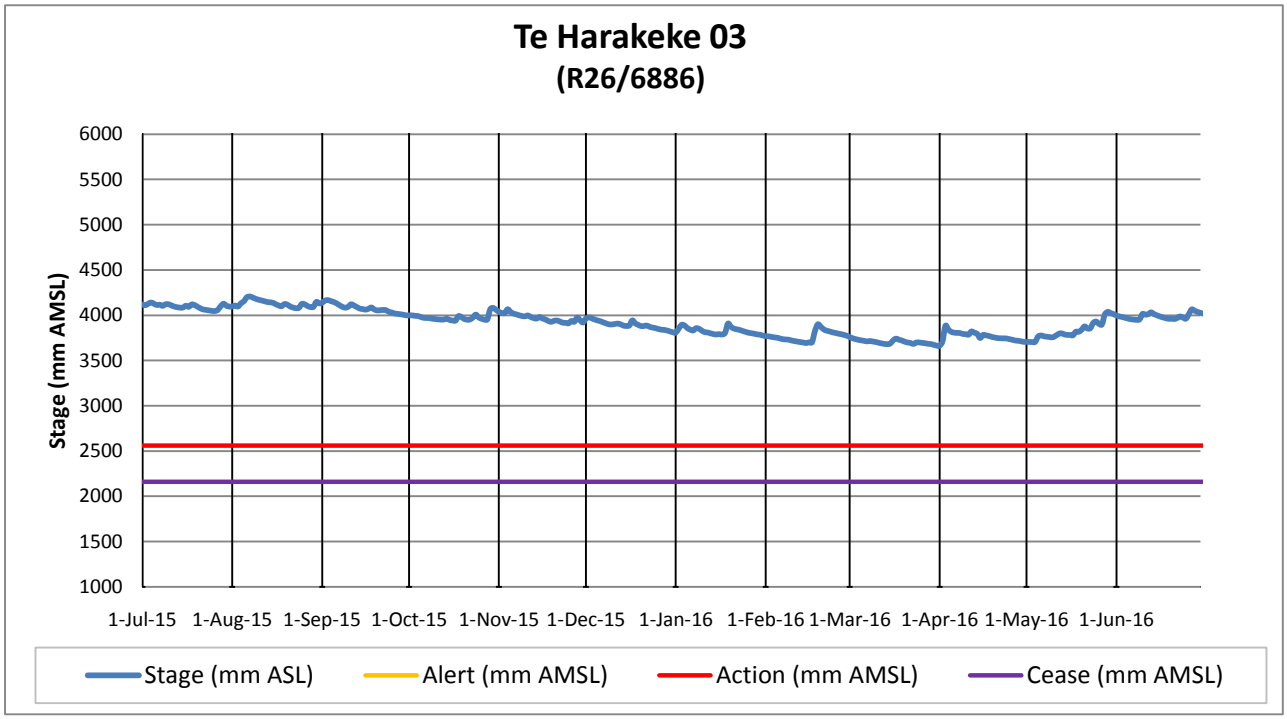

Figure C1.5: Water Levels at Te Harakeke 3 Monitoring Bore (R26/6286)

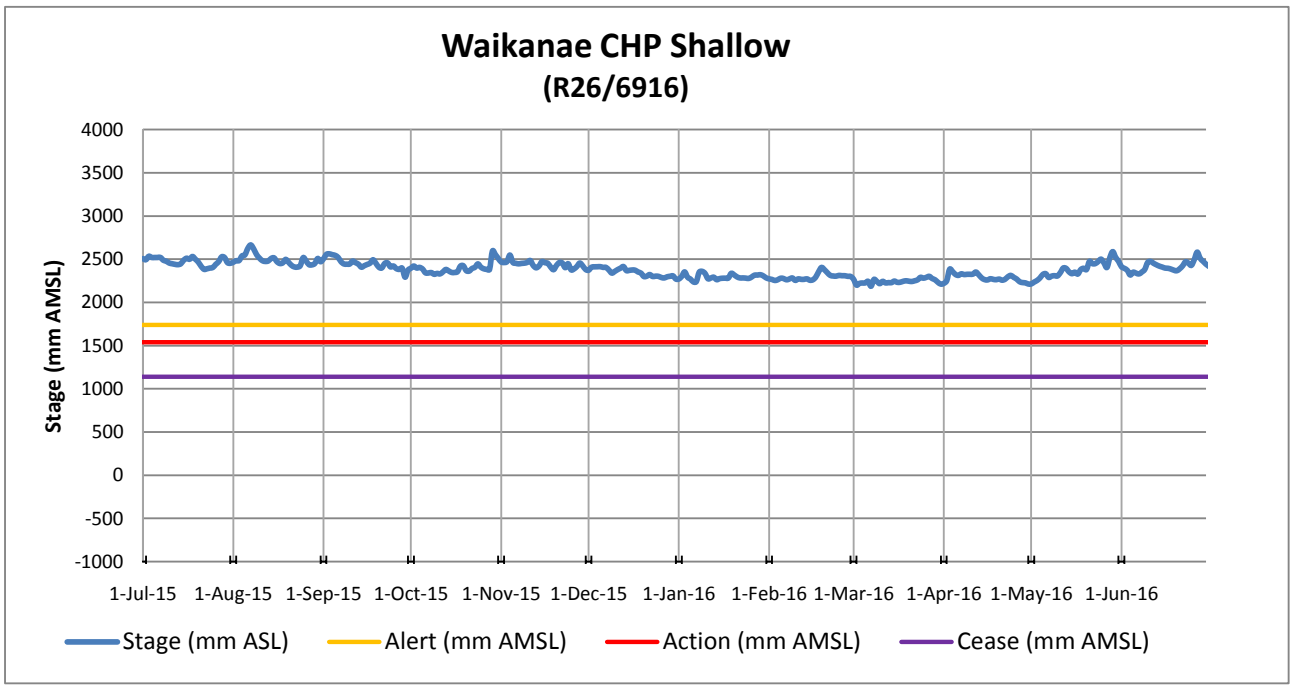

Figure C1.6: Water Levels at Waikanae CHP Shallow Monitoring Bore (R26/6916).

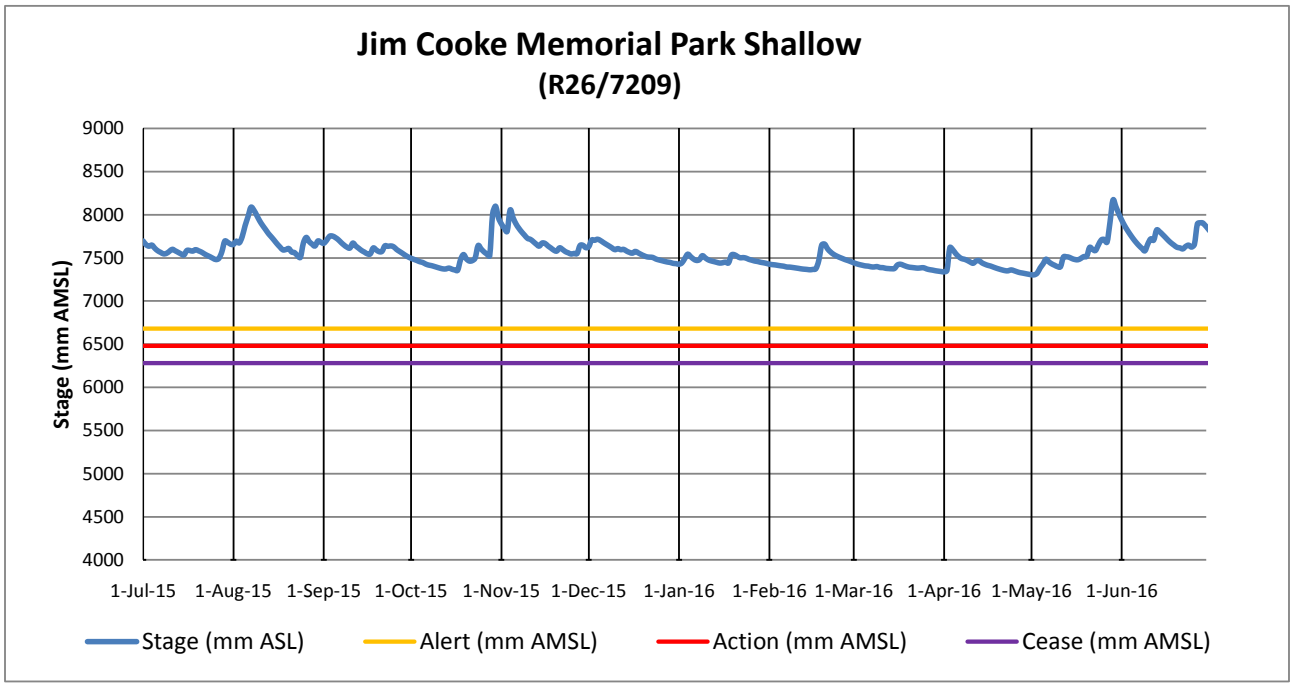

Figure C1.7: Water Levels at Jim Cooke Memorial Park Shallow Monitoring Bore (Bore ID tba)

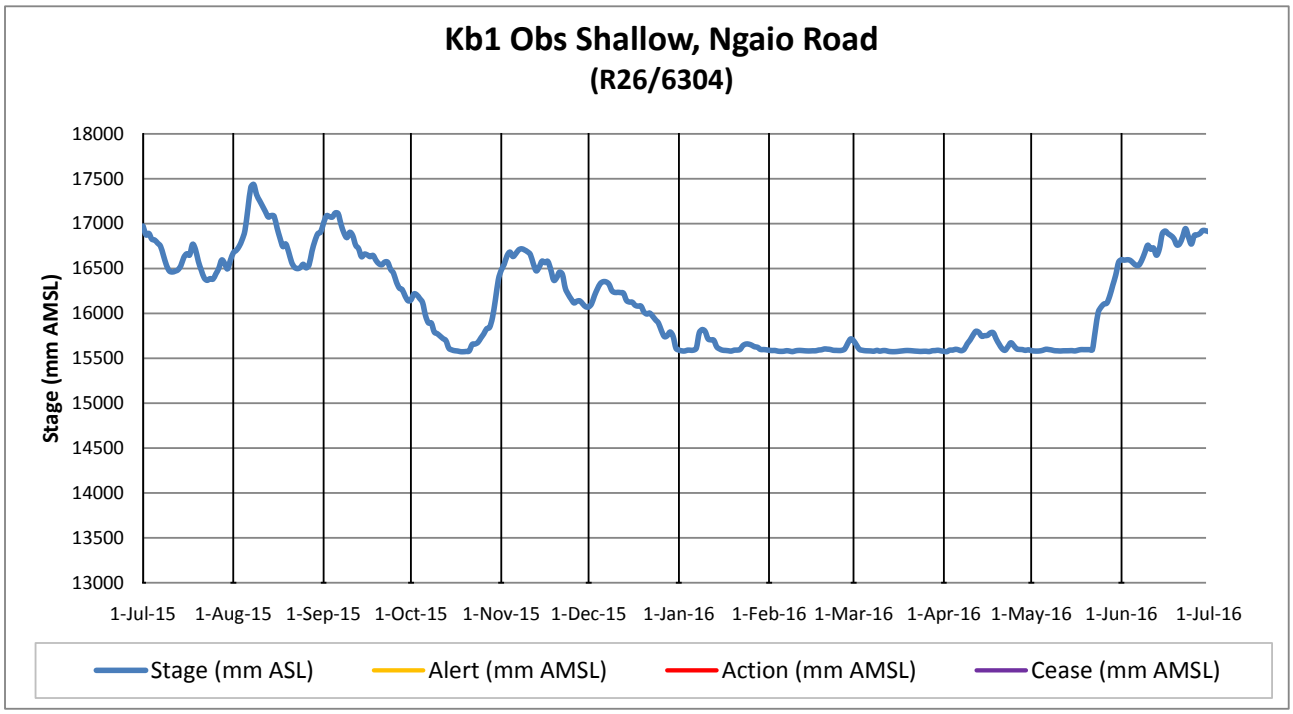

Figure C1.8: Water Levels at Kb1 Obs Shallow, Ngaio Road Monitoring Bore (R26/6304). Trigger levels have not been set due to water level naturally falling below well bottom (15573mmAMSL). Council has agreed to maintain collection of water level data for next monitoring season.

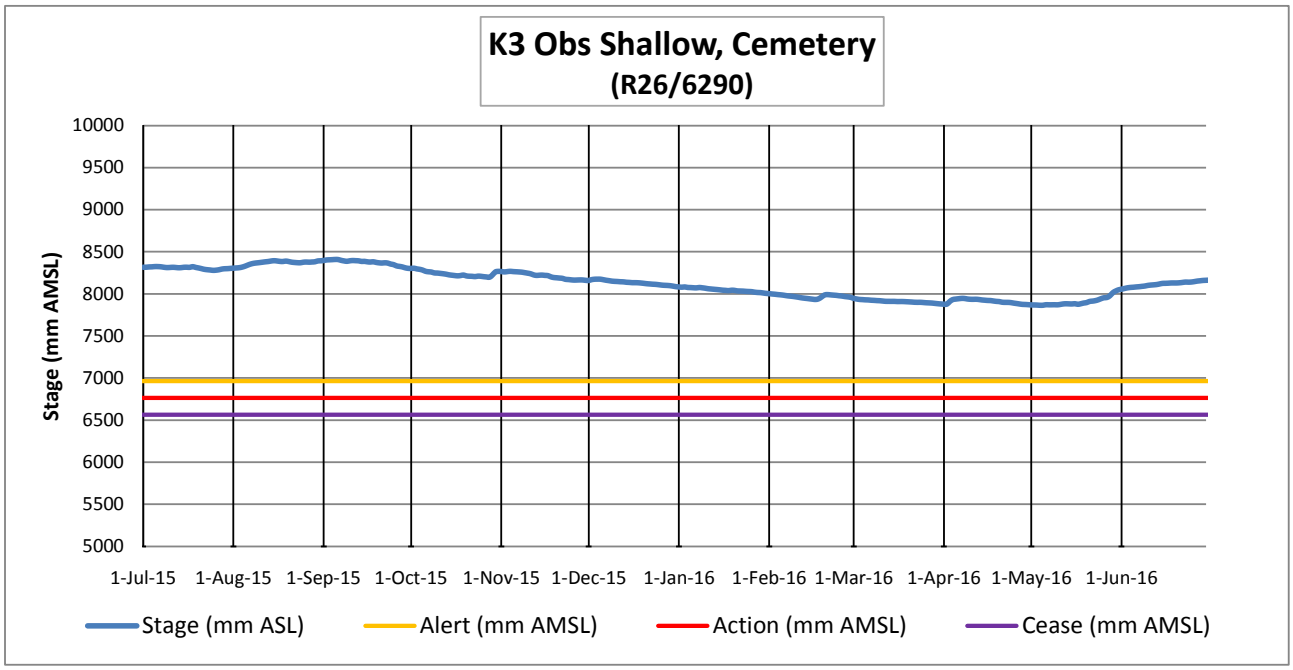

Figure C1.9: Water Levels at K3 Obs Shallow, Cemetery Monitoring Bore (R26/6290).

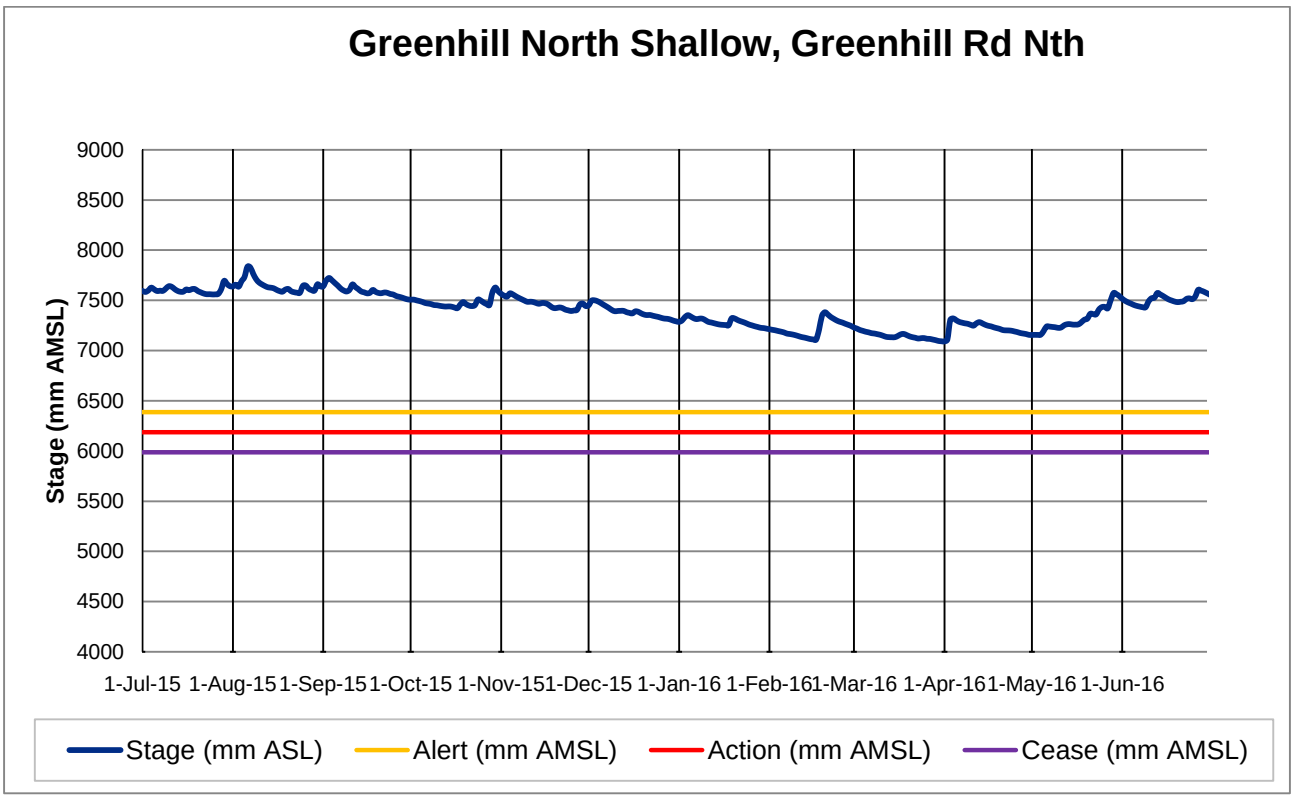

Figure C1.10: Water Levels at Greenhill North Shallow, Greenhill Rd North Monitoring Bore (Bore ID tba).

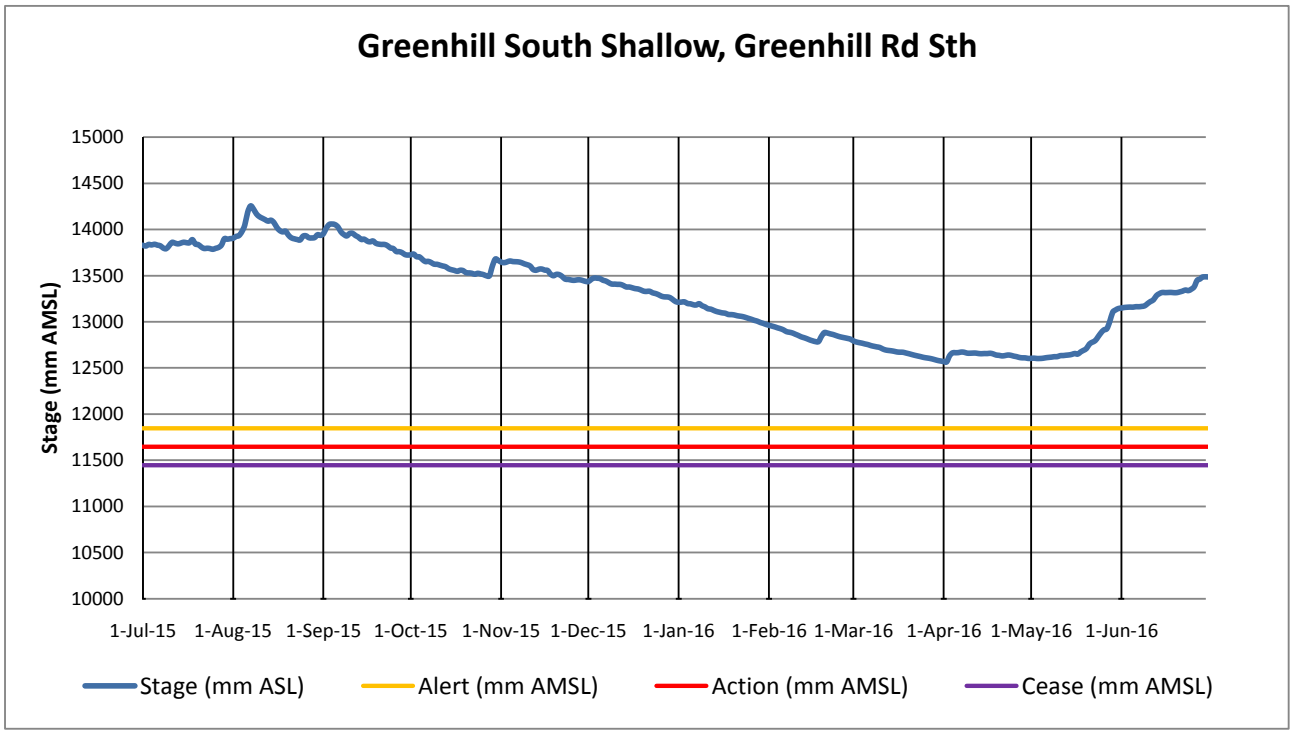

Figure C1.11: Water Levels at Greenhill South Shallow, Greenhill Rd South Monitoring Bore (Bore ID tba).

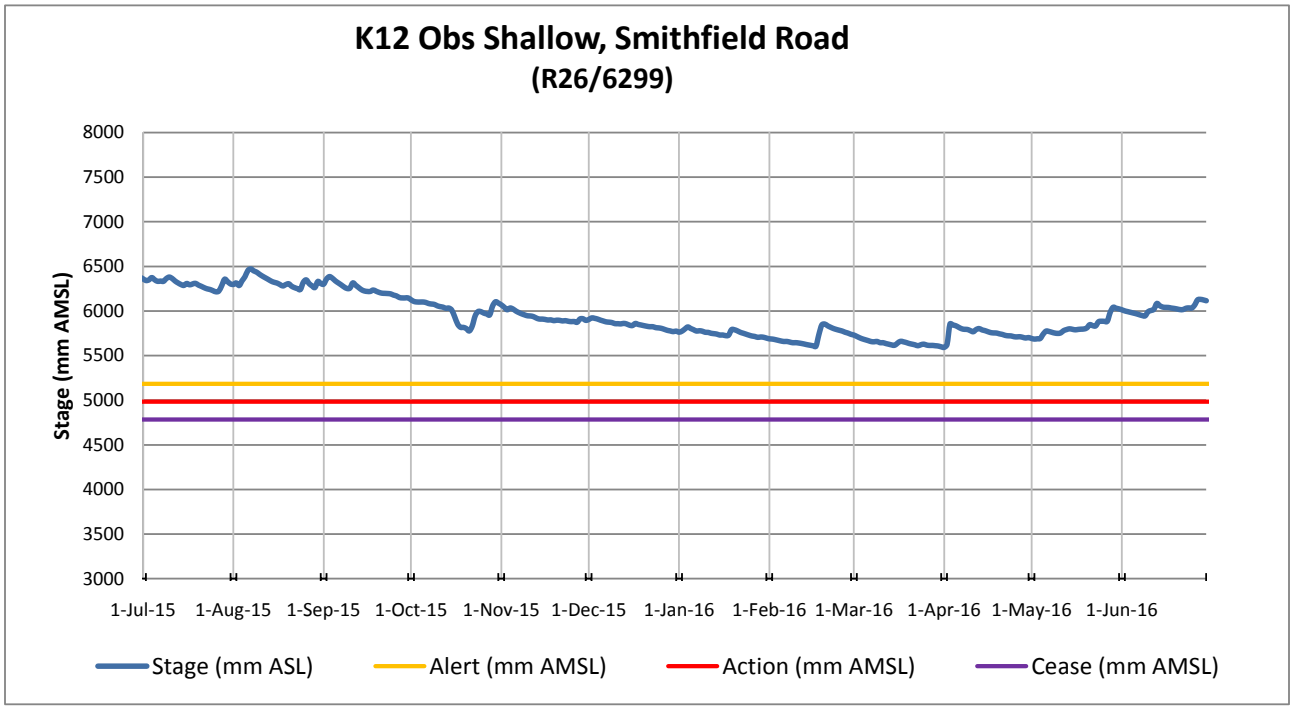

Figure C1.12: Water Levels at K12 Obs Shallow Smithfield Road (R26/6300)

C.2 Deep Aquifer Water Level Monitoring

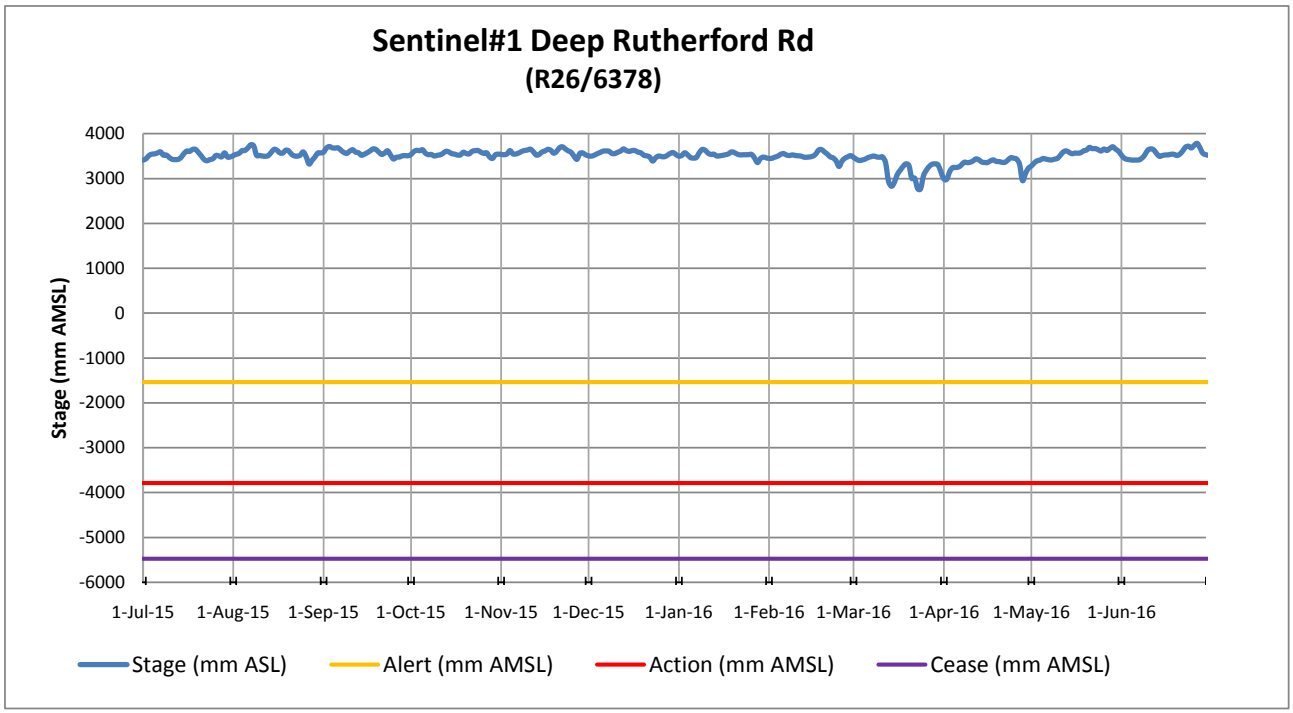

Figure C2.1: Water Levels in Sentinel #1 Deep Monitoring Bore at Rutherford Drive (R26/6378)

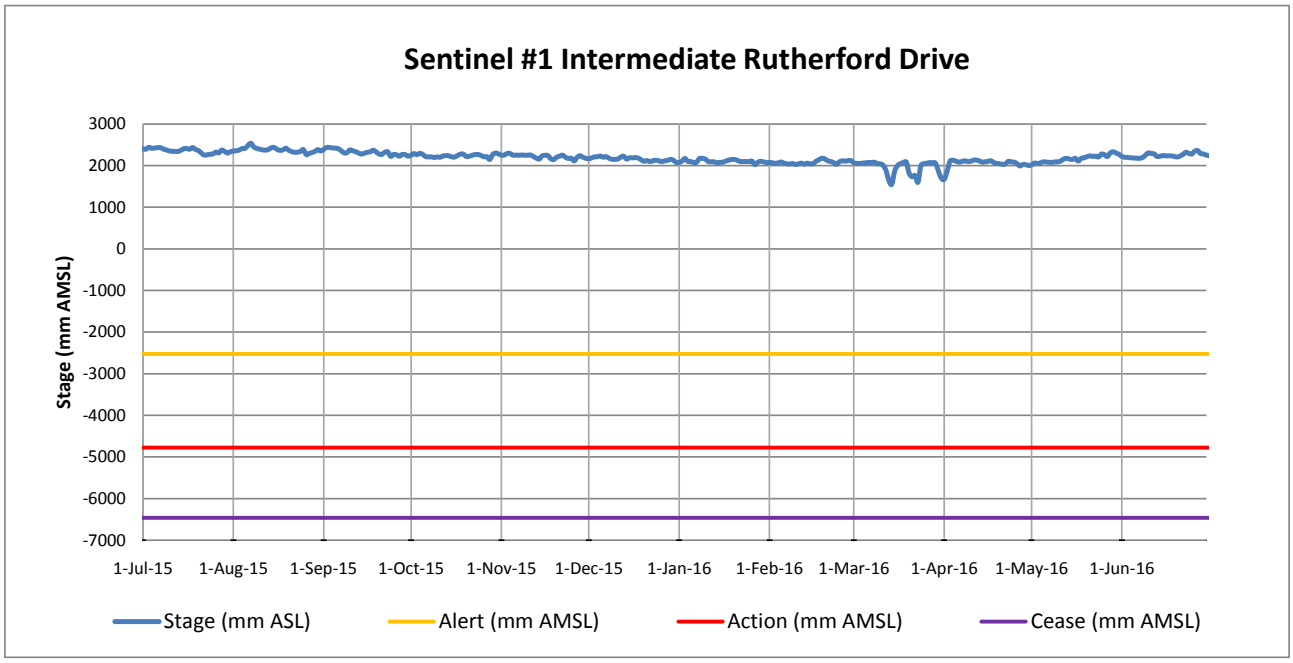

Figure C2.2: Water Levels in Sentinel #1 Intermediate Monitoring Bore at Rutherford Drive (Bore ID tba)

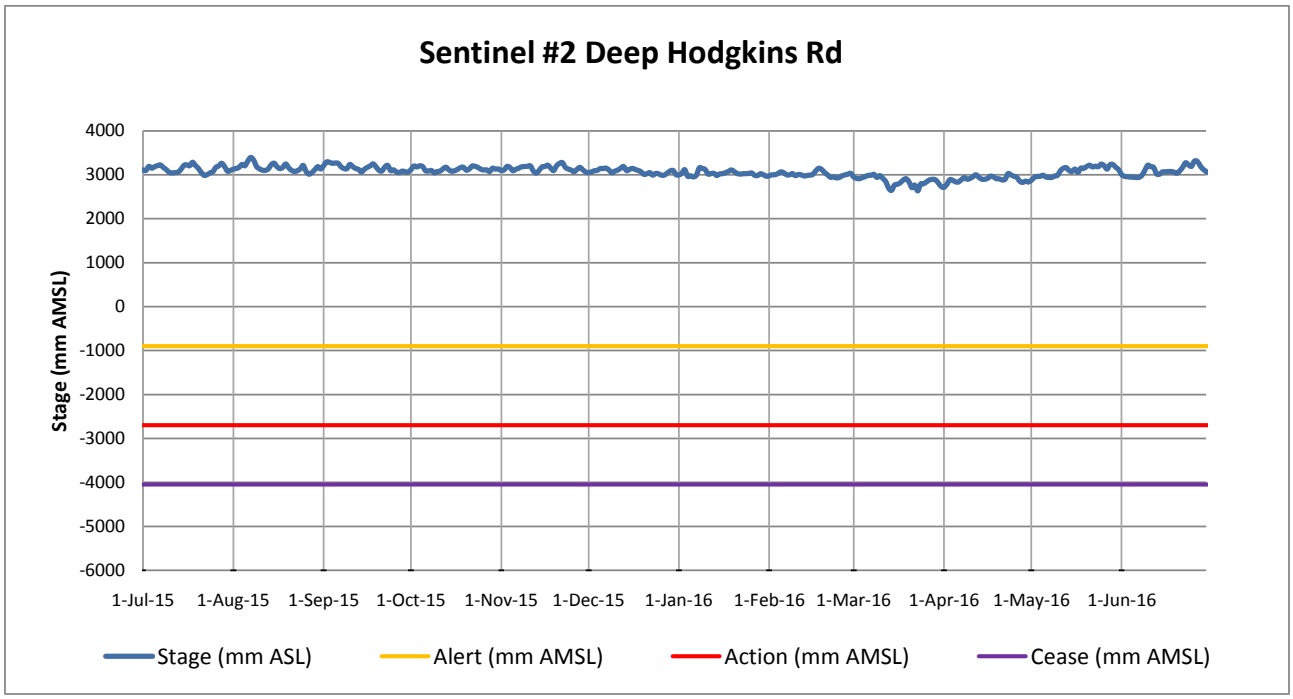

Figure C2.3: Water Levels in Sentinel #2 Deep Monitoring Bore at Hodgkins Rd (Bore ID tba)

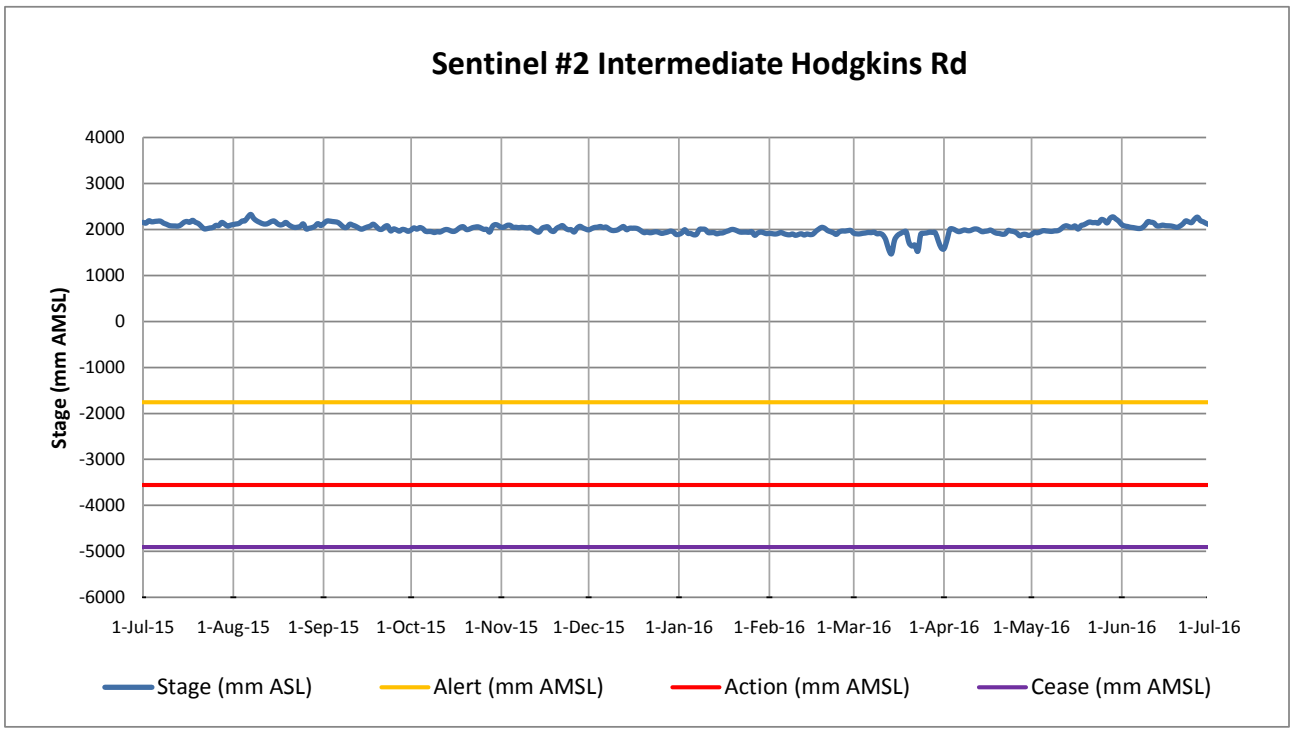

Figure C2.4: Water Levels in Sentinel#2 Intermediate Monitoring Bore at Hodgkins Rd (Bore ID tba)

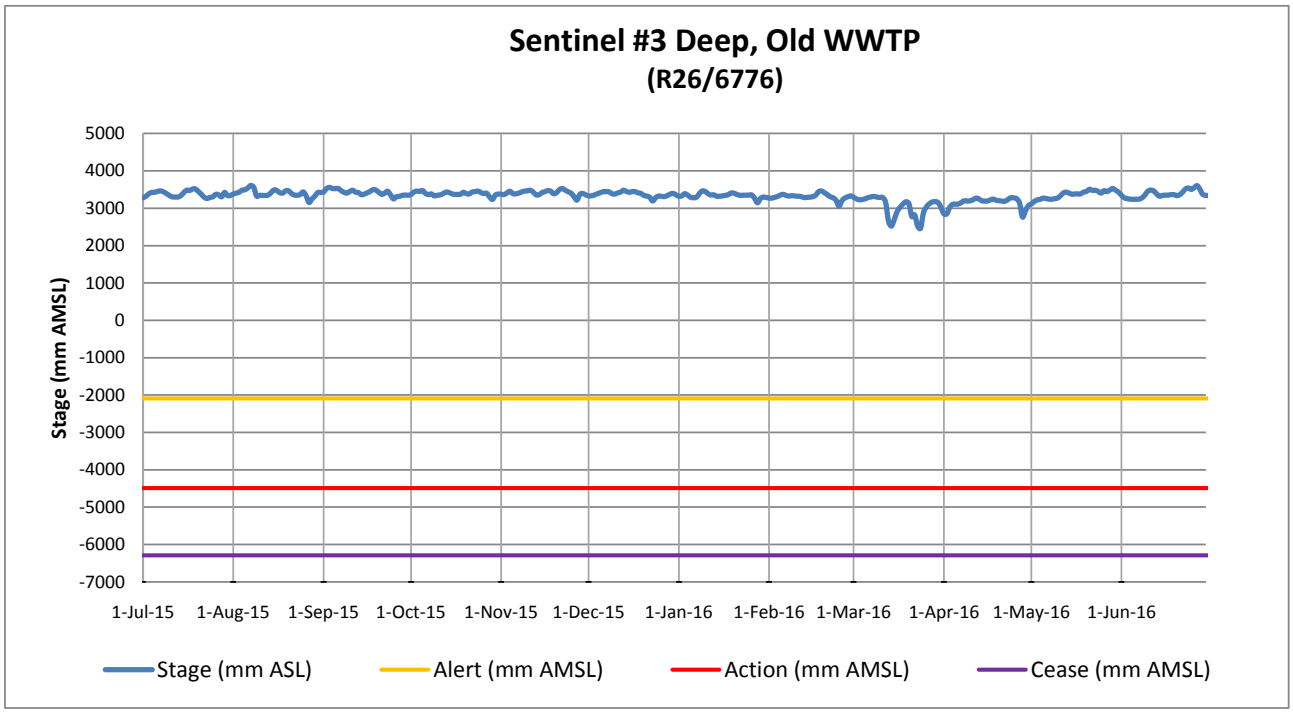

Figure C2.5: Water Levels in Sentinel #3 Deep Monitoring Bore at Old WWTP (R26/6776)

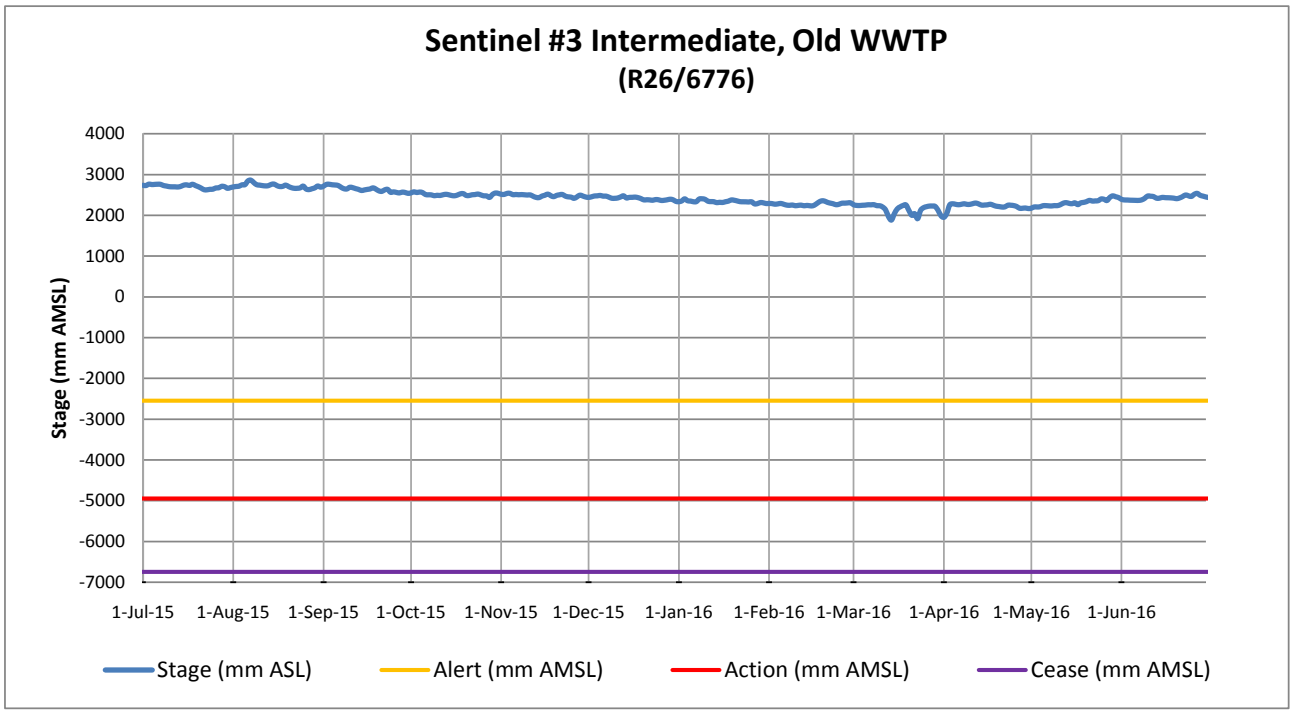

Figure C2.6: Water Levels in Sentinel #3 Intermediate Monitoring Bore at Old WWTP (Bore ID tba)

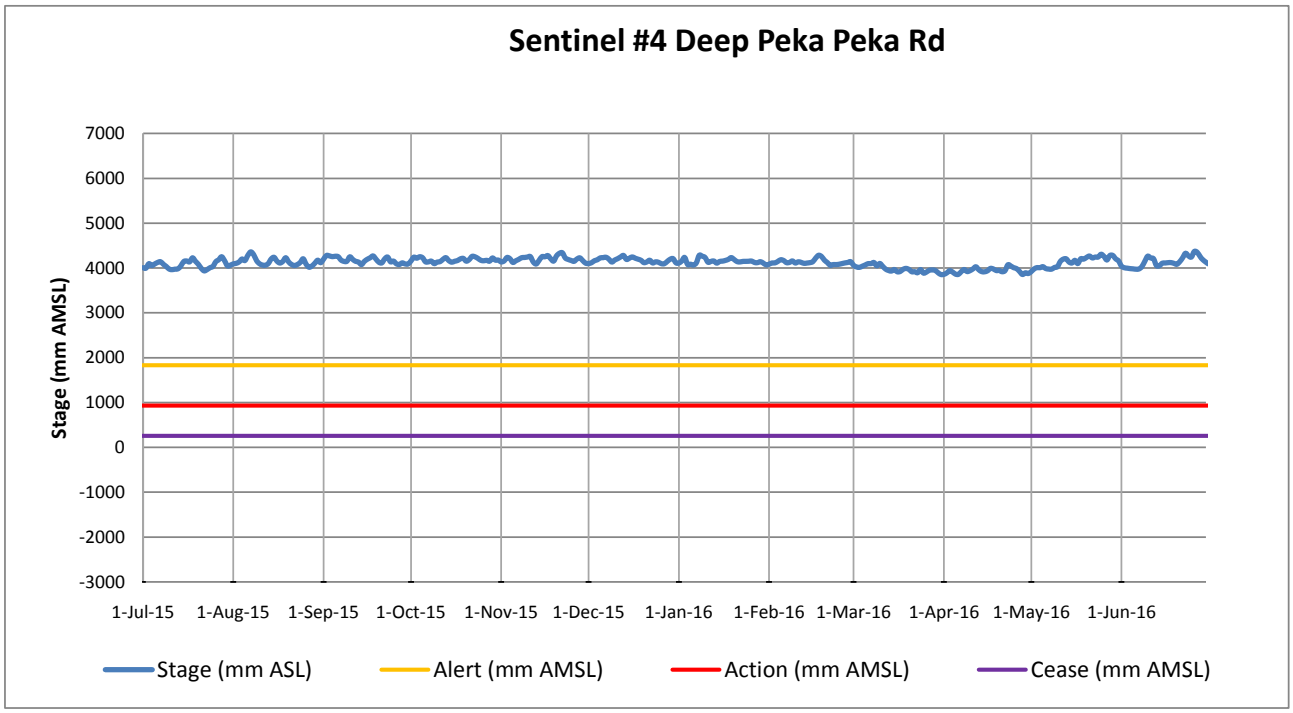

Figure C2.6: Water Levels in Sentinel #4 Deep Monitoring Bore at Peka Peka Rd (Bore ID tba)

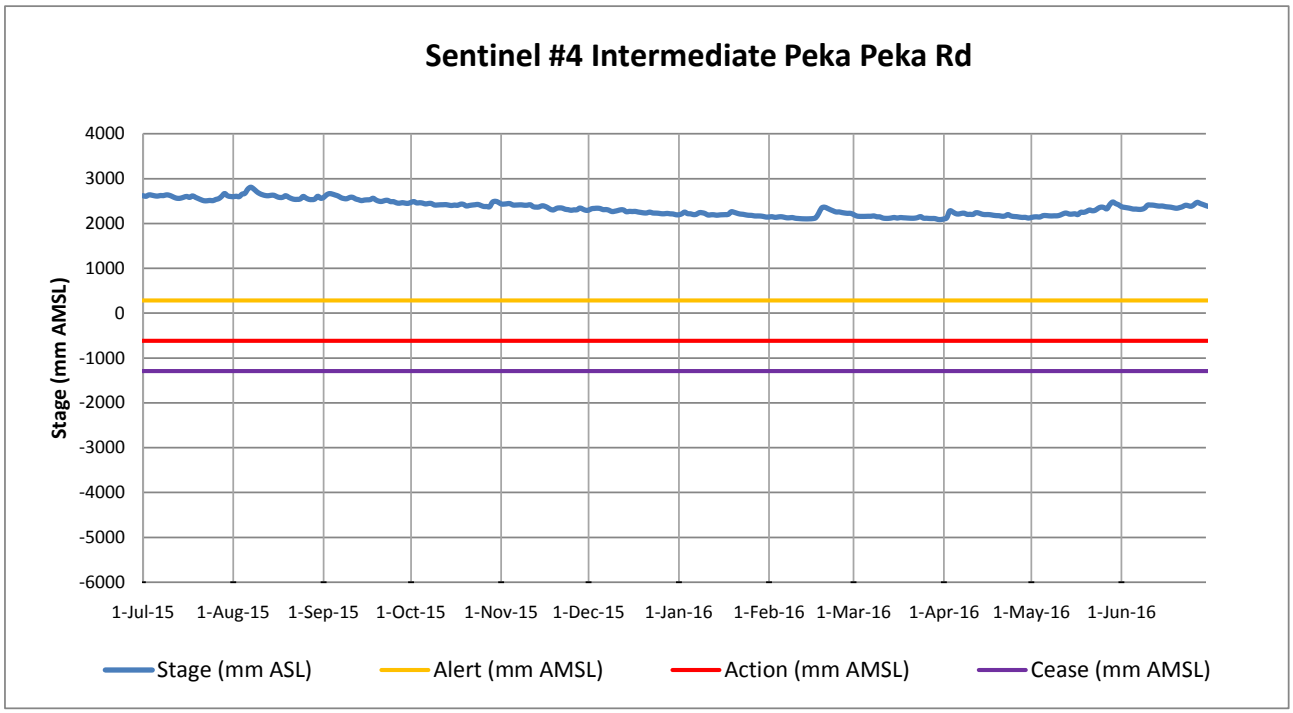

Figure C2.6: Water Levels in Sentinel #4 Intermediate Monitoring Bore at Peka Peka Rd (Bore ID tba)

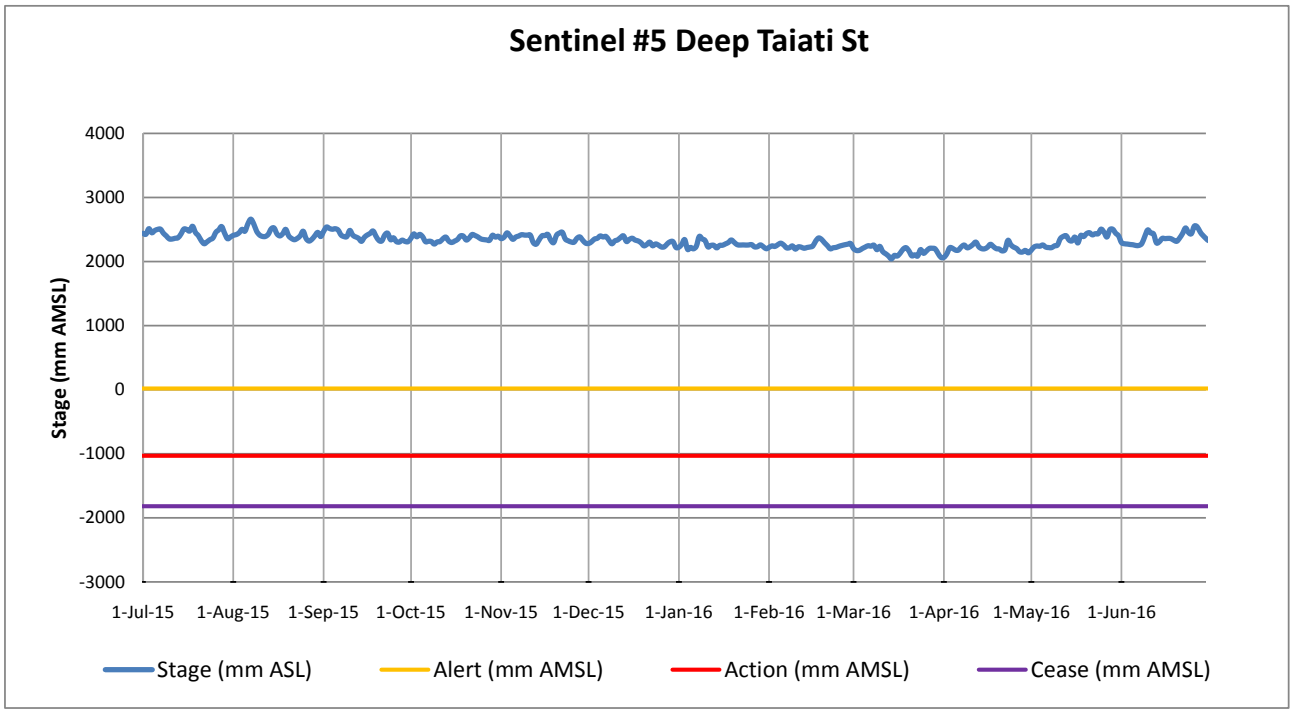

Figure C2.7: Water Levels in Sentinel #5 Deep at Taiata St (Bore ID tba)

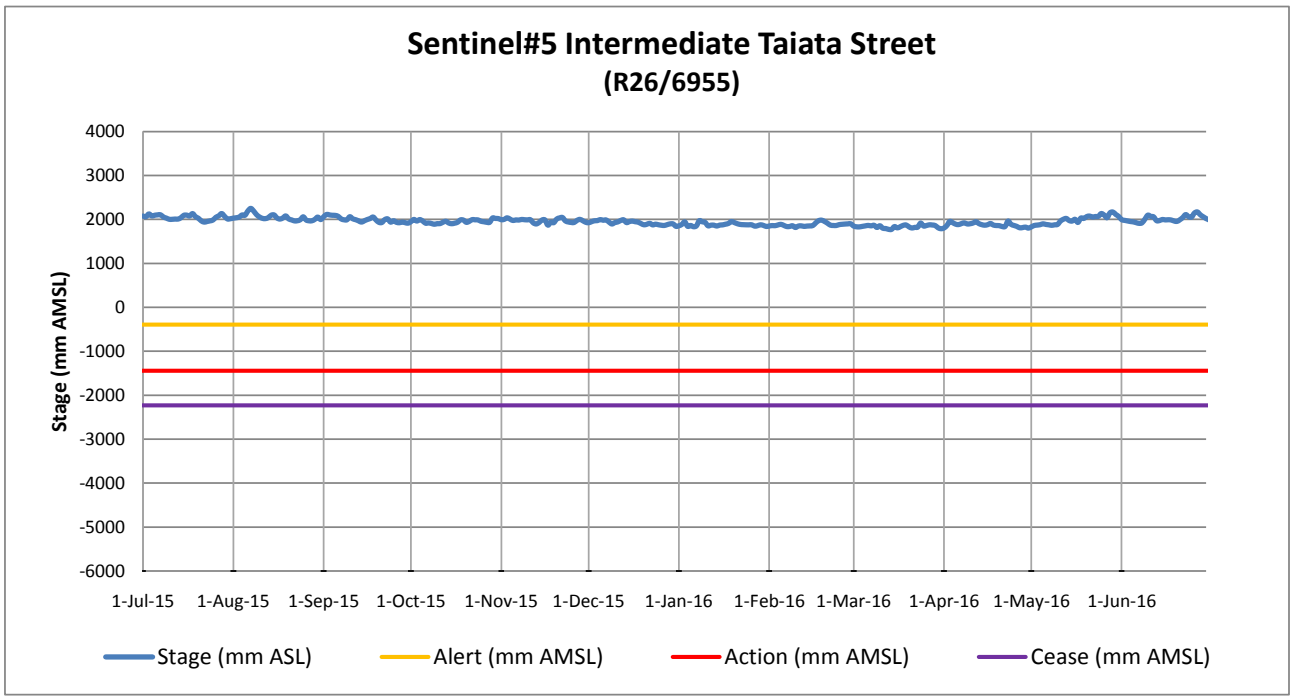

Figure C2.8: Water Levels in Sentinel #5 Intermediate at Taiata St (R26/6955).

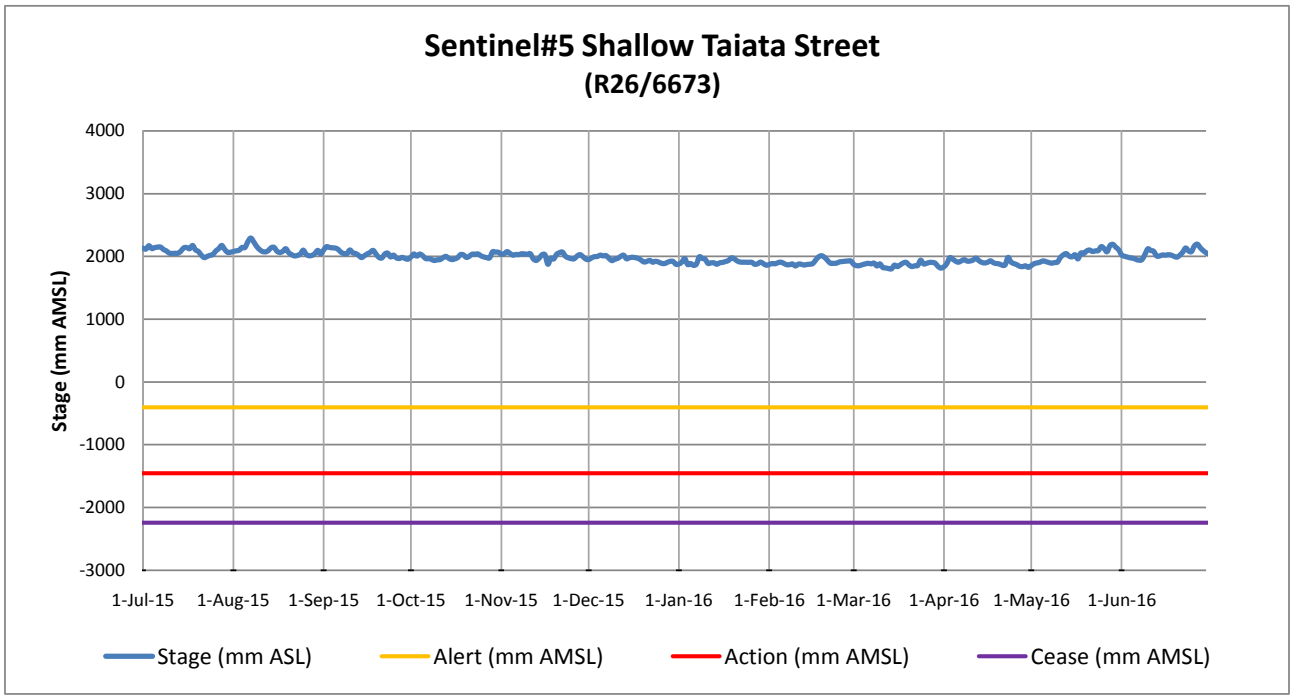

Figure C2.9: Water Levels in Sentinel #5 Shallow at Taiata St (R26/6673).

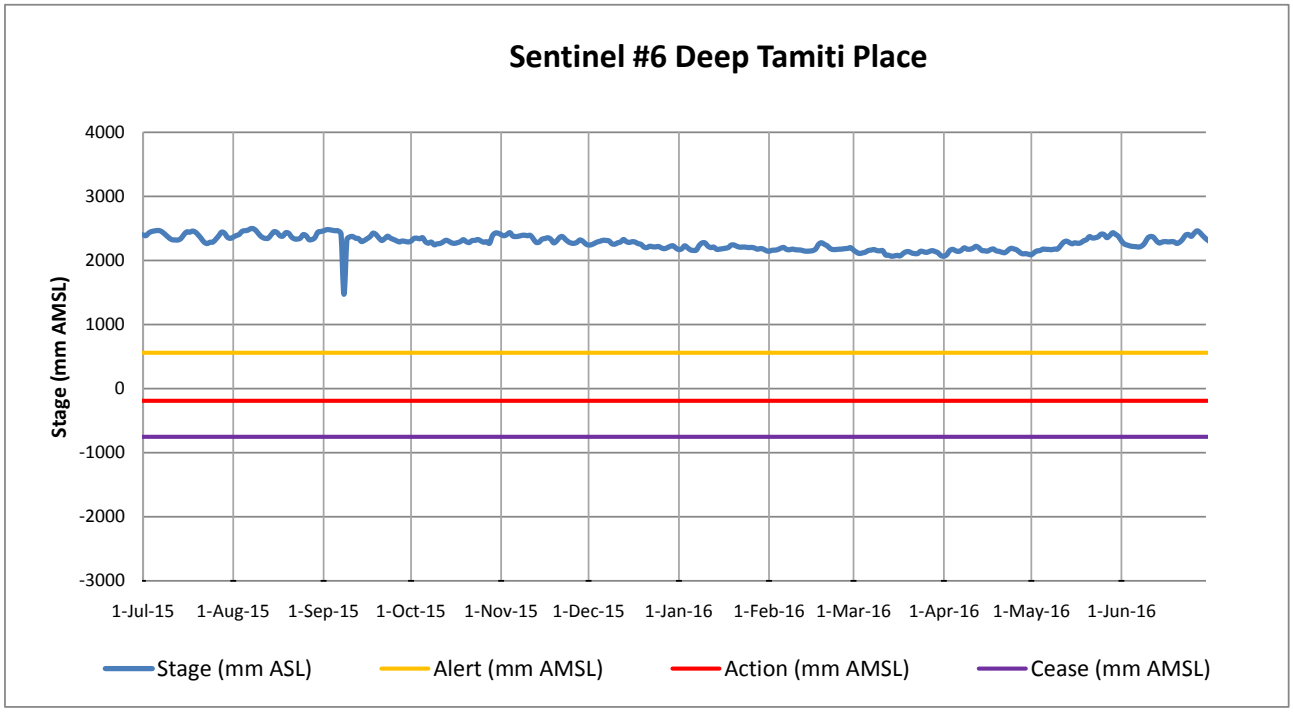

Figure C2.10: Water Levels in Sentinel #6 Deep at Tamati Place (Bore ID tba).

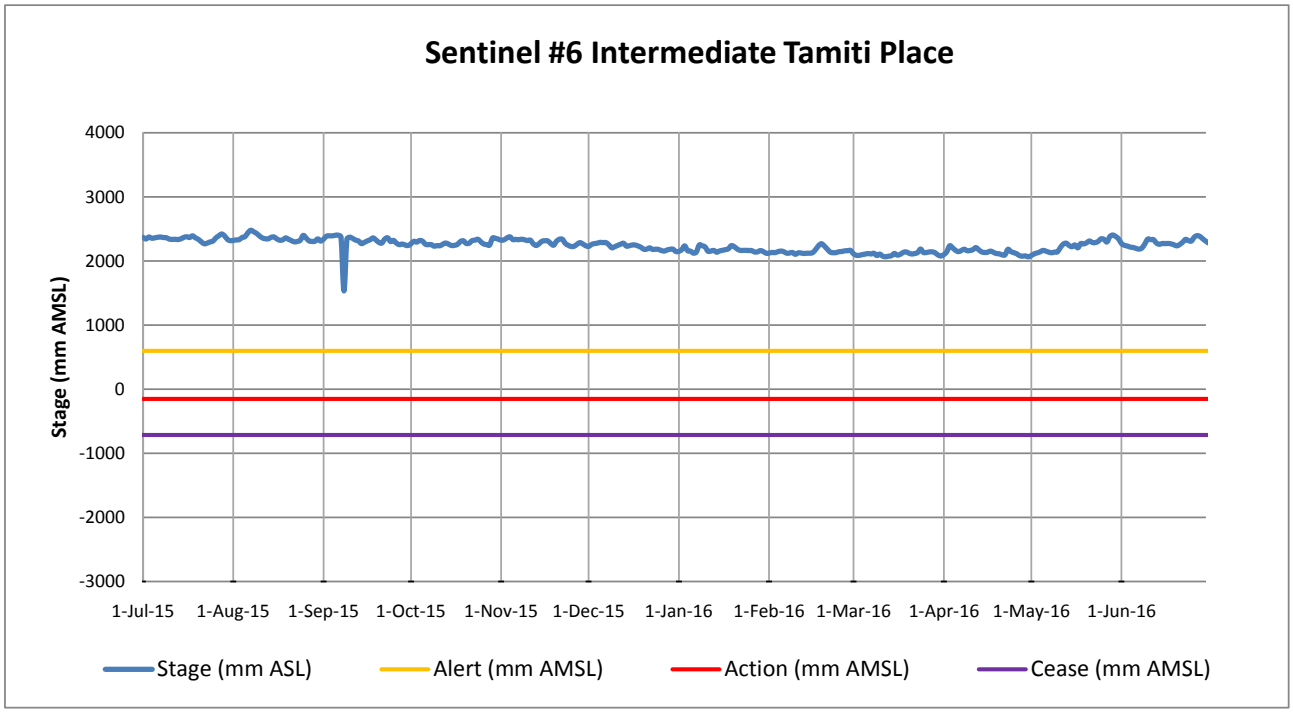

Figure C2.11: Water Levels in Sentinel #6 Intermediate at Tamati Place (Bore ID tba).

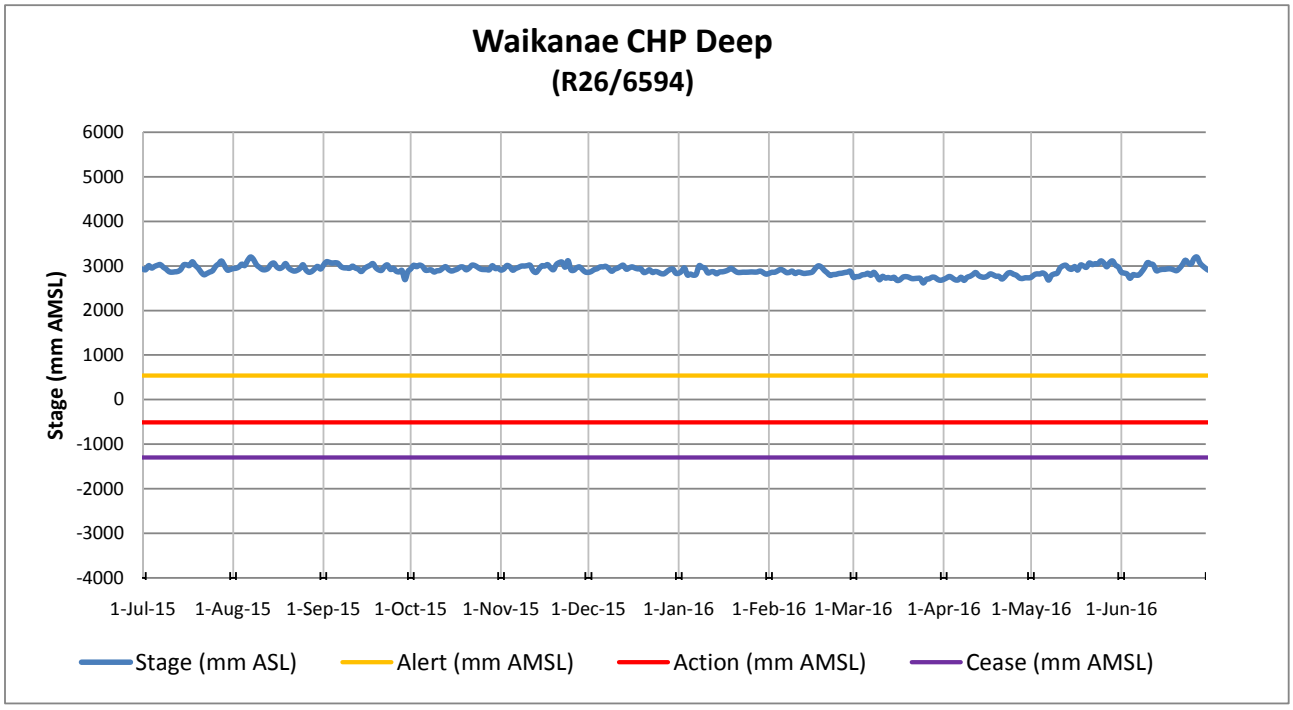

Figure C14: Water Levels in Waikanae CHP Deep Monitoring Bore (R26/6594).

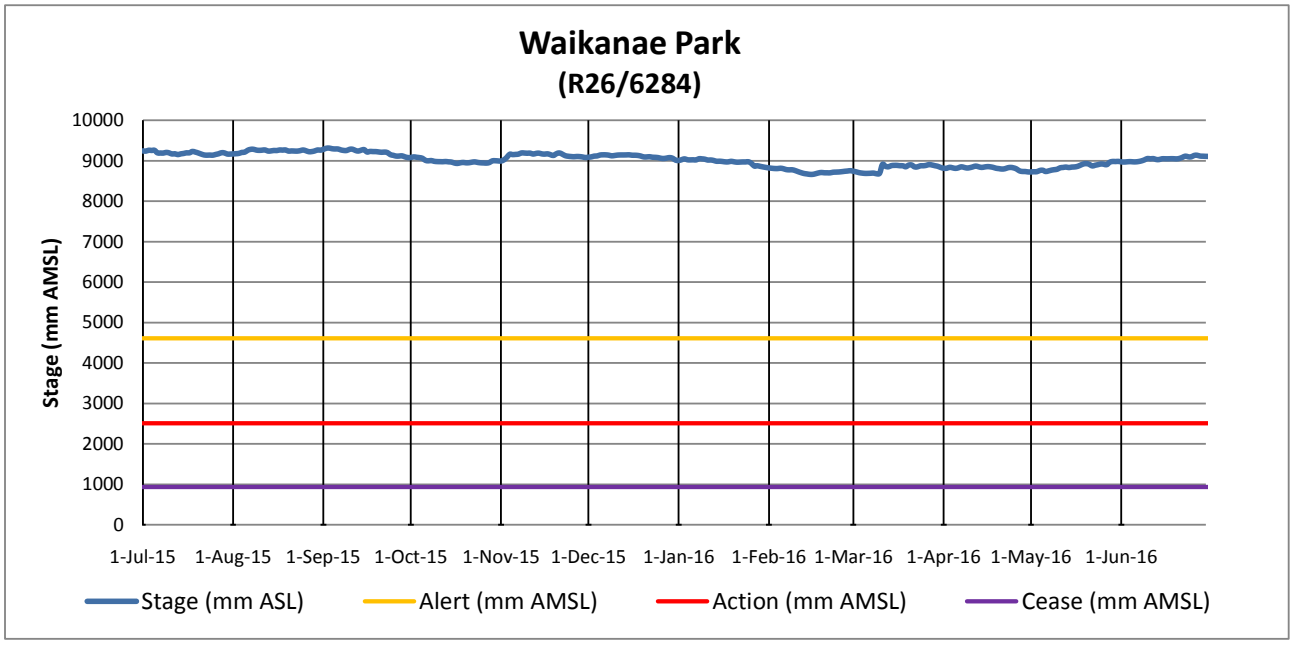

Figure C15: Water Levels in Waikanae Park Monitoring Bore (R26/6284).

C.3 Electrical Conductivity Monitoring

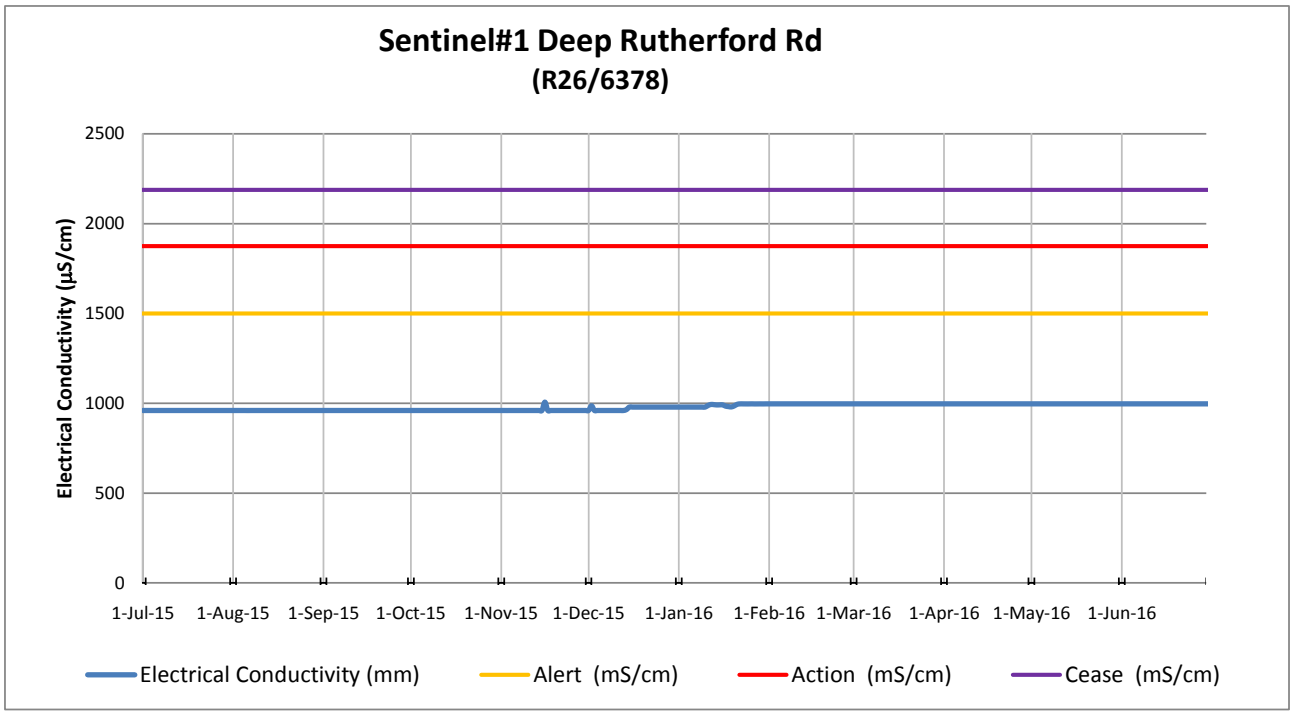

Figure C3.1: Electrical Conductivity in Sentinel #1 Deep Rutherford Drive Monitoring Bore (R26/6378).

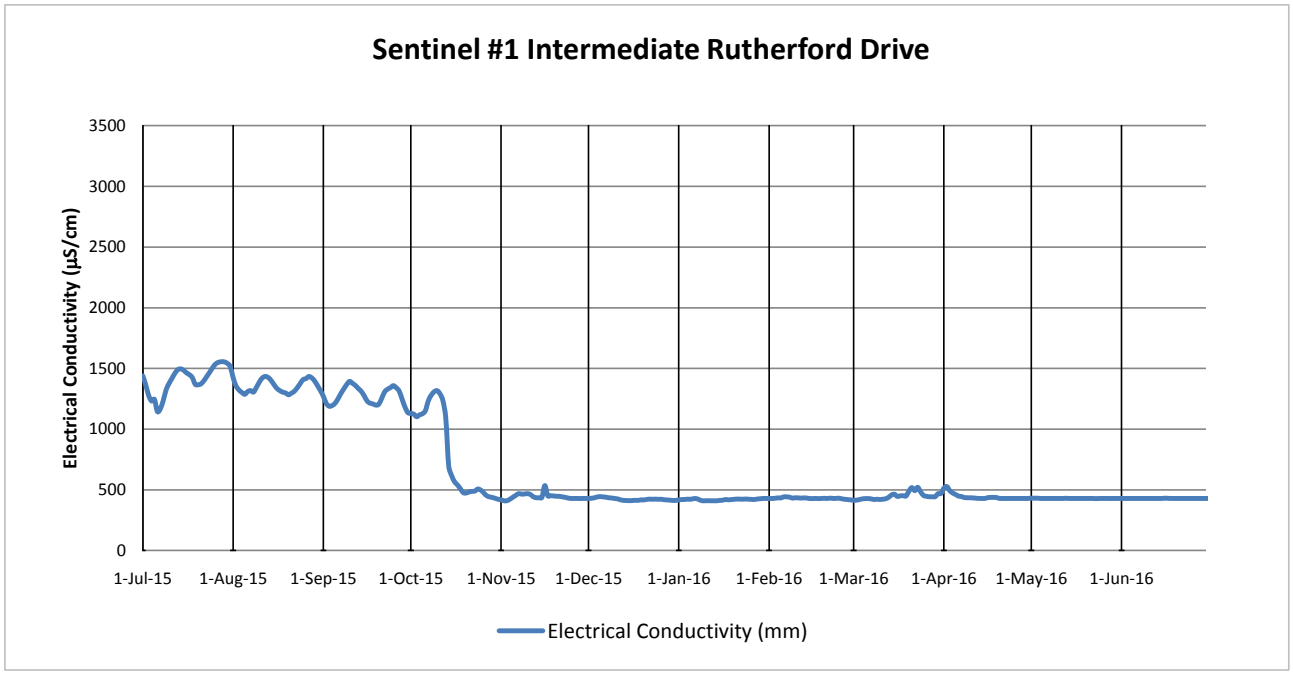

Figure C3.2: Electrical Conductivity in Sentinel #1 Intermediate Rutherford Drive Monitoring Bore (Bore ID tba). recommended to have one more year of background data prior to setting interim triggers.

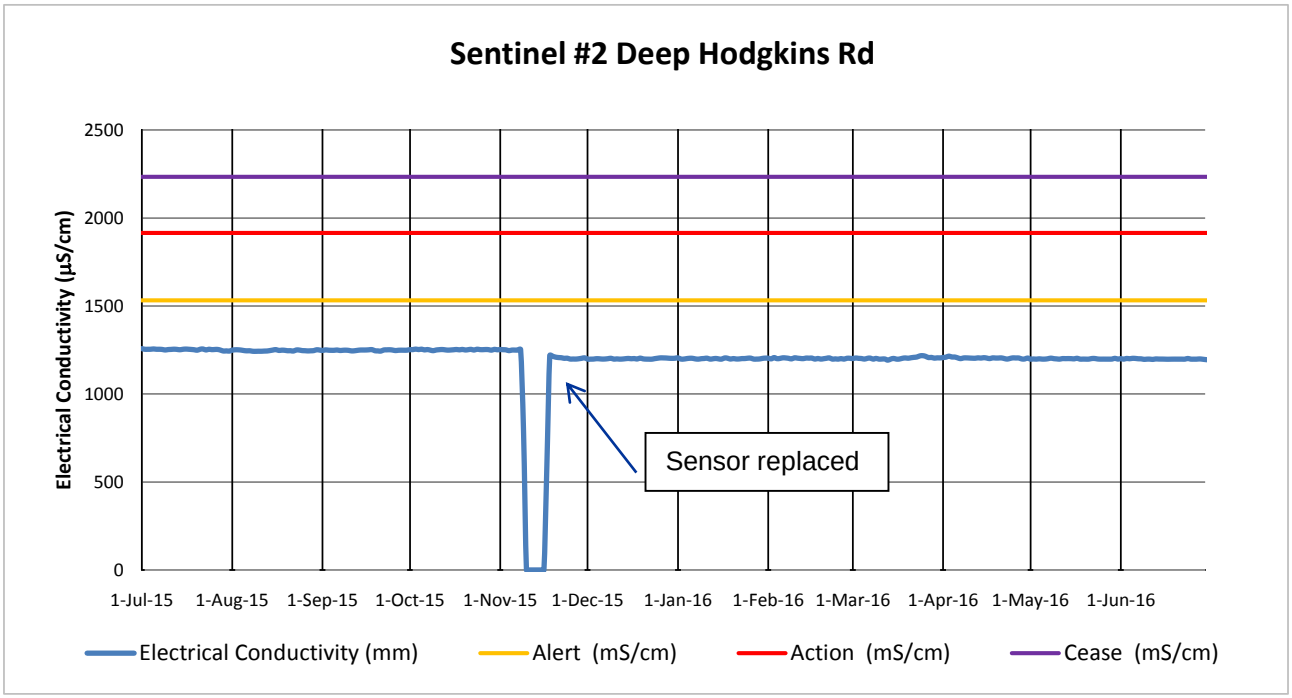

Figure C3.3: Electrical Conductivity in Sentinel #2 Deep Hodgkins Rd Monitoring Bore (Bore ID tba)

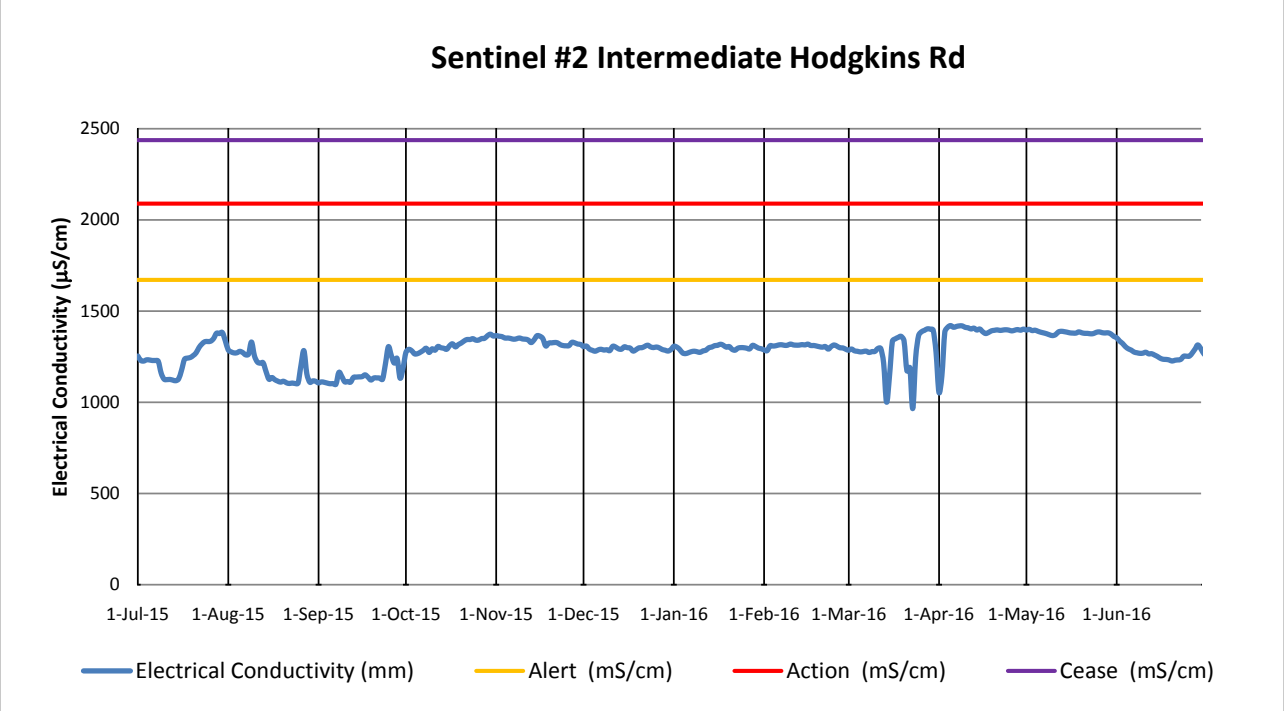

Figure C3.4: Electrical Conductivity in Sentinel #2 Intermediate Hodgkins Rd Monitoring Bore (Bore ID tba)

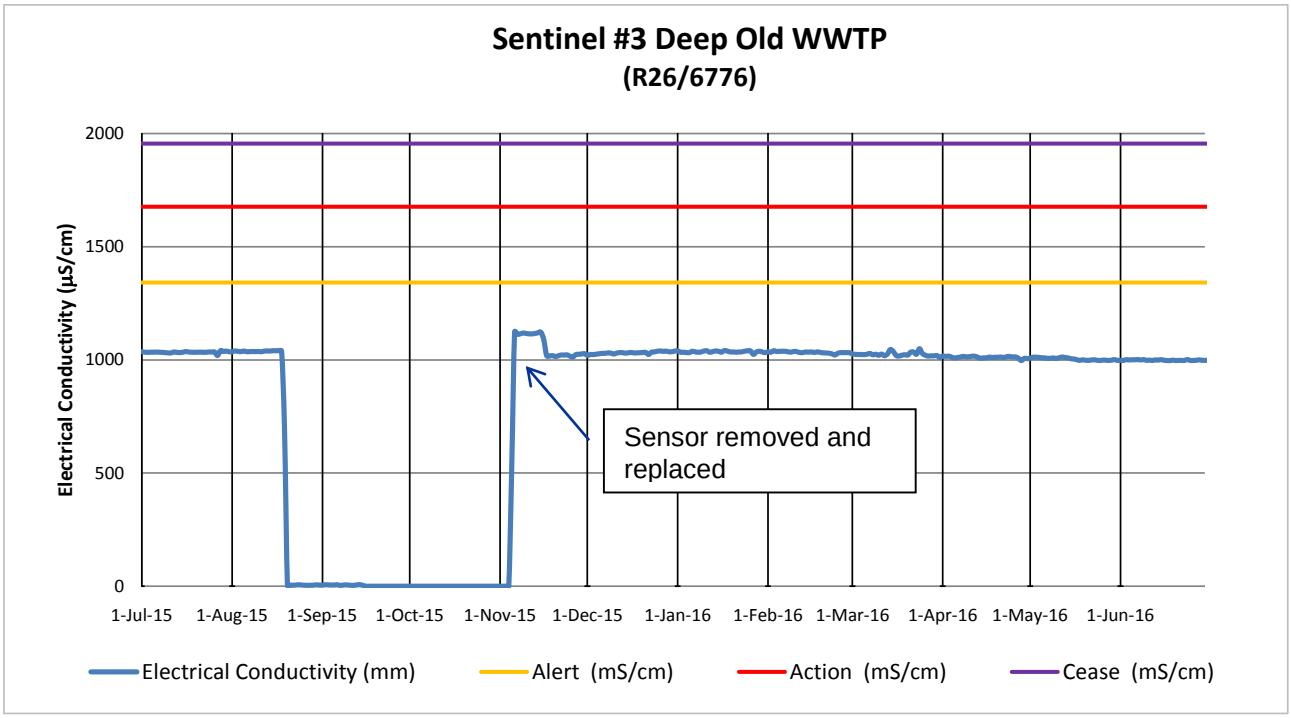

Figure C3.5: Electrical Conductivity in Sentinel #3 Deep Old WWTP Monitoring Bore (R26/6776)

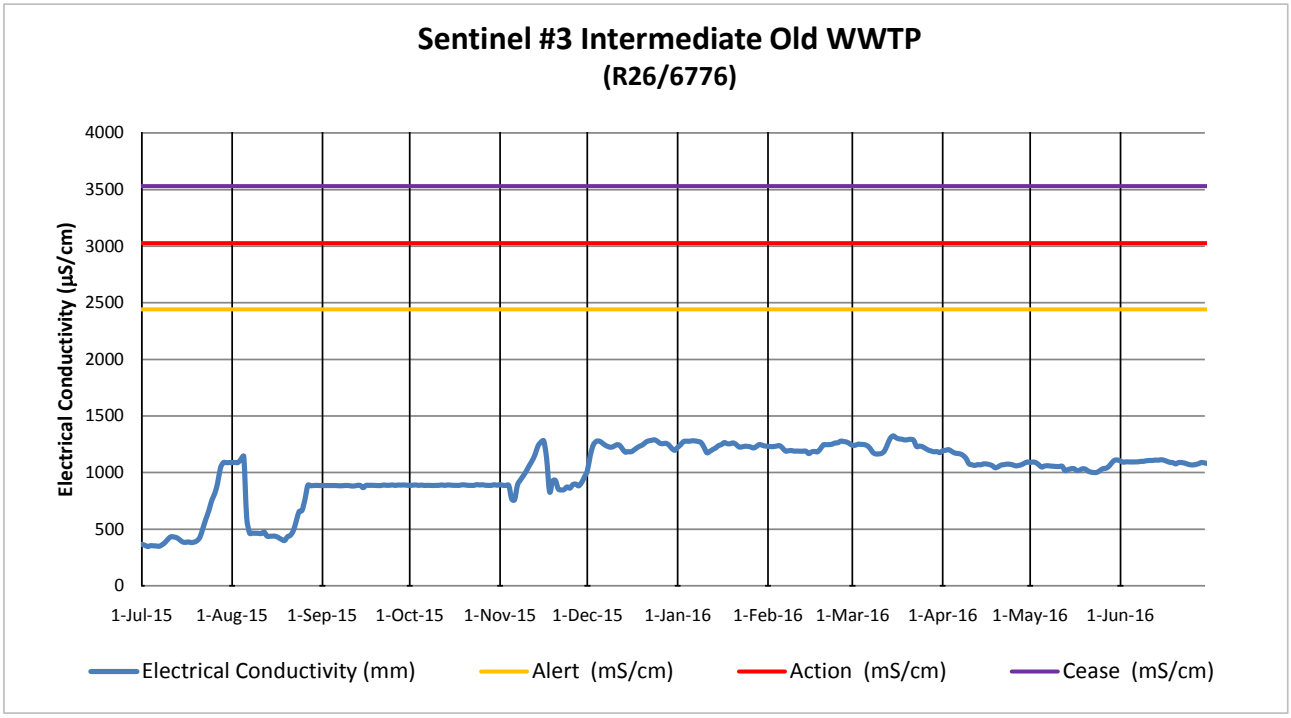

Figure C3.6: Electrical Conductivity in Sentinel #3 Intermediate Old WWTP Monitoring Bore (R26/6776)

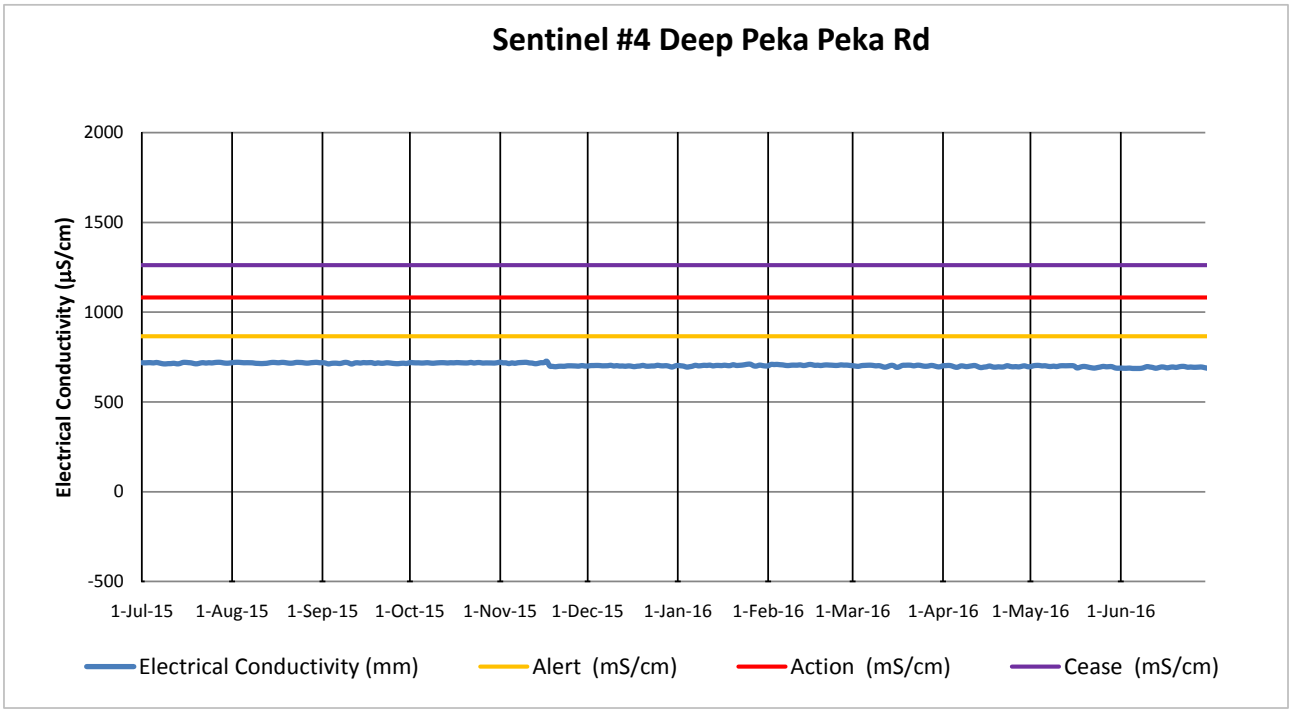

Figure C3.7: Electrical Conductivity in Sentinel #4 Deep Peka Peka Rd Monitoring Bore (Bore ID tba)

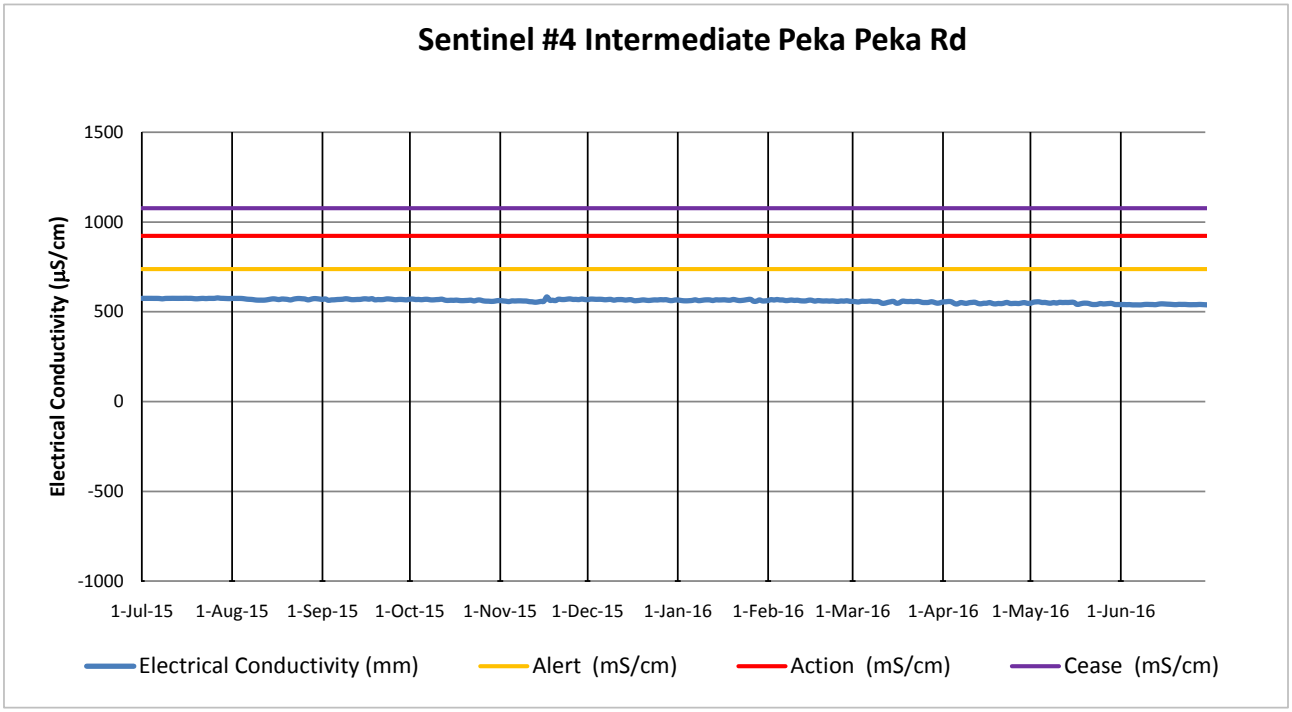

Figure C3.8: Electrical Conductivity in Sentinel #4 Intermediate Peka Peka Rd Monitoring Bore (Bore ID tba)

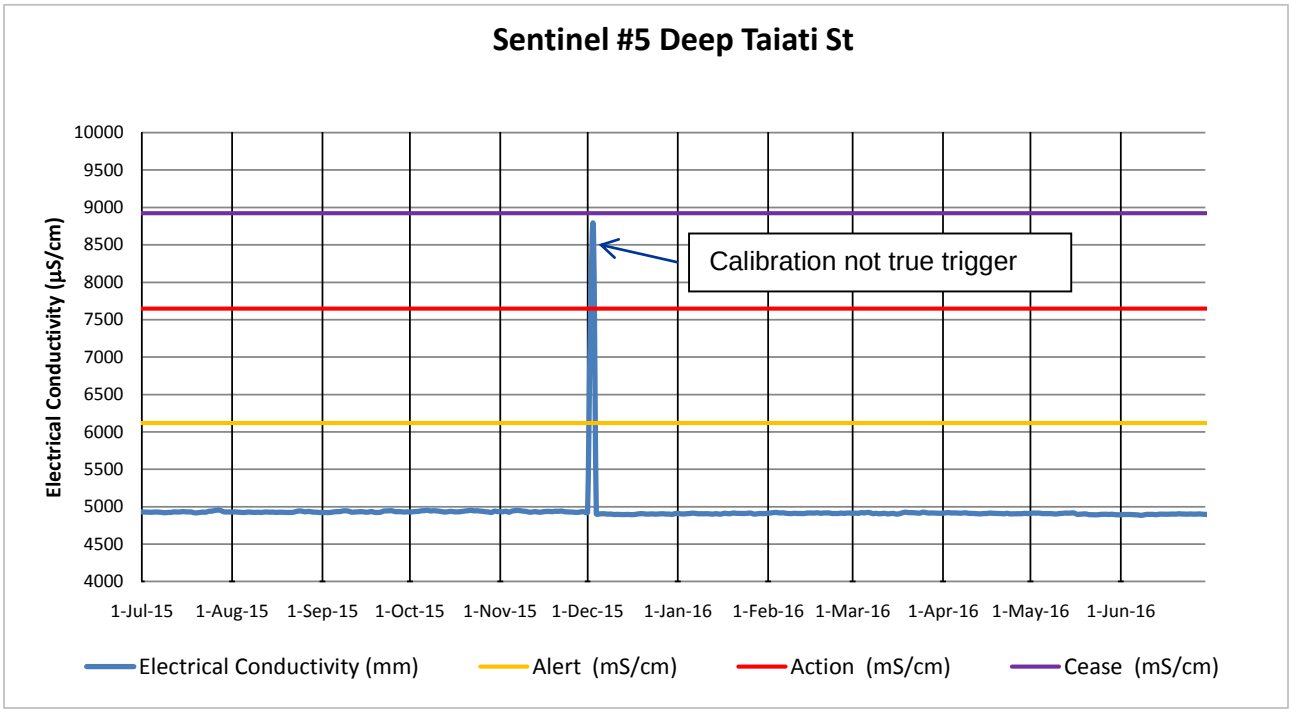

Figure C3.9: Electrical Conductivity in Sentinel #5 Deep Taiata St Monitoring Bore (Bore ID tba)

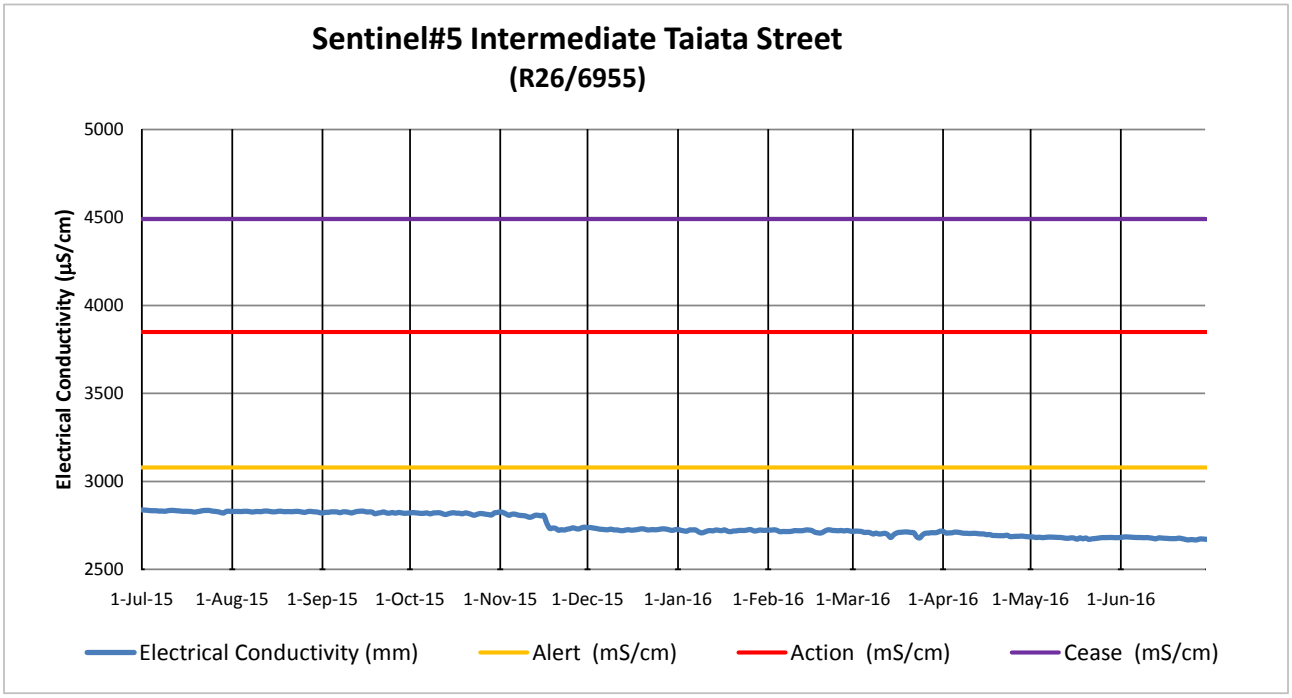

Figure C3.10: Electrical Conductivity in Sentinel #5 Intermediate Taiata St Monitoring Bore (Bore ID tba). Drop in mid-November due to maintenance of equipment and incorrect programming of sensor.

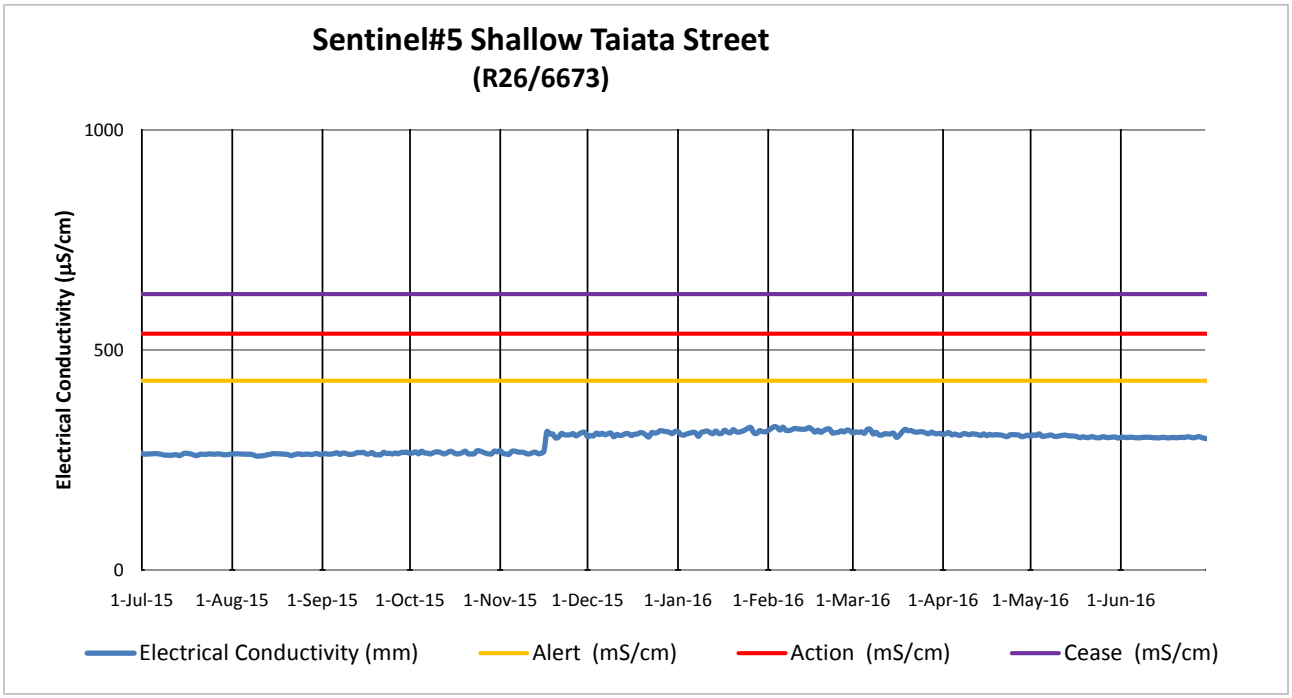

Figure C3.11: Electrical Conductivity in Sentinel #5 Shallow Taiata St Monitoring Bore (R26/6673). Spike in mid-November due to maintenance of equipment and incorrect programming of sensor.

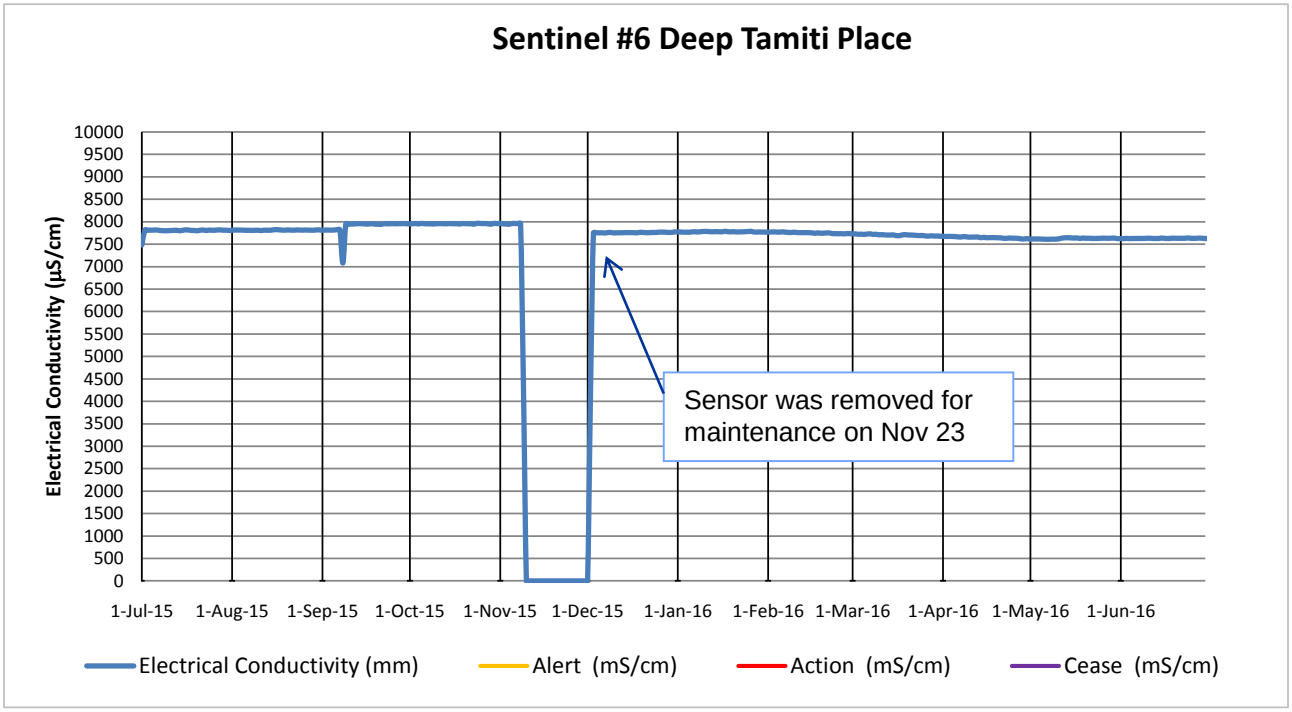

Figure C3.12: Electrical Conductivity in Sentinel #6 Deep Tamati Place Monitoring Bore (Bore ID tba).

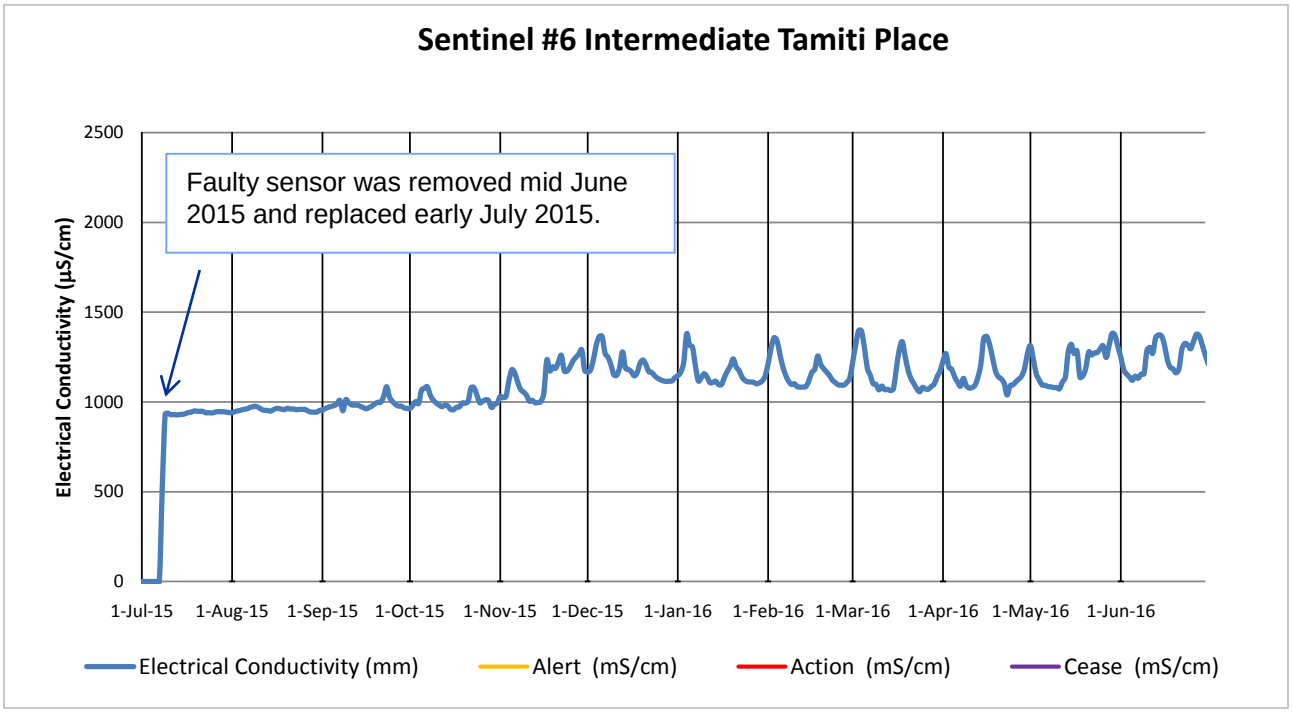

Figure C3.13: Electrical Conductivity in Sentinel #6 Intermediate Tamati Place Monitoring Bore (Bore ID tba). Sensor replaced July 12 2015.

Appendix D

Bore Water Quality Summary

Comments on following tables

Laboratory detection limits, resource consent condition and water quality guideline values have been added to the following tables.

Note the ANZECC (2000) Guidelines are applicable to the receiving body of water (in this case the Waikanae River) rather than the bore water discharge. Although the bore water exceeds the guideline values for some parameters, once the groundwater enters the river and is diluted it is expected that the concentrations in the river will be acceptable.

The water from all bores meets the Drinking-water Standards for New Zealand 2005 (revised 2008) maximum acceptable values, except for a slightly higher value for Nitrite Nitrogen in the KB4 Bore.

Bore		Temperature (field) (°C)	pH (field) -	pH (lab) -	Conductivity (field) mS/m	Conductivity (lab, @25°C) mS/m	Dissolved Oxygen (field) mg/l	Dissolved Oxygen (lab) g O2/m3	Total (NP) Organic Carbon g/m3	Alkalinity - Total g CaCO3/m3	Total Dissolved Solids g/m3	Bicarbonate g CaCO3/m3	Free CO2 g CO2/m3	Anion Sum meq/l
Laboratory detection limit				0.1		0.1	0.1	1	0.5	0.3	1	1	1	1
Resource consent WGN130103 [33761] condition 7		n/a	7.0 - 8.8	7.0 - 8.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Drinking-water Standards for New Zealand 2005 (revised 2008)		n/a	7.0-8.5 (GV)	7.0-8.5 (GV)	n/a	n/a	n/a	n/a	n/a	n/a	1000 (GV)	n/a	n/a	n/a
ANZECC 2000 Guidelines	99.00%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	95.00%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
KB4	Maximum	15	7.62	7.8	78	108	0.15	0.15	0.5	199	594	198	8	9.48
	Minimum	14.9	7.49	7.7	75.9	104	0.1	0.1	0.5	192	574	191	6	8.68
	Average	14.975	7.5625	7.75	77.3	106	0.1225	0.1225	0.5	196.25	582.25	195.25	7.25	9.18
	Number of Samples	4	4	4	4	4	4	4	4	4	4	4	4	4
K4	Maximum	16	7.41	7.8	46.8	64.4	0.21	0.21	1	113	354	113	9	5.45
	Minimum	15.1	7.32	7.7	44.6	59.2	0.13	0.13	0.9	108	326	108	7	5.15
	Average	15.525	7.365	7.75	45.4	61.9	0.16	0.16	0.925	110.25	340.5	110	8	5.285
	Number of Samples	4	4	4	4	4	4	4	4	4	4	4	4	4
K5	Maximum	16.5	7.92	7.7	77.5	106	0.1	0.1	0.7	216	582	214	4	9.09
	Minimum	15.9	7.87	7.7	76.4	104	0.1	0.1	0.7	214	571	212	4	8.87
	Average	16.2	7.895	7.7	76.95	105	0.1	0.1	0.7	215	576.5	213	4	8.98
	Number of Samples	2	2	2	2	2	2	2	2	2	2	2	2	2
K6	Maximum	14.8	7.5	7.8	60.6	110	0.07	0.07	0.7	281	606	279	11	10
	Minimum	14.8	7.5	7.7	60.6	110	0.07	0.07	0.7	281	606	279	11	10
	Average	14.8	7.5	7.75	60.6	110	0.07	0.07	0.7	281	606	279	11	10
	Number of Samples	1	1	1	1	1	1	1	1	1	1	1	1	1
K10	Maximum	15.9	7.46	7.8	77.5	83.6	0.46	0.46	0.6	214	460	213	12	7.09
	Minimum	15.1	7.19	7.36	53.7	79.4	0.07	0.07	0.1	11	436	11	<1	3.59
	Average	15.52	7.348	7.548	61.52	81.45	0.216	0.216	0.32	188.4	447.9	187.6	9.1	6.481
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10
Kb7	Maximum	16.2	7.76	7.8	60.9	63.9	0.5	0.5	12.8	97	352	97	3	5.63
	Minimum	15.2	7.47	7.61	42.2	61.8	0.04	0.04	<0.01	89	340	89	2	5.22
	Average	15.61	7.637	7.713	50.82	63.24	0.154	0.154	1.35	92.9	347.8	92.3	2.2	5.377
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10
K12	Maximum	15.8	7.76	7.8	43.8	50.4	0.42	0.42	0.2	91	277	91	3	4.35
	Minimum	15	7.17	7.17	32.6	49.5	0.03	0.03	<0.1	82	272	81	2	4.11
	Average	15.26	7.608	7.676	39.13	49.84	0.114	0.114	0.1	85.9	274.2	85.3	2.2	4.237
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10
N2	Maximum	17.1	7.46	7.8	39.4	43.2	0.68	0.68	0.4	82	237	82	5	3.81
	Minimum	14.5	7.09	7.17	27.7	41.2	0.03	0.03	<0.1	70	226	70	1	3.47
	Average	15.18	7.249	7.486	33.75	42.51	0.226	0.226	0.19	74.3	233.4	74.2	3.3	3.595
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10
River Sampling Dec 2015 to Apr 2016 (5 sites)	Maximum	21.45	8.84	8.2	1.108	18.3	39.6							
	Minimum	1.12	6.24	7.2	0.09	9.4	4.8							
	Average	16.39	7.64	7.58	0.12	11.28	10.67							
	Number of Samples	75	75	75	75	75	70							
Blended Bore Water Quality	Maximum	15.5	7.54	7.7	62.9	86.3	0.12	0.6	0.7	176	475	175	7	7.49
	Minimum	14.8	7.5	7.7	60.6	81.3	0.04	<0.5	0.5	151	447	150	6	7.26
	Average	15.13	7.53	7.70	61.97	84.27	0.08	0.60	0.60	162.00	463.33	161.33	6.33	7.34
	Number of Samples	3	3	3	3	3	3	3	3	3	3	3	3	3

Bore		Cation Sum meq/l	Ion Balance %	Fluoride g/m3	Chloride g/m3	Nitrite - Nitrogen g/m3	Bromide g/m3	Nitrate - Nitrogen g/m3	Sulphate g/m3	Ammonia Nitrogen g/m3	Total Hardness g CaCO3/m3	Boron - Dissolved g/m3	Calcium - Dissolved g/m3	Iron - Dissolved g/m3	Magnesium - Dissolved g/m3	Manganese - Dissolved g/m3
Laboratory detection limit		0.001	0.001	0.01	0.02	0.01	0.02	0.01	0.02	0.01	1	0.005	0.01	0.005	0.01	0.005
Resource consent WGN130103 [33761] condition 7		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	n/a	0.9	n/a	n/a	n/a	n/a
Drinking-water Standards for New Zealand 2005 (revised 2008)		n/a	n/a	1.5	250 (GV)	0.06	n/a	11.3	250 (GV)	1.5 (GV)	200 (GV)	1.4	n/a	0.2 (GV)	n/a	0.4
ANZECC 2000 Guidelines	99.00%	n/a	n/a	n/a	n/a	n/a	n/a	4.9	n/a	0.32	n/a	0.09	n/a	n/a	n/a	1.2
	95.00%	n/a	n/a	n/a	n/a	n/a	n/a	7.2	n/a	0.9	n/a	0.37	n/a	n/a	n/a	1.9
KB4	Maximum	10.2	28.8	0.05	219	0.09		<0.01	1.1	0.05	133	0.276	34	<0.005	11.6	0.021
	Minimum	5.25	0.69	0.03	195	<0.01		<0.01	1.06	0.04	118	0.253	30.2	<0.005	10.2	0.016
	Average	8.365	10.2775	0.04	210.25	0.26		<0.01	1.0775	0.0475	126	0.2625	32.1	<0.005	11.1	0.01875
	Number of Samples	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
K4	Maximum	5.62	26.6	0.23	114	<0.01	0.43	<0.01	18.3	0.02	39	0.105	5.77	0.006	5.89	0.184
	Minimum	3.12	2.35	0.2	107	<0.01	0.35	<0.01	17.2	0.02	36	0.082	5.32	<0.005	5.59	0.172
	Average	4.6725	9.35	0.215	110.25	<0.01	0.385	<0.01	17.725	0.02	37.75	0.09425	5.535	0.0035	5.7975	0.177
	Number of Samples	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
K5	Maximum	9.96	5.81	0.07	197	<0.01	0.67	<0.01	0.5	0.31	119	0.446	27.2	0.03	12.3	0.067
	Minimum	9.19	0.54	0.06	190	<0.01	0.66	<0.01	0.43	0.3	111	0.387	25.5	0.024	11.6	0.055
	Average	9.575	3.175	0.065	193.5	<0.01	0.665	<0.01	0.465	0.305	115	0.4165	26.35	0.027	11.95	0.061
	Number of Samples	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
K6	Maximum	9.99	0.16	0.04	191	<0.01	0.65	<0.01	0.22	0.44	130	0.642	29.1	<0.005	13.9	0.066
	Minimum	9.99	0.16	0.04	191	<0.01	0.65	<0.01	0.22	0.44	130	0.642	29.1	<0.005	13.9	0.066
	Average	9.99	0.16	0.04	191	<0.01	0.65	<0.01	0.22	0.44	130	0.642	29.1	<0.005	13.9	0.066
	Number of Samples	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K10	Maximum	8.2	36	0.04	127	0.02	0.59	<0.01	<0.02	0.25	196	0.178	50.5	0.008	13.3	0.169
	Minimum	7.54	3.61	0.03	115	<0.01	0.45	<0.01	<0.02	0.15	164	0.135	44.8	<0.005	11.3	0.145
	Average	7.75	9.52	0.032	120.4	<0.01	0.518	<0.01	<0.02	0.224	172	0.1576	47.15	0.003	12.42	0.1585
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Kb7	Maximum	6.18	6.93	0.08	132	0.02	0.52	<0.01	15.8	<0.01	69	0.534	14	0.037	8.34	0.016
	Minimum	5.18	0.34	0.06	119	<0.01	0.32	<0.01	13.5	<0.01	63	0.452	12.6	0.007	7.07	0.012
	Average	5.693	3.722	0.068	124.7	0.01	0.411	<0.01	14.78	<0.01	65.1	0.4982	13.18	0.0231	7.733	0.0137
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
K12	Maximum	4.95	7.79	0.09	90.6	0.02	0.33	<0.01	16.9	0.01	84	0.412	18.5	0.006	9.24	0.052
	Minimum	4.03	0.22	0.08	84.5	<0.01	0.26	<0.01	14.9	<0.01	73	0.363	16.2	<0.005	7.8	0.041
	Average	4.523	3.812	0.083	87.79	0.0075	0.29	<0.01	15.88	<0.01	77.7	0.3864	17.17	0.003	8.398	0.0465
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
N2	Maximum	4.08	6.56	0.17	73.9	<0.01	0.28	<0.01	21	0.05	102	0.064	28.5	0.022	7.46	0.097
	Minimum	3.56	0.28	0.15	65.5	<0.01	0.2	<0.01	19.4	0.01	87	0.024	24.1	<0.005	6.1	0.07
	Average	3.782	2.478	0.158	69.51	<0.01	0.24	<0.01	20.06	0.045	93.6	0.051	26.23	0.0113	6.725	0.0833
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
River Sampling Dec 2015 to Apr 2016 (5 sites)	Maximum												6.87			
	Minimum												4.62			
	Average												5.40			
	Number of Samples												74			
Blended Bore Water Quality	Maximum	7.7	2.94	0.13	163	<0.01	0.56	<0.002	9.57	0.17	100	0.319	23.1	<0.005	10.2	0.103
	Minimum	7.15	0.72	0.1	157	<0.01	0.53	<0.002	7.51	0.03	84	0.175	19.4	<0.005	8.58	0.092
	Average	7.37	1.76	0.12	159.67	<0.01	0.54	<0.002	8.33	0.10	90.00	0.24	20.67	<0.005	9.29	0.10
	Number of Samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Bore		Potassium - Dissolved g/m3	Sodium - Dissolved g/m3	Total Phosphorus g/m3	Dissolved Reactive Phosphorus g/m3	Total Nitrogen g/m3	Arsenic - Dissolved g/m3	Cadmium - Dissolved g/m3	Chromium - Dissolved g/m3	Copper - Dissolved g/m3	Lead - Dissolved g/m3	Nickel - Dissolved g/m3	Zinc - Dissolved g/m3
Laboratory detection limit		0.01	0.02	0.005	0.005	0.05	0.001	0.0002	0.001	0.0005	0.0005	0.0005	0.002
Resource consent WGN130103 [33761] condition 7		n/a	n/a	n/a	n/a	n/a	0.03	0.0005	0.0022	0.0033	n/a	n/a	0.018
Drinking-water Standards for New Zealand 2005 (revised 2008)		n/a	200 (GV)	n/a	n/a	n/a	0.01	0.004	0.05	2	0.01	0.08	1.5 (GV)
ANZECC 2000 Guidelines	99.00%	n/a	n/a	n/a	n/a	n/a	0.001 (As III) 0.0008 (As V)	0.00006	0.00001	0.001	0.001	0.008	0.0024
	95.00%	n/a	n/a	n/a	n/a	n/a	0.024 (As III) 0.013 (As V)	0.0002	0.001	0.0014	0.0034	0.011	0.008
KB4	Maximum	6.43	172	0.037	0.037	0.06	<0.001	<0.0002	<0.001	0.0008	<0.0005	<0.0005	0.009
	Minimum	5.4	59.2	0.032	0.034	<0.05	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.006
	Average	5.9	131.05	0.03525	0.0355	0.05	<0.001	<0.0002	<0.001	0.0007	<0.0005	<0.0005	0.008
	Number of Samples	4	4	4	4	4	4	4	4	4	4	4	4
K4	Maximum	1.88	111	0.103	0.098	0.07	<0.001	<0.0002	<0.001	0.0017	<0.0005	<0.0005	0.056
	Minimum	1.63	54	0.096	0.088	<0.05	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.004
	Average	1.75	89.15	0.09975	0.0945	0.04	<0.001	<0.0002	<0.001	0.00036	<0.0005	<0.0005	0.02125
	Number of Samples	4	4	4	4	4	4	4	4	4	4	4	4
K5	Maximum	7.61	170	0.117	0.117	0.33	0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.002
	Minimum	6.77	156	0.115	0.112	0.32	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	<0.002
	Average	7.19	163	0.116	0.1145	0.325	0.0005	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.001
	Number of Samples	2	2	2	2	2	2	2	2	2	2	2	2
K6	Maximum	8.73	164	0.076	0.065	0.43	0.001	<0.0002	<0.001	0.0145	<0.0005	<0.0005	0.015
	Minimum	8.73	164	0.076	0.065	0.43	0.001	<0.0002	<0.001	0.0145	<0.0005	<0.0005	0.015
	Average	8.73	164	0.076	0.065	0.43	0.001	<0.0002	<0.001	0.0145	<0.0005	<0.0005	0.015
	Number of Samples	1	1	1	1	1	1	1	1	1	1	1	1
K10	Maximum	8.56	106	0.108	0.05	0.25	0.001	<0.0002	<0.001	0.0073	<0.0005	<0.0005	0.079
	Minimum	7.3	90.7	0.062	0.037	0.22	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.0016
	Average	7.785	95.63	0.0728	0.0425	0.236	0.001	<0.0002	<0.001	0.002	<0.0005	<0.0005	0.01606
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10
Kb7	Maximum	3.23	110	0.037	0.035	<0.05	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.006
	Minimum	2.39	88.3	0.031	0.029	<0.05	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	<0.002
	Average	2.715	99.58	0.0336	0.0308	<0.05	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.003
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10
K12	Maximum	2.44	76.1	0.071	0.049	<0.05	<0.001	<0.0002	<0.001	0.0022	<0.0005	<0.0005	0.005
	Minimum	1.6	58	0.046	0.042	<0.05	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.002
	Average	1.958	67.3	0.0506	0.0448	<0.05	<0.001	<0.0002	<0.001	0.0005	<0.0005	<0.0005	0.0043
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10
N2	Maximum	3.33	46.5	0.147	0.126	0.08	0.001	0.0003	<0.001	0.001	<0.0005	0.0007	0.009
	Minimum	2.63	38.7	0.126	0.118	<0.05	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	0.003
	Average	2.968	42.31	0.1359	0.1222	0.0375	0.0007	0.0002	<0.001	0.00043	<0.0005	0.0003	0.0055
	Number of Samples	10	10	10	10	10	10	10	10	10	10	10	10
River Sampling Dec 2015 to Apr 2016 (5 sites)	Maximum			0.13	0.12	0.46							
	Minimum			0.009	0.005	0.08							
	Average			0.02	0.01	0.18							
	Number of Samples			75	75	75							
Blended Bore Water Quality	Maximum	5.13	135	0.088	0.081	0.2	0.001	<0.002	<0.001	0.0014	<0.005	<0.005	0.109
	Minimum	3.88	118	0.072	0.067	0.11	0.001	<0.002	<0.001	0.0014	<0.005	<0.005	0.109
	Average	4.53	125.67	0.08	0.08	0.16	0.00	<0.002	<0.001	0.00	<0.005	<0.005	0.11
	Number of Samples	3	3	3	3	3	3	3	3	3	3	3	3

Appendix E

Wetlands Baseline Monitoring Annual Report 2015/16

Wetland Baseline Monitoring Annual Report

A report on 2015/16 data collection for water permit WGN130103[33759]

Prepared for Kapiti Coast District Council

28th July 2016

Boffa Miskell

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Reviewed by:	Dr Vaughan Keesing Senior Ecologist Boffa Miskell Limited	
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Contents

Appendices

1. Introduction

There are thirteen wetlands being monitored on the Kapiti Coast associated with the Kapiti Coast District Council (Council) consents River Recharge with Groundwater project (RRwGW). This monitoring is being carried out in accordance with the approved wetland baseline monitoring plan (WBMP) under consent WGN 130103 [33759] condition 29.

The purpose of the baseline monitoring is to gather some information that will form the pre-activity measures of the wetlands condition and variability in the absence of the potential effect.

The wetlands are as follows (wetlands are shown on Figure 1):

1. Poplar Ave Wetland
2. Crown Hill Manuka Bush Wetland
3. Muaupoko Swamp Forest
4. Otaihanga Southern Wetland
5. Tini Bush Wetland
6. El Rancho Wetland (Weggery)
7. Te Harakeke / Kawakahia Wetland
8. Nga Manu Wetland
9. Ngarara Wetland
10. Ngarara Bush Wetland
11. Peka Peka Road Swamp
12. Te Hapua Swamp Complex A
13. Te Hapua Swamp Complex D

The baseline wetland monitoring for the period of December 2014 – May 2017 comprises of:

- Water level piezometer monitoring; as measured at 15min intervals over the December – May monitoring season.
- Annual Summer wetland condition monitoring, including photo points and set permanent vegetation plots;
- A map of high resolution aerial photography and associated vegetation communities.

This report details the results of the second year of three baseline monitoring years and is required to present:

- Details of the results of Wetland Condition Monitoring as prescribed in the Wetland Condition Monitoring Sheets (Clarkson et al., 2004), including photographs of fixed photo-points for each wetland.
- Updated information of fauna presence, based on observations during Wetland Condition Monitoring and botanical survey work (and any other known information).
- Updated information on wetland classification as per Johnson and Gerbeaux (2004).
- Details of monthly groundwater levels from each of the data loggers from each of the water level piezometers.

These areas will be covered site by site in the following report, with the exception of the wetland condition indices (Section 3.1) and wetland classification (Section 4 page 48) which are covered by one table addressing all sites.

A detailed high-resolution aerial photograph of each monitored wetland, with associated vegetation communities (as per Atkinson (1985)) overlaid, was presented in 2014/15 Wetland Condition monitoring baseline report .This is to remain the baseline reference map and are kept within this year's report for additional reference. It is proposed that any significant changes measured in subsequent impact monitoring (as opposed to the three year baseline monitoring) of the wetland condition monitoring indices or vegetation communities, will trigger remapping of the wetlands to further ascertain the extent of the change.

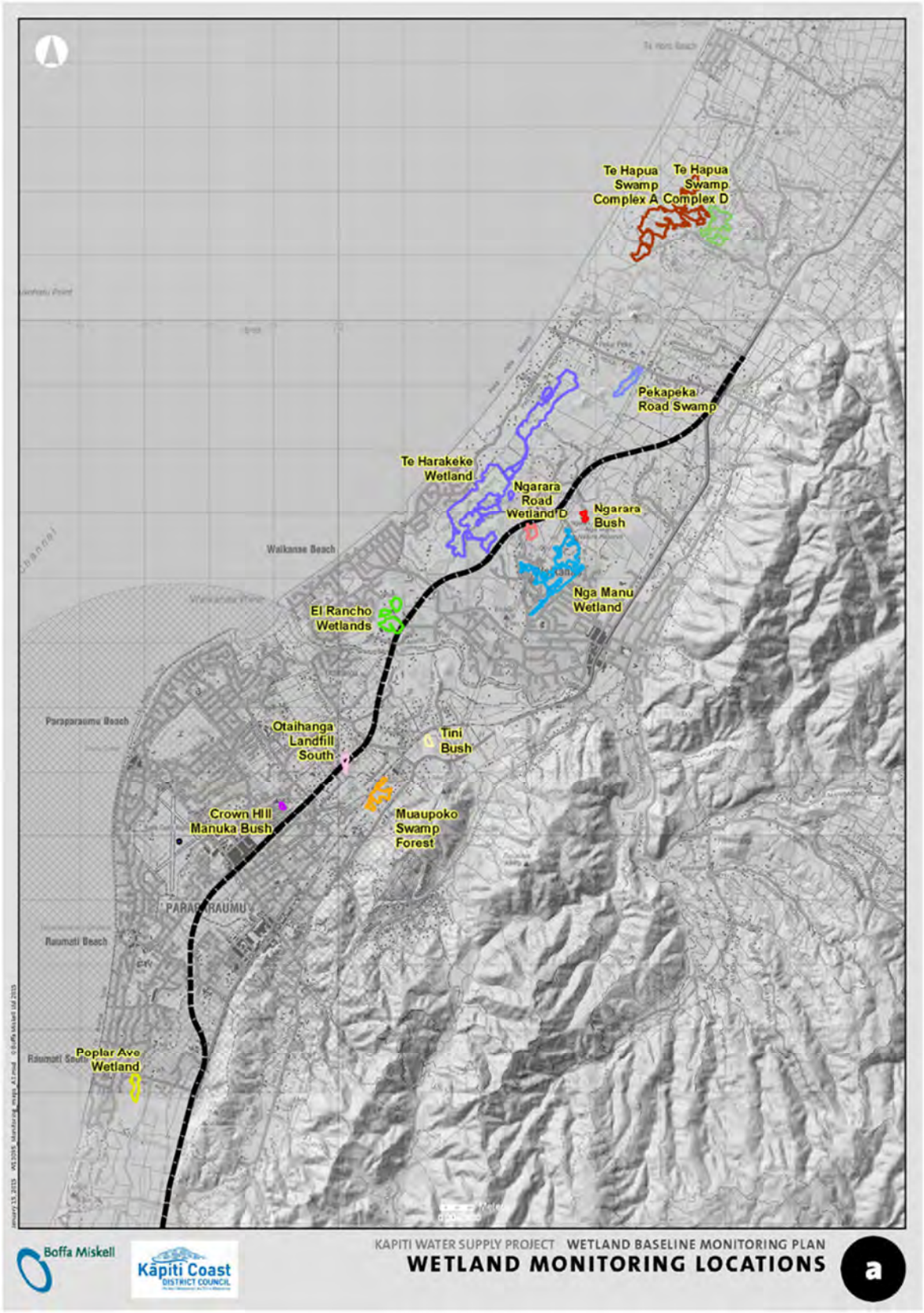

Figure 1. Monitored wetland locations

2. Methods

The monitoring methods are set out in the Wetland BMP and follow the Handbook for Monitoring Wetland Condition (Clarkson et al., 2004). In February 2015 two monitoring plots were established in each of the monitored wetlands, with the exception of Ngarara wetland whose small size only allowed for one plot. Plot placement targeted representative vegetation communities that boarded most obvious wet to dry ecotone, as to easily record subtle changes within the wetland. Photo points were established at staked points to further encapsulate future changes to wetland form.

Vegetation species found in plots were then classified according to fidelity to a wetland environment as identified in Clarkson, 2013.

The aerial photography was undertaken in March 2015 using a DJI Phantom drone with 12Mp camera and the photos stitched together to form the aerial using Pix4D mapping.

Piezometers for the purpose of recording groundwater levels for project consents were installed in mid-November 2014 in Muaupoko Swamp Forest, Peka Peka Rd Swamp, Crown Hill Manuka Bush, and Poplar Ave Wetland. Additional groundwater information was gained from other piezometers within the region from both existing council piezometers and those related to the MacKays to Peka Peka expressway construction.

3. Results

The wetland condition monitoring for the 2015/16 baseline monitoring survey and analysis were carried out by Boffa Miskell (BML) staff and Pat Enright, a local botanist.

The monitoring period for wetlands as set out by Condition 22 of consent WGN130103 [33759] require monitoring to be undertaken between 01 December and 31 May each year. Subsequent to this period, monitoring of the wetlands is required if river recharge activities have occurred.

For the 2015/16 monitoring period river recharge was used in October (outside of the required monitoring period), and subsequently the graphs below display periods from 01 October to 31 May.

Raw data of wetland condition monitoring collected at each site is presented in Appendix A.

3.1 Kapiti Coast Climate Summer 2015-16

The weather preceding the surveys was exceptionally warm with Paraparaumu recording the highest temperature, the 3rd highest summer mean and highest minimum air temp since records began in 1953 (Figure 2 NIWA National Climate Centre, 2016).

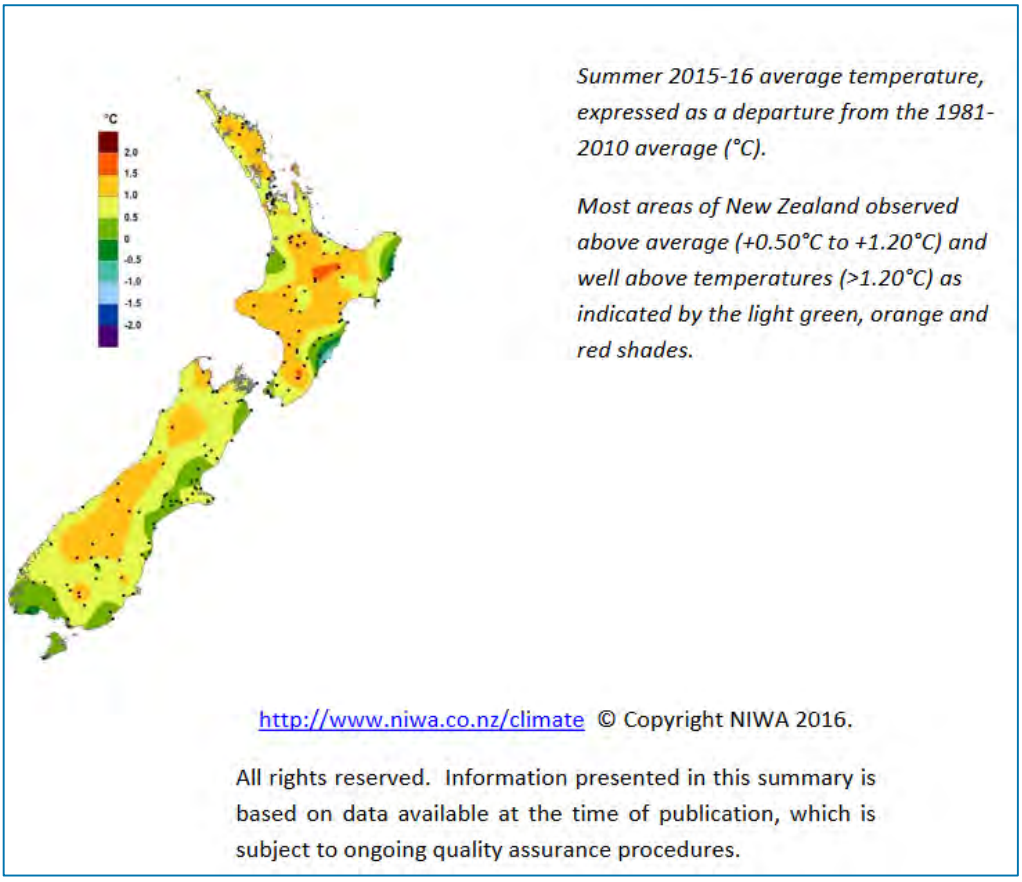

Figure 2: The differences in average summer temperature expressed as a departure from past average summer temperatures throughout New Zealand. Note the Kapiti Coast, where wetland sites are surveyed experienced above average summer temperatures.

3.2 Wetland Condition Indices

Four elements make up the wetland condition monitoring system. The results of these indices are summarised in the following tables for both last and this year.

The wetland condition index (Table 1), uses hydrological integrity, physio-chemical parameters, fire, intactness, dominance of native species, as sub-indices.

The wetland pressure index (Table 2), uses assessments of modification, water quality, animal access, and weed presence sub-indices. These indices are applied to the entire wetland (not to each plot).

The third index is the indicator score (Table 3), uses canopy cover, understory and species "health" sub-indices. This index is scored on permanent plot basis.

The scores established are out of a total possible of 25 for condition, 30 for pressure and 20 for plot indices. These scores set the basis for the wetland monitoring programme where an increase in wetland condition, or indicator score reflect an increase in condition, and an increase in pressure reflects a decrease in condition.

Each of the monitored wetlands are further discussed below in respect to their baseline vegetation communities, fauna present and piezometer records in 2016.

Raw data in wetland plot sheets for each site can be found in Appendix A

Table 1 Wetland condition index for each monitored wetland for the 2015, 2016 summer monitoring surveys.

Wetland condition index	2015 Survey	2016 Survey
Poplar Ave	20.6	17.8
Crown Hill	20.2	16.5
Muaupoko Swamp Forest	18.75	21.0
Otaihanga South	20.7	16.0
Tini Bush	16.8	19.7
El Rancho	18	19.2
Te Harakeke	19.6	17.8
Nga Manu	19.7	20.9
Ngarara	17.9	14.7
Ngarara Bush	15.4	17.6
Peka Peka	14.2	19.6
Te Hapua Complex A	16.7	18.6
Te Hapua Complex D	20.7	18.9

Table 2: Wetland pressure index for each monitored wetland for the 2015, 2016 summer monitoring surveys.

Wetland pressure index	2015 Survey	2016 Survey
Poplar Ave	16	16
Crown Hill	12	16
Muaupoko Swamp Forest	18	12
Otaihanga South	20	20
Tini Bush	7	12
El Rancho	15	12
Te Harakeke	15	10
Nga Manu	15	12
Ngarara	17	17
Ngarara Bush	18	18
Peka Peka	24	15
Te Hapua Complex A	16	19
Te Hapua Complex D	19	15

Table 3: Wetland indicator scores for each wetland plot for the 2015, 2016 summer monitoring surveys.

Wetland indicator score	Plot 1		Plot 2	
Year of survey	**2015**	**2016**	**2015**	**2016**
Poplar Ave	17	17	20	17
Crown Hill	19	19	18	19
Muaupoko Swamp Forest	20	20	9	20
Otaihanga South	12	10	17	16
Tini Bush	20	20	16	0
El Rancho	18	18	17	0
Te Harakeke	16	16	20	12
Nga Manu	0	19	20	19
Ngarara	12	12	19	-
Ngarara Bush	18	18	18	17
Peka Peka	20	20	12	0
Te Hapua Complex A	6	7	19	0
Te Hapua Complex D	17	11	20	20

3.3 Poplar Ave Wetland

3.3.1 Wetland fauna

A fantail was observed during this wetland survey.

3.3.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.3.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Poplar Ave Plot 1 is a manuka-machaerina wetland; Poplar Ave Plot 2 is a reedland (Isolepis), moss field with a thin scattering of manuka. Table 4 summarises the plot vegetation species presence and cover data.

The baseline map of Poplar Ave wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 3.The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 4. Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Poplar Ave Wetland.

Parameters		Poplar Ave_1	Poplar Ave_2
Proportion of visual estimates of vegetation cover.	Exotic	4%	1%
	Native	96%	99%
	UPL	0%	0%
	FACU	0%	0%
	FACW	1%	12%
	FAC	4%	30%
	OBL	95%	58%
	Total % cover	117	183
Proportion of species.	Exotic	20%	11%
	Native	80%	89%
	UPL	0%	0%
	FACU	0%	0%
	FACW	20%	22%
	FAC	20%	33%
	OBL	60%	44%
	Total no. of spp	5	9

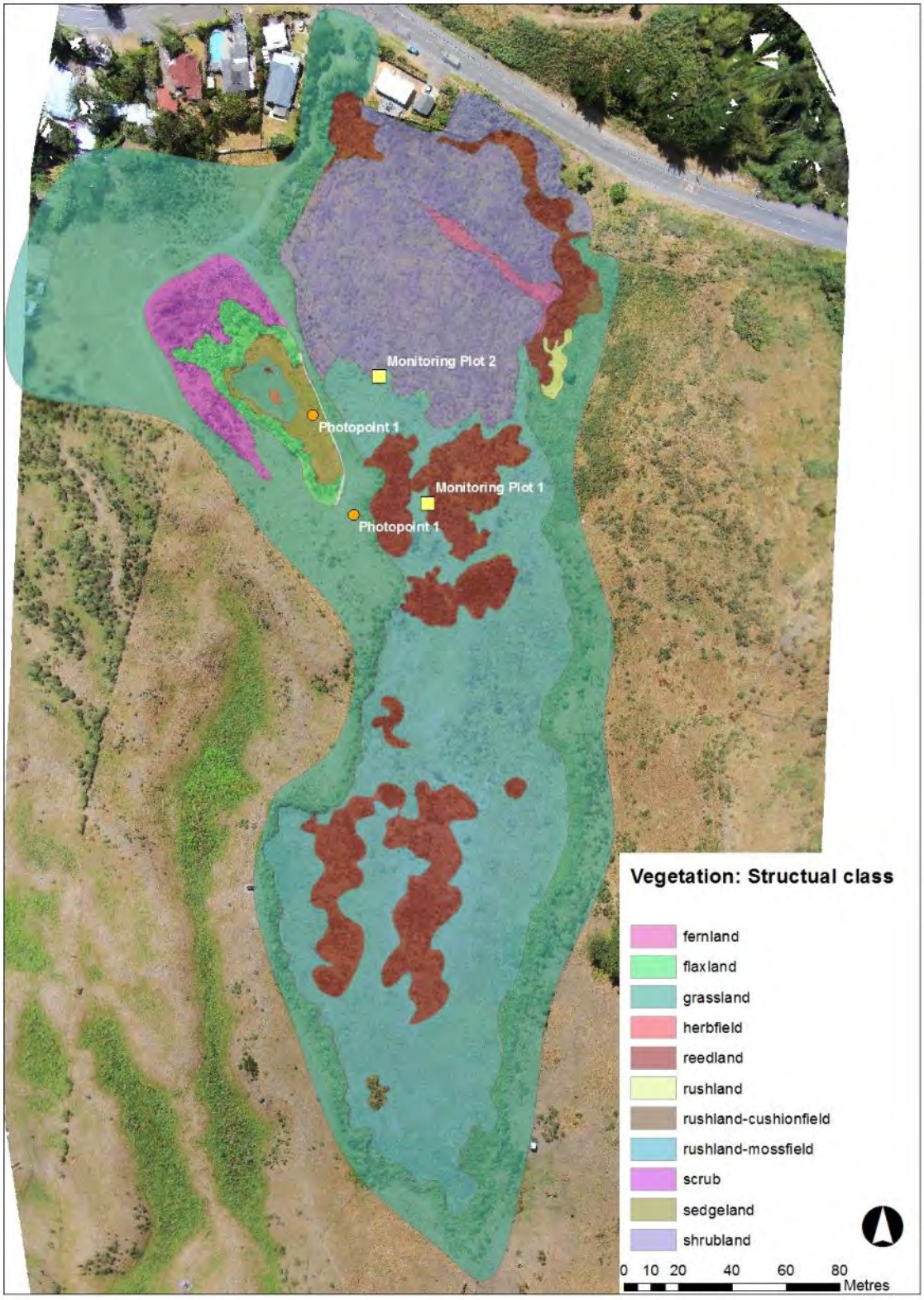

Figure 3: Local wetland vegetation communities at Poplar Ave Wetland (based on March 2015 aerial photography and vegetation surveys).

3.3.4 Piezometer records

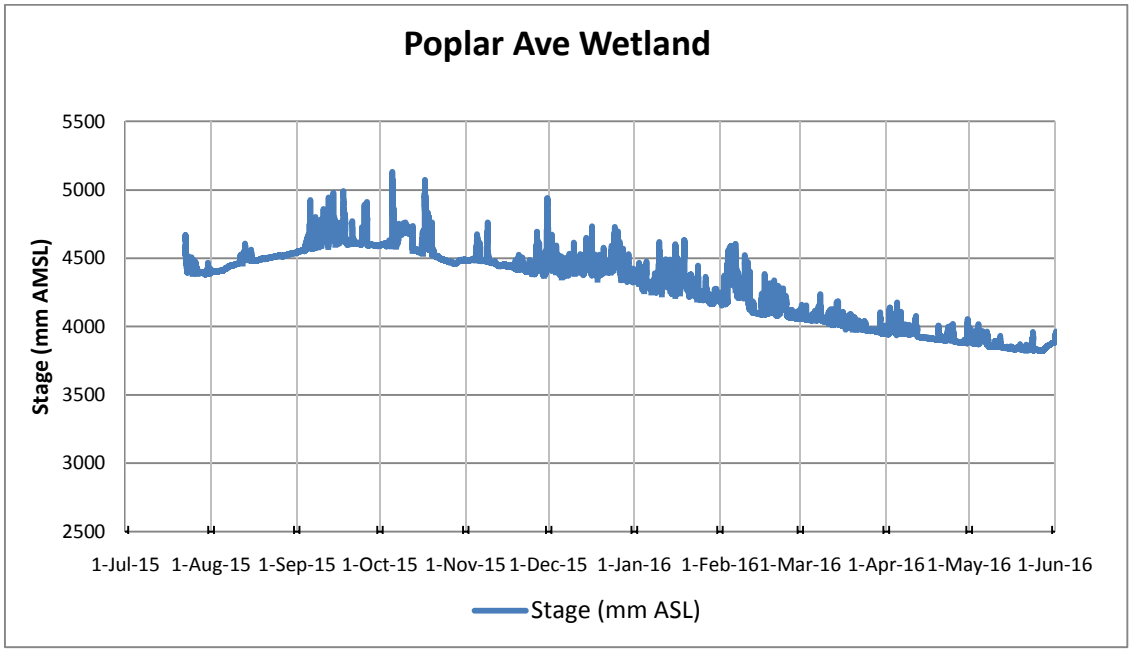

Figure 4: Shallow groundwater levels for Poplar Ave wetland during the 2015/16 monitoring period

3.4 Crown Hill Manuka Bush Wetland

3.4.1 Wetland fauna

During the 2016 survey no native fauna was seen.

3.4.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.4.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 5 summarises the plot vegetation species presence and cover data. Crown Hill Plot 1 is a kanuka swamp forest with pukatea; Crown Hill Plot 2 is a manuka swamp.

The baseline map of Crown Hill Manuka Bush wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 5. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 5. Showing proportions (as a % of total cover) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Crown Hill Wetland.

Parameters		**Crown Hill_1**	**Crown Hill_2**
Proportion of visual estimates of vegetation cover.	Exotic	0%	0%
	Native	100%	100%
	UPL	0%	0%
	FACU	0%	42%
	FACW	8%	10%
	FAC	12%	38%
	OBL	11%	0%
	Total % cover	131	84
Proportion of species.	Exotic	0%	0%
	Native	100%	100%
	UPL	0%	0%
	FACU	0%	13%
	FACW	20%	38%
	FAC	40%	25%
	OBL	20%	0%
	Total no. of spp	5	8

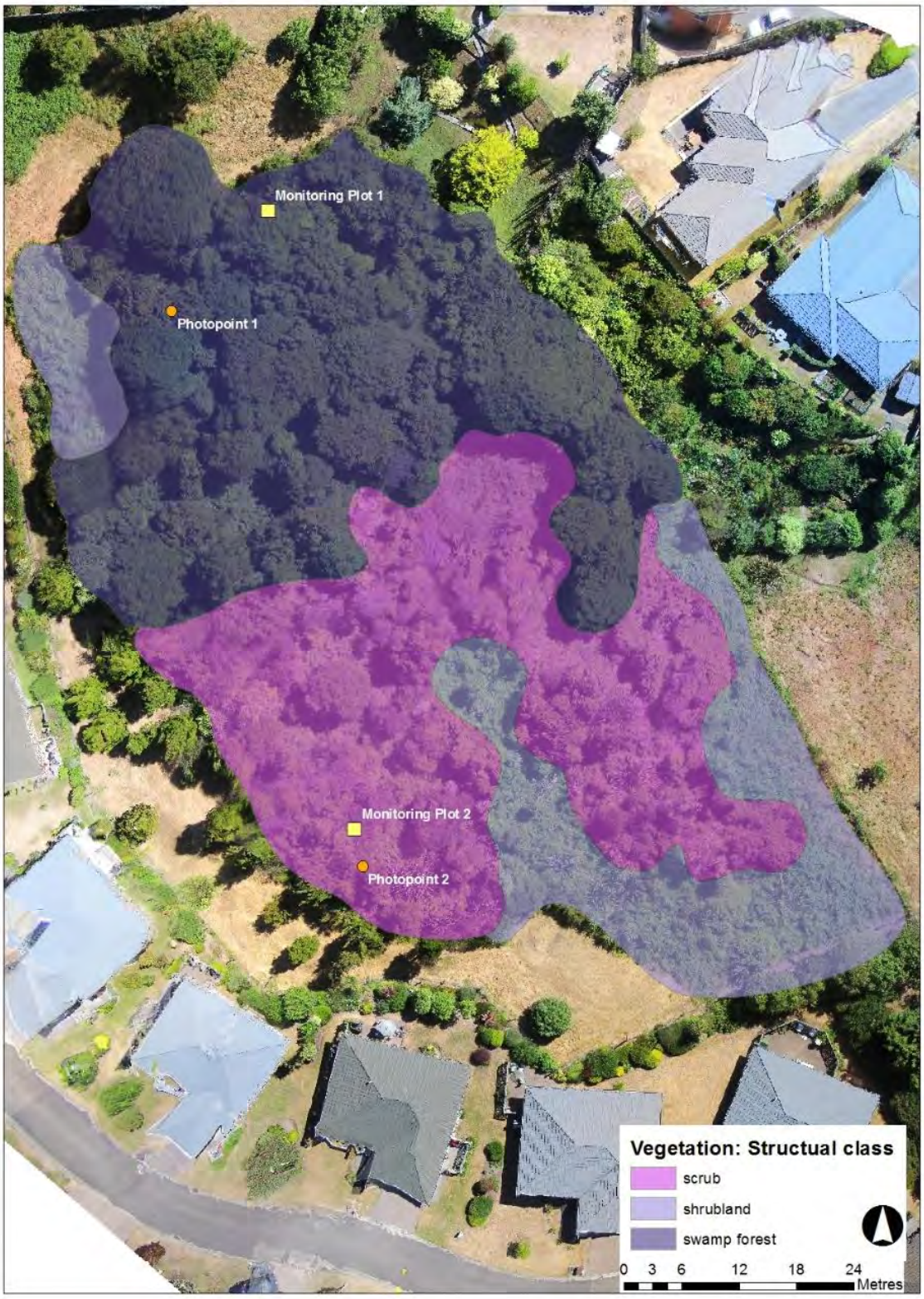

Figure 5. Local wetland vegetation communities at Crown Hill Manuka Bush Wetland (based on March 2015 aerial photograph).

3.4.4 Piezometer records

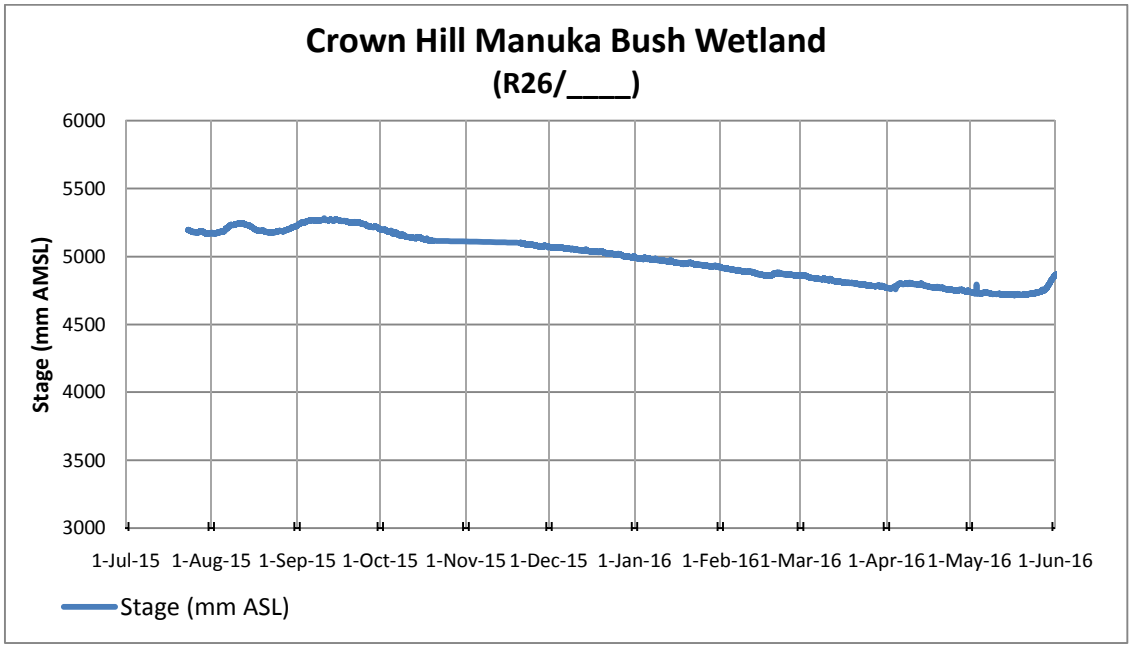

Figure 6: Shallow groundwater levels for Crown Hill Manuka Bush wetland during the 2015/16 reporting period.

3.5 Muaupoko Swamp Forest

3.5.1 Wetland fauna

A ruru (morepork) was startled during the 2016 survey.

3.5.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.5.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 6 summarises the plot vegetation species presence and cover data. Muaupoko Plot 1 is a wetland forest with pukatea, nikau and *Freycinetia banksii*; Muaupoko Plot 2 is a coastal wetland forest with swamp maire, ngaio and broadleaf over hen and chicken fern.

The baseline map of Muaupoko Swamp wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 7. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 6 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Muaupoko Swamp Forest

Parameters		Muaupoko Swamp forest_1	Muaupoko Swamp forest_2
Proportion of visual estimates of vegetation cover.	Exotic	0%	0%
	Native	100%	100%
	UPL	4%	24%
	FACU	96%	76%
	FACW	0%	0%
	FAC	0%	0%
	OBL	0%	0%
	Total % cover	70	82
Proportion of species.	Exotic	0%	0%
	Native	100%	100%
	UPL	29%	25%
	FACU	71%	75%
	FACW	0%	0%
	FAC	0%	0%
	OBL	0%	0%
	Total no. of spp	7	4

Figure 7: Local wetland vegetation communities at Muaupoko Swamp forest with position of permanent monitoring plots and photopoints (March 2015 aerial photograph).

3.5.4 Piezometer records

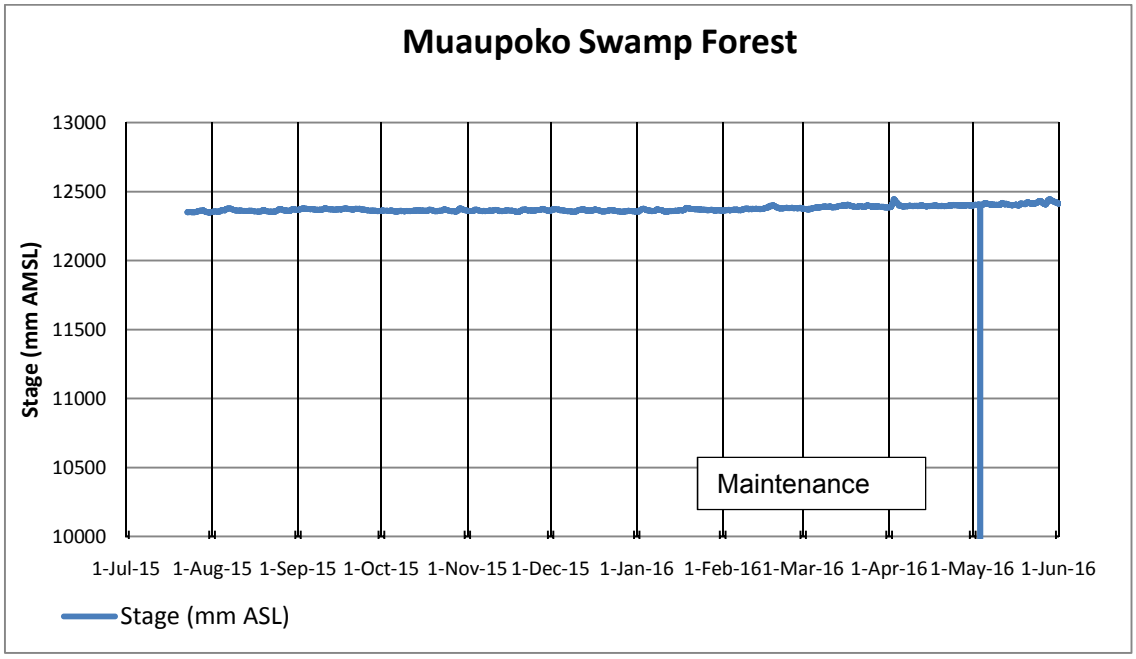

Figure 8: Shallow groundwater levels for Muaupoko swamp forest during the 2015/16 monitoring period

3.6 Otaihanga Southern Wetland

3.6.1 Wetland fauna

No fauna were recorded in the 2016 survey.

3.6.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.6.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 7 summarises the plot vegetation species presence and cover data. Otaihanga Southern Plot 1 is a sedgeland with a dominance of *Carex secta* and the weed beggars tick; Otaihanga Southern Plot 2 is a sedgeland dominated by *Carex virgata*.

The baseline map of Otaihanga Southern wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 9.The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 7 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Otaihanga South Wetland.

Parameters		Otaihanga South_1	Otaihanga South_2
Proportion of visual estimates of vegetation cover.	Exotic	85%	10%
	Native	15%	90%
	UPL	0%	1%
	FACU	1%	1%
	FACW	60%	13%
	FAC	24%	7%
	OBL	15%	76%
	Total % cover	84	67
Proportion of species.	Exotic	50%	25%
	Native	50%	75%
	UPL	0%	13%
	FACU	17%	13%
	FACW	17%	38%
	FAC	17%	13%
	OBL	50%	25%
	Total no. of spp	6	8

Figure 9. Local wetland vegetation communities at Otaihanga South Wetland (March 2015 aerial photograph).

3.6.4 Piezometer records

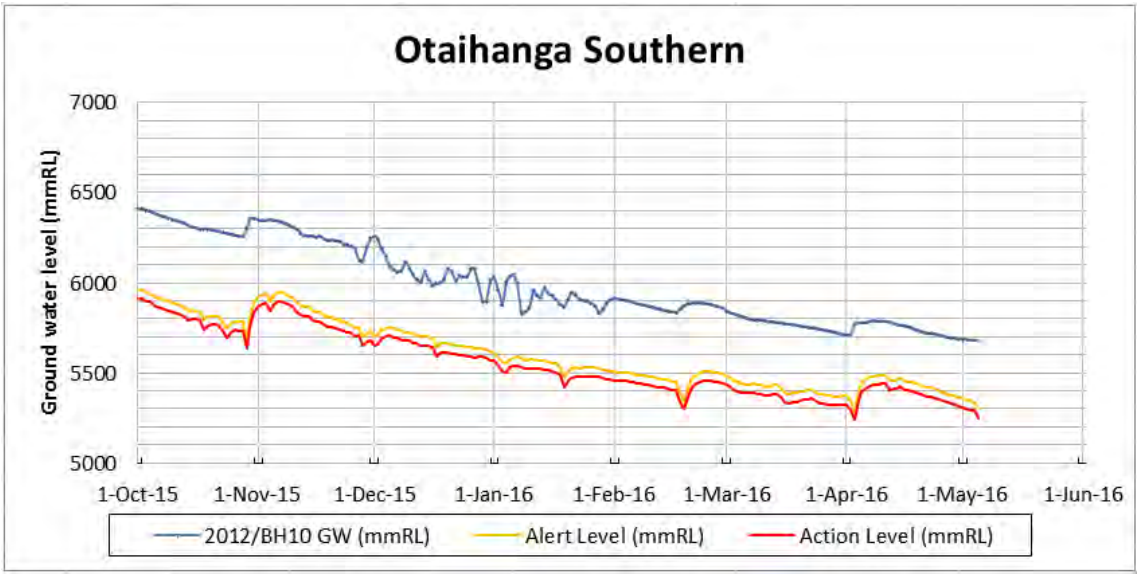

Figure 10: Shallow groundwater levels for Otaihanga wetland site BH 10 during the 2015/16 reporting period.

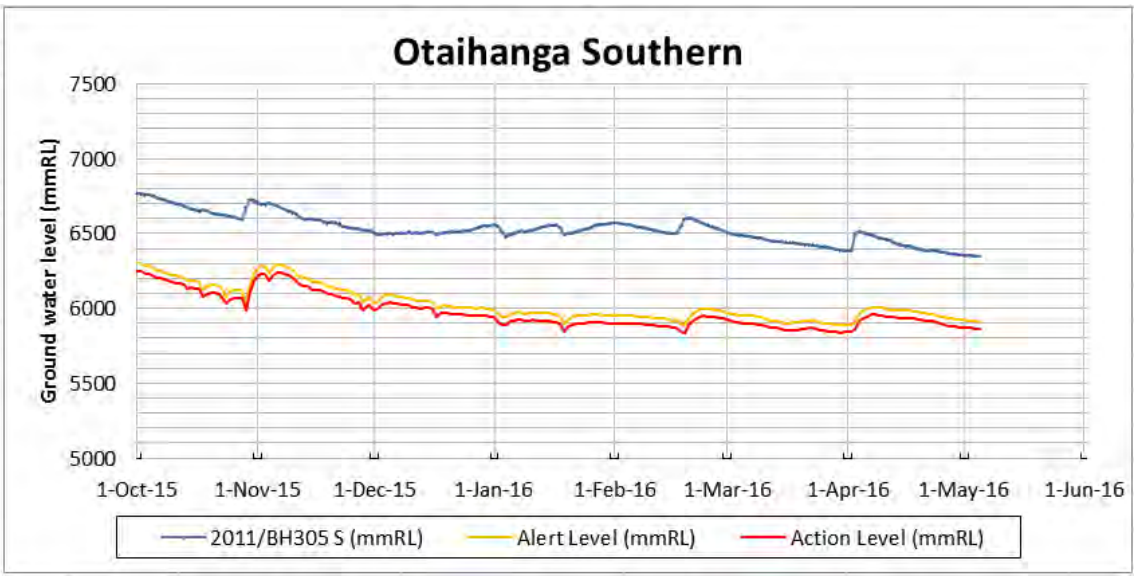

Figure 11: Shallow groundwater levels for Otaihanga wetland site BH 305N during the 2015/16 reporting period.

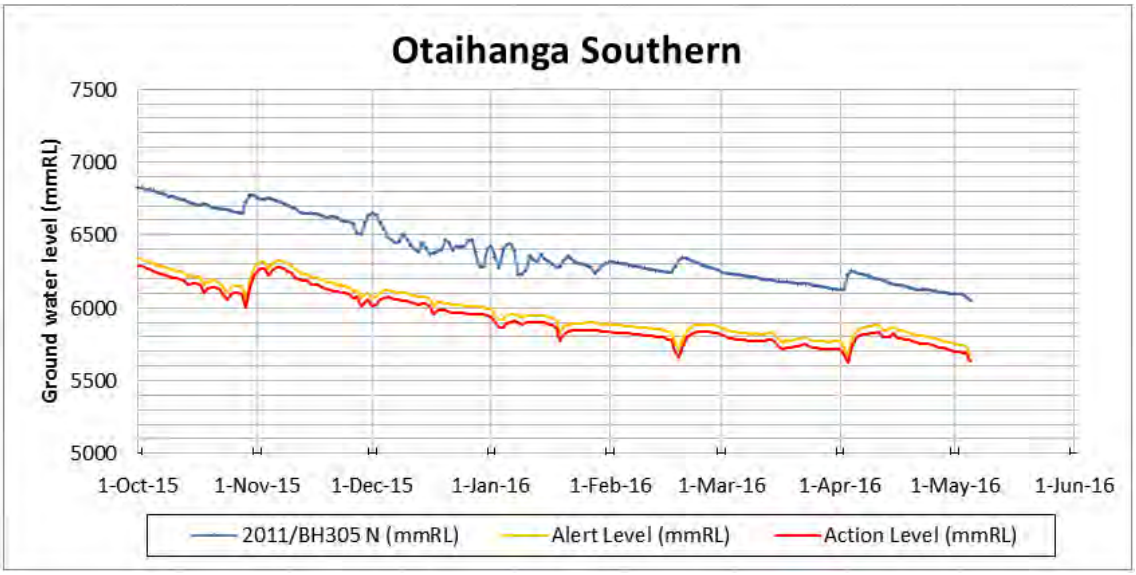

Figure 12: Shallow groundwater levels for Otaihanga wetland site BH 305S during the 2015/16 reporting period.

3.7 Tini Bush Wetland

3.7.1 Wetland fauna

Tui were observed in the 2016 survey.

3.7.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.7.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 8 summarises the plot vegetation species presence and cover data. Plot 1 is a Pukatea swamp forest with *Freycinetia banksii*; Tini Bush Plot 2 is a tree fern developing wetland forest with young kahikatea and pukatea under mamaku.

The baseline map of Tini Bush wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 13. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 8 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Tini Bush Wetland.

Parameters		Tini Bush_1	Tini Bush_2
Proportion of visual estimates of vegetation cover.	Exotic	0%	2%
	Native	100%	98%
	UPL	0%	2%
	FACU	9%	76%
	FACW	0%	18%
	FAC	91%	3%
	OBL	0%	2%
	Total % cover	44	62
Proportion of species.	Exotic	0%	11%
	Native	100%	89%
	UPL	0%	11%
	FACU	75%	44%
	FACW	0%	22%
	FAC	25%	11%
	OBL	0%	11%
	Total no. spp	4	9

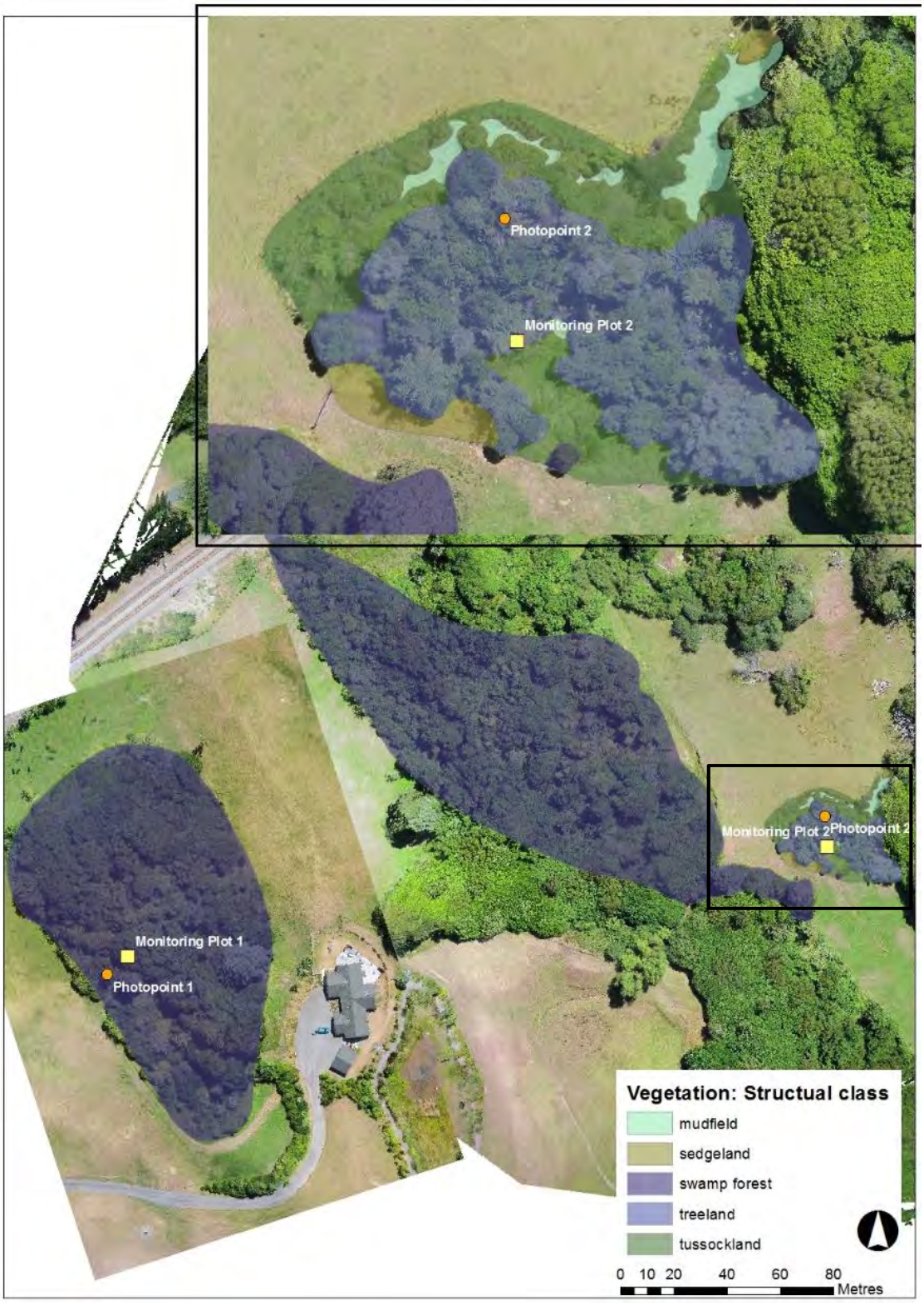

Figure 13. Local wetland vegetation communities at Tini Bush Wetland (March 2015 aerial photograph), Note second plot is enlarged in insert for clarity.

3.7.4 Piezometer Records

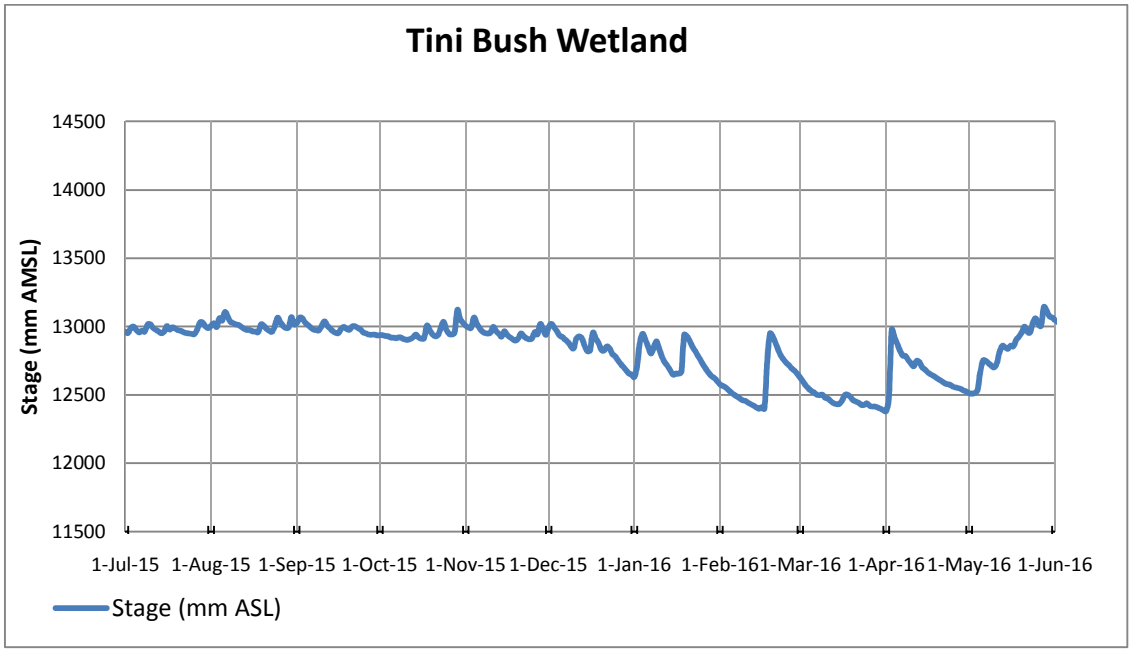

Figure 14: Shallow groundwater levels for Tini Bush wetland during the 2015/16 reporting period.

3.8 El Rancho Wetland (Weggery)

3.8.1 Wetland fauna

No wetland fauna was recorded during the 2016 survey.

3.8.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.8.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 9 summarises the plot vegetation species presence and cover data. El Rancho Plot 1 is a manuka swamp; El Rancho Plot 2 is also a manuka swamp.

The baseline map of El Rancho wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 15. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 9 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for El Rancho Wetland.

Parameters		El Rancho_1 (east)	Elrancho_2
Proportion of visual estimates of vegetation cover.	Exotic	0%	14%
	Native	100%	86%
	UPL	0%	0%
	FACU	0%	57%
	FACW	60%	43%
	FAC	20%	0%
	OBL	20%	0%
	Total % cover	5	7
Proportion of species.	Exotic	0%	14%
	Native	100%	86%
	UPL	0%	0%
	FACU	0%	57%
	FACW	60%	43%
	FAC	20%	0%
	OBL	20%	0%
	Total no. spp	5	7

Figure 15: Local wetland vegetation communities at El Rancho wetland (March 2015 aerial photograph).

3.8.4 Piezometer records

The area round piezometer 2008/BH 205 (M2PP site) was flooded in May 2015 due to an extreme rainfall events and not data have been collected since.

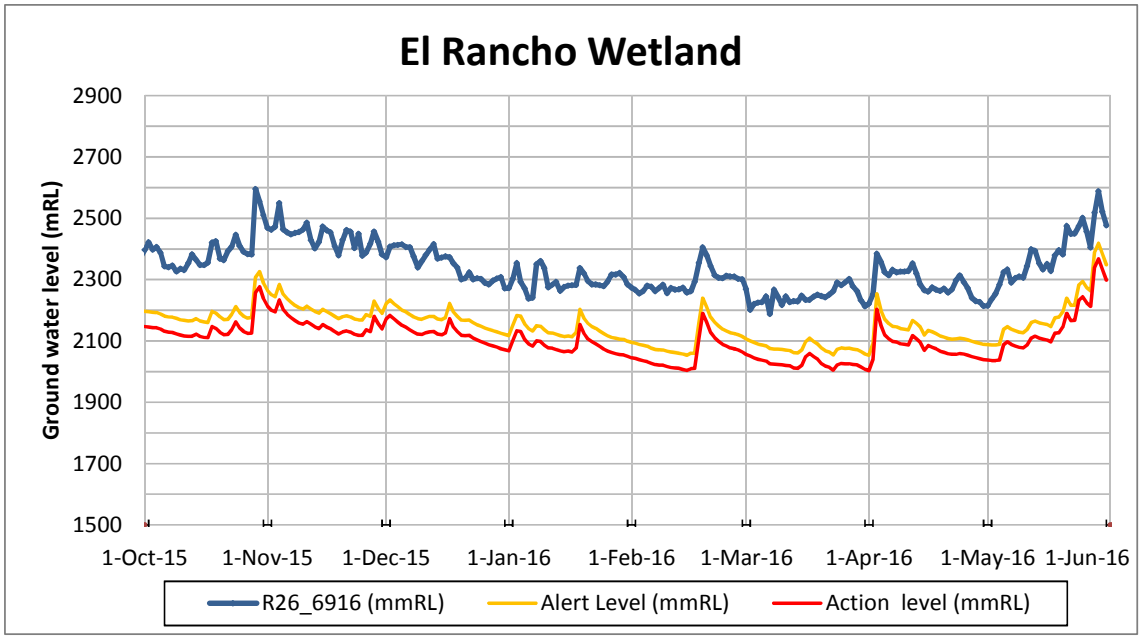

Figure 16: Shallow groundwater levels for El Rancho (Weggery) wetland logger R26_6916 during the 2015/16 reporting period.

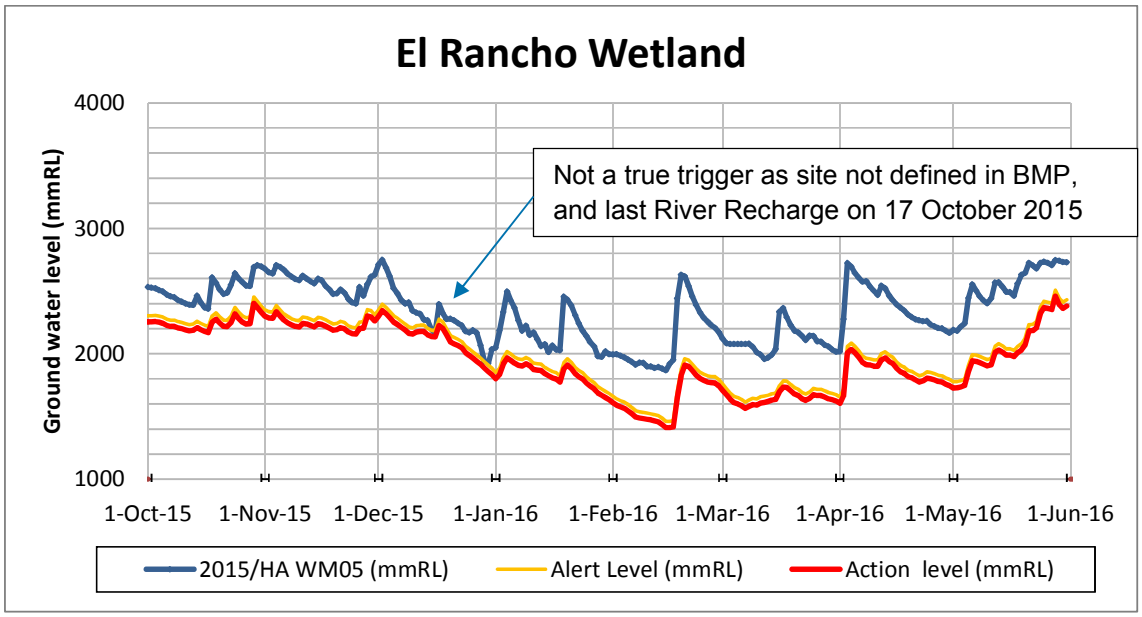

Figure 17 Shallow groundwater levels for El Rancho (Weggery) wetland logger 2015/HA WM05, during the 2015/16 reporting period. Triggers copied from pervious site (2011/HA WM05), no triggers have been formally set for this site.

3.9 Te Harakeke / Kawakahia Wetland

3.9.1 Wetland fauna

During the 2016 survey common native bird species were observed: grey warbler, fantail, and tui.

3.9.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.9.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 10 summarises the plot vegetation species presence and cover data. Te Harakeke Plot 1 is a sedgeland with a dominance of *Carex lessoniai, t*he creeper (convolvulus: *Calystegia sepium*) and blackberry (Rubus fruticosus). Te Harakeke Plot 2 is a sedge/grassland fen with a dominance of raupo, juncus and willow-weed. Both plots are in Palustrine fens in basins (depressions).

The baseline map of Te Harakeke wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 18. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 10 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Te Harakeke Wetland.

Parameters		Te Harakeke_	Te Harakeke_2
Proportion of visual estimates of vegetation cover.	Exotic	75%	57%
	Native	25%	43%
	UPL	0%	0%
	FACU	100%	0%
	FACW	0%	71%
	FAC	0%	21%
	OBL	0%	7%
	Total % cover	20	70
Proportion of species.	Exotic	50%	60%
	Native	50%	40%
	UPL	0%	0%
	FACU	100%	0%
	FACW	0%	60%
	FAC	0%	20%
	OBL	0%	20%
	Total no. spp	2	5

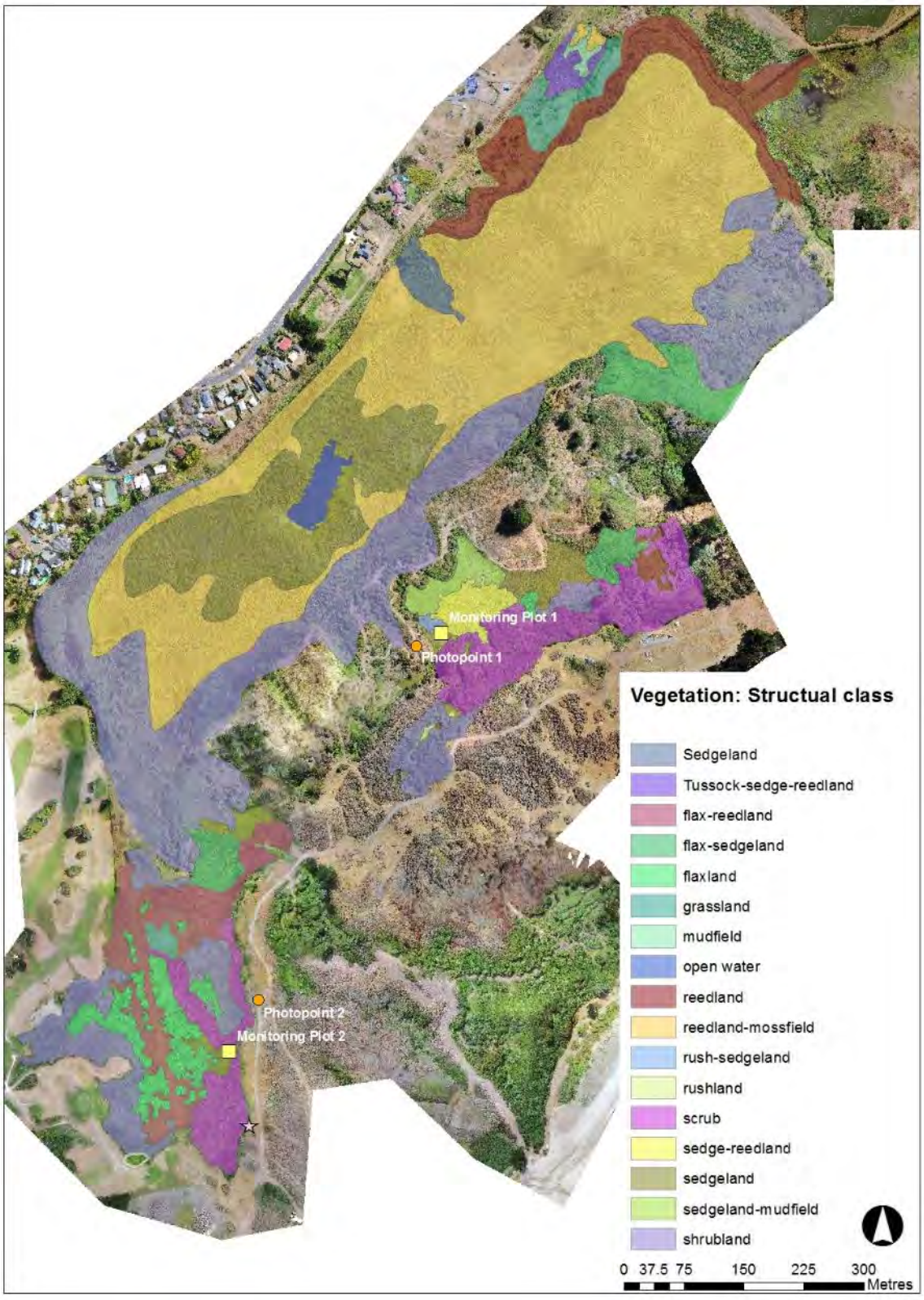

Figure 18. Local wetland vegetation communities Te Harakeke / Kawakahia wetland over the March 2015 aerial photograph.

3.9.4 Piezometer records

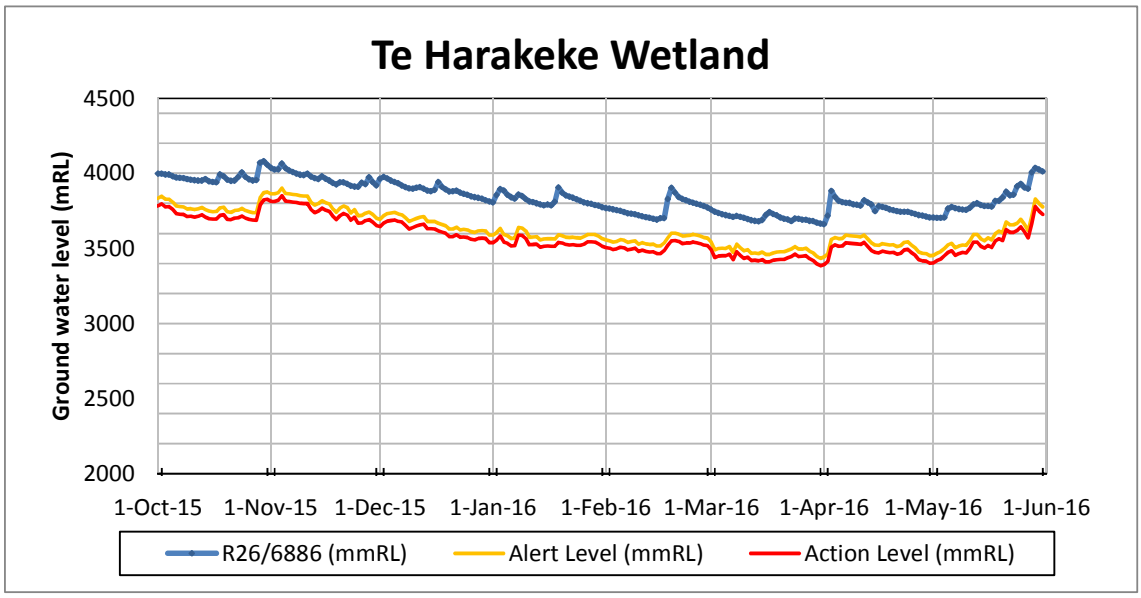

Figure 19: Shallow groundwater levels for Te Harakeke wetland during the monitoring period for 2015/16

3.10 Nga Manu Wetland

3.10.1 Wetland fauna

Tui, kereru and a large number of waterfowl were observed at the site.

3.10.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.10.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 11 summarises the plot vegetation species presence and cover data. Nga Manu Plot 1 is a flaxland fen with wetland shrubs; Nga Manu Plot 2 is a sedge/grassland fen with a dominance of *Carex virgata*, and bracken.

The baseline map of Nga Manu wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 20. There are several wetland types present, but the dominant classes are carex sedgeland and flaxland-wet shrubland. Note the community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 11 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Nga Manu Wetland.

Parameters		Nga Manu_1	Nga Manu_2
Proportion of visual estimates of vegetation cover.	Exotic	1%	6%
	Native	99%	106%
	UPL	0%	3%
	FACU	23%	44%
	FACW	4%	39%
	FAC	0%	14%
	OBL	72%	0%
	Total % cover	90	79
Proportion of species.	Exotic	14%	8%
	Native	86%	92%
	UPL	0%	8%
	FACU	43%	33%
	FACW	29%	33%
	FAC	0%	17%
	OBL	29%	0%
	Total no. spp	7	12

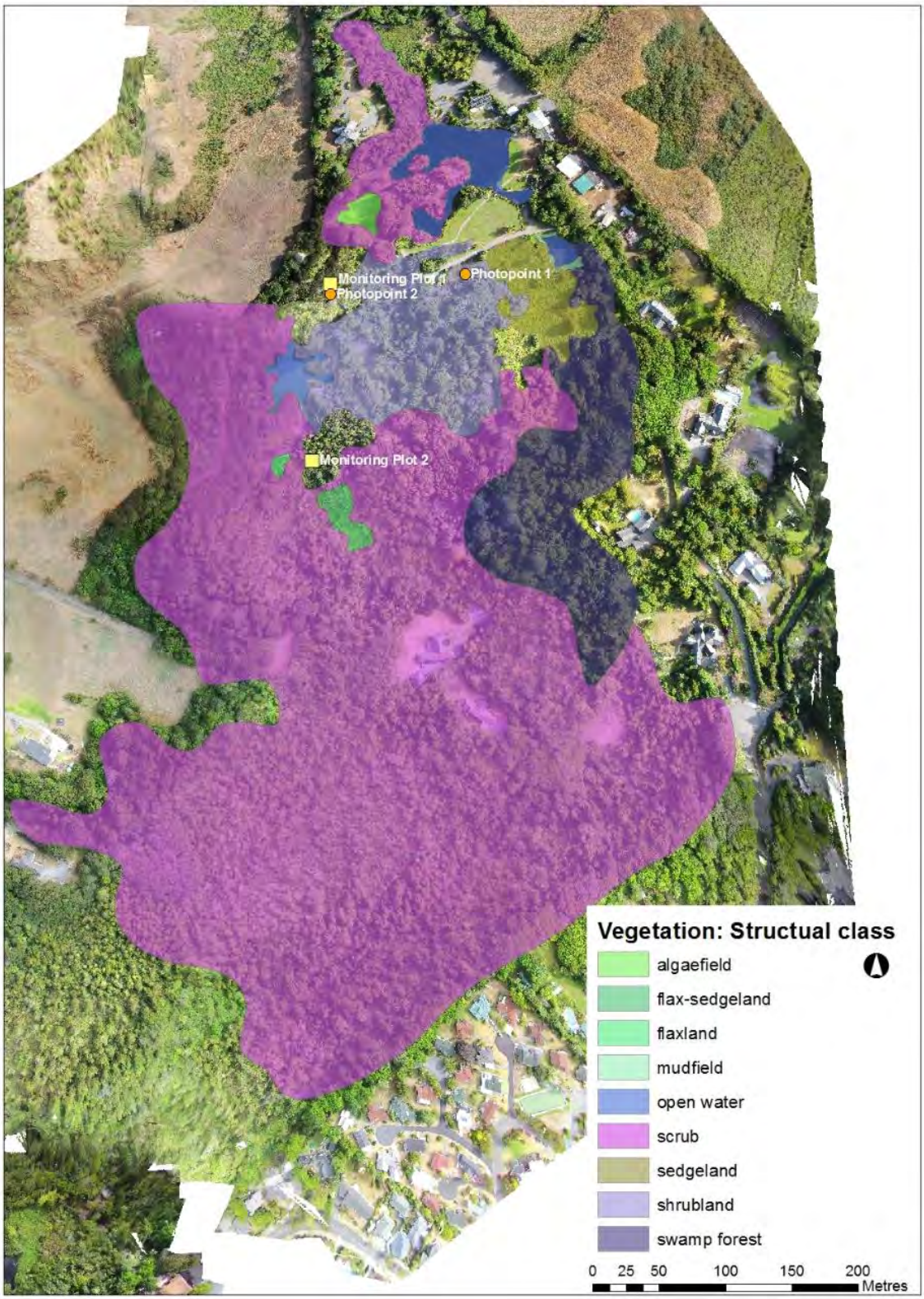

Figure 20. Baseline Map (from March 2015 survey) of vegetation communities within Nga Manu wetland over the aerial photograph

3.10.4 Piezometer records

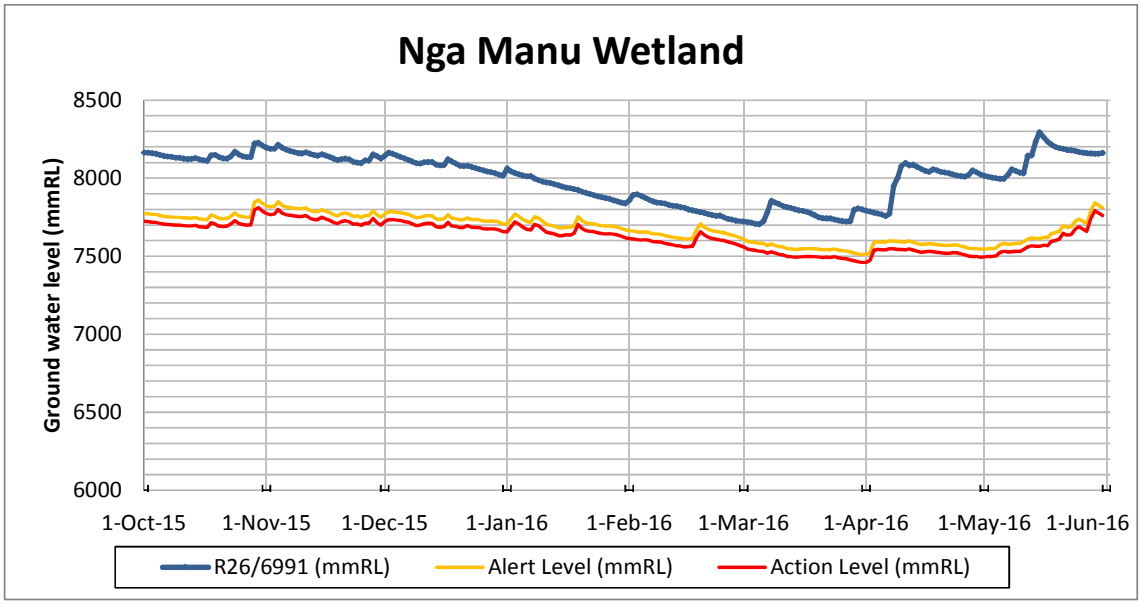

Figure 21: Shallow groundwater levels for Nga Manu wetland during the 2015/16 reporting period.

3.11 Ngarara Wetland

3.11.1 Wetland fauna

No native fauna were recorded in the 2016 survey. Fernbird have been recorded previously in the wider area.

3.11.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.11.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

The fens here are Carex sedgeland that are strongly invaded by blackberry. Table 12 summarises the plot vegetation species presence and cover data. Ngarara Plot 1 is a blackberry growth over Carex. Plot 2 is a *Carex virgata* sedgeland.

The baseline map of Ngarara wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 22.The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Table 12 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Ngarara Road Wetland.

Parameters		Ngarara Road _1
Proportion of visual estimates of vegetation cover.	Exotic	93%
	Native	7%
	UPL	0%
	FACU	90%
	FACW	3%
	FAC	0%
	OBL	7%
	Total % cover	67
Proportion of species.	Exotic	67%
	Native	33%
	UPL	0%
	FACU	33%
	FACW	33%
	FAC	0%
	OBL	33%
	Total no. spp	3

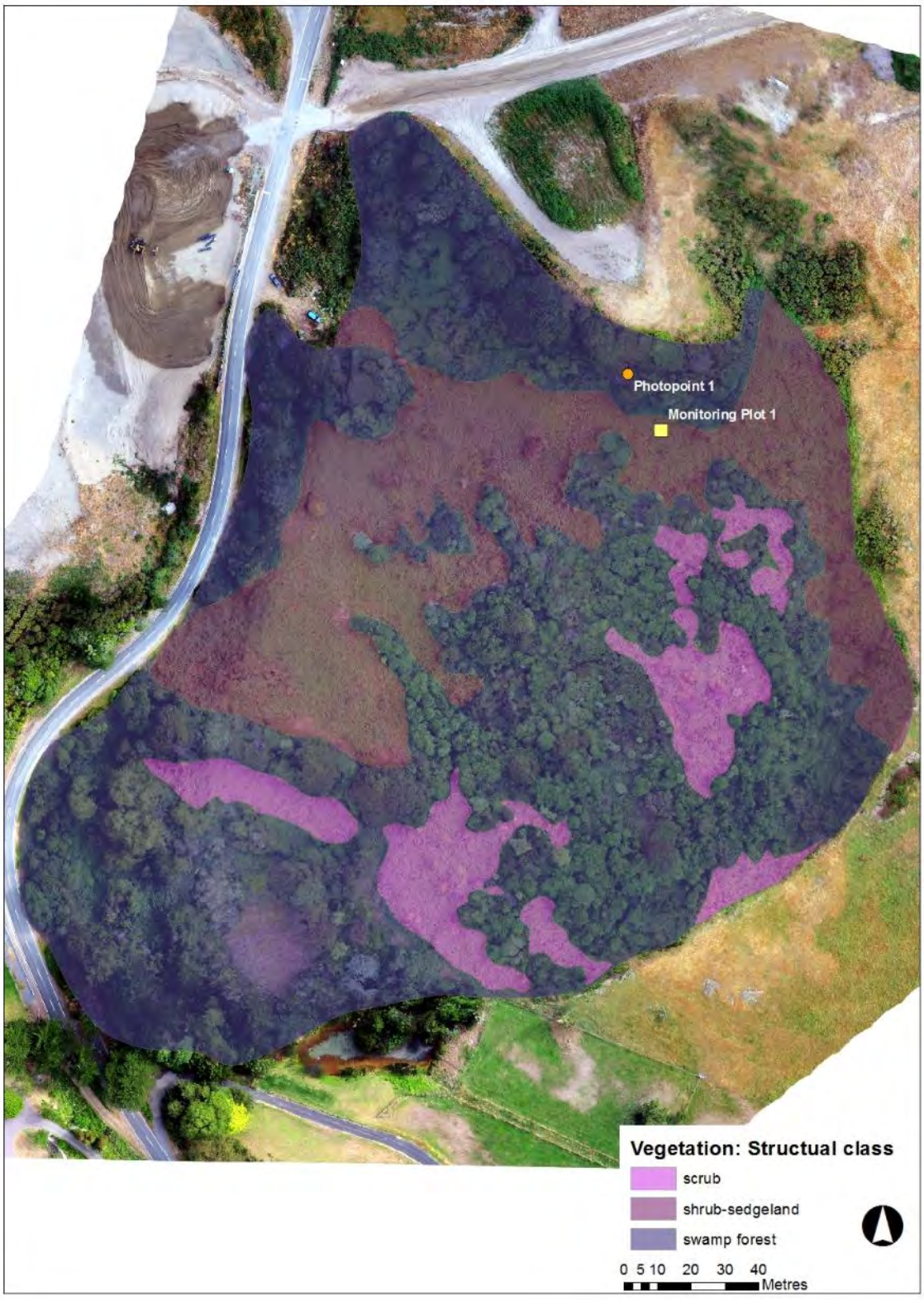

Figure 22. Local wetland vegetation communities at Ngarara Wetland over the March 2015 aerial photograph.

3.11.4 Piezometer records

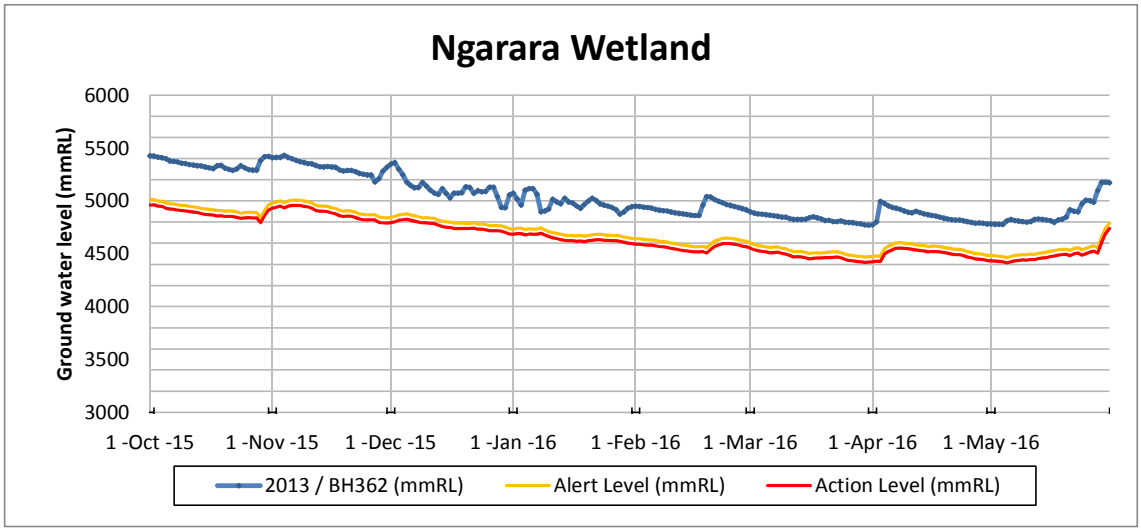

Figure 23: Shallow groundwater levels for Ngarara wetland during the 2015/16 reporting period.

3.12 Ngarara Bush Wetland

The property owner of Ngarara Bush wetland changed following the 2014/2015 reporting period. This meant that wetland condition monitoring at Ngarara Bush wetland was slightly delayed, until access permission was granted.

3.12.1 Wetland fauna

During the 2016 survey common native bird species were observed i.e.: grey warbler and tui.

3.12.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.12.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 13 summarises the plot vegetation species presence and cover data. Ngarara Bush Plot 1 is a mahoe-kahikatea swamp forest with a drier kohekohe edge and typical limited (by shading) damp forest under canopy species. Ngarara Bush Plot 2 is a mahoe forest with regenerating pukatea and kohekohe and broadleaf native shrub and lower canopy species.

The baseline map of Ngarara wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 24. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable. The vegetation is principally a pukatea, kahikatea, semi-swamp forest, with kohekohe on margins.

Table 13 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Ngarara Bush Wetland.

Parameters		Ngarara Bush_1	Ngarara Bush_2
Proportion of visual estimates of vegetation cover.	Exotic	0%	27%
	Native	100%	73%
	UPL	7%	30%
	FACU	7%	21%
	FACW	33%	1%
	FAC	40%	47%
	OBL	0%	0%
	Total % cover	15	81
Proportion of species.	Exotic	0%	25%
	Native	100%	75%
	UPL	17%	25%
	FACU	17%	25%
	FACW	17%	13%
	FAC	33%	25%
	OBL	0%	0%
	Total no. spp	6	8

Figure 24. Local wetland vegetation communities at Ngarara Bush wetland over the March 2015 aerial photograph.

3.12.4 Piezometer records

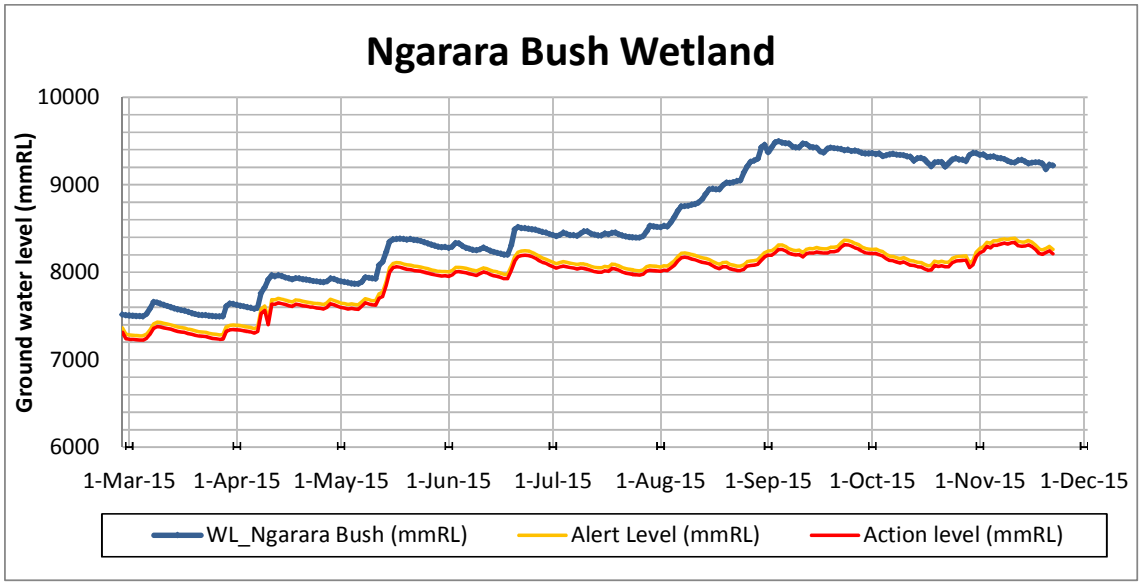

Figure 25: Shallow groundwater levels for Ngarara Bush wetland during the 2015 reporting period.

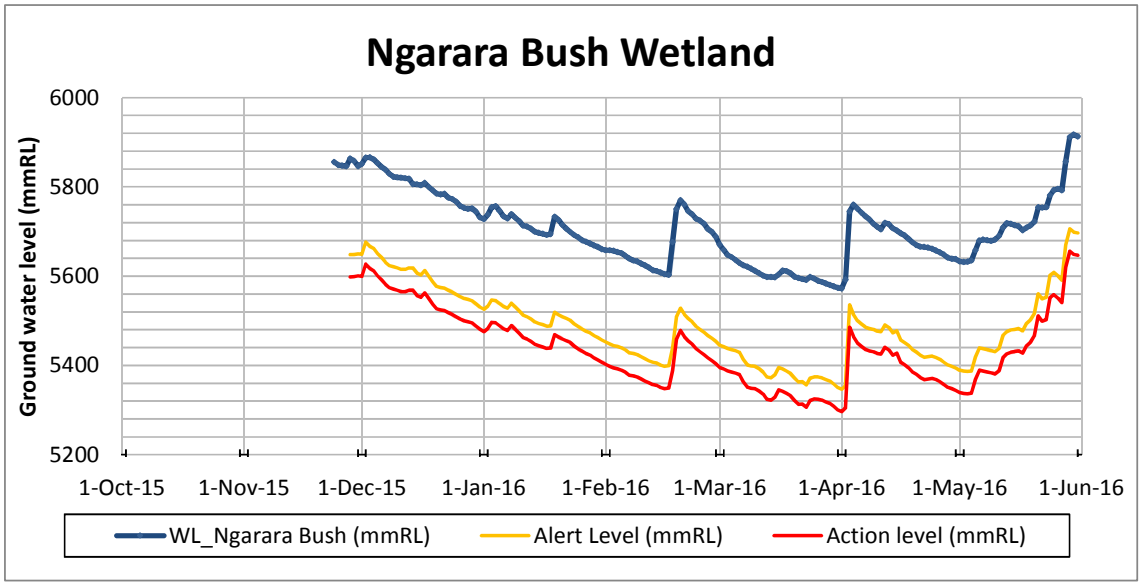

Figure 26: Shallow groundwater levels for Ngarara Bush wetland during the 2015/16 reporting period following installation of new logger at time of per-monitoring season checks.

3.13 Peka Peka Road

3.13.1 Wetland fauna

No wetland fauna recorded in the 2016 survey.

3.13.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.13.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 14 summarises the plot vegetation species presence and cover data. Peka Peka Plot 1 is a harakeke, raupo fen with edge wetland mingimingi. Peka Peka Plot 2 is a toitoi, wetland mingimingi wetland shrubland.

The Peka Peka site is a “fen” with toitoi, raupo and native wetland shrubs with areas of blackberry and willow. The baseline map of Peka Peka Road wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 27. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable.

Table 14 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Peka Peka Wetland.

Parameters		Pekapeka_1	Pekapeka_2
Proportion of visual estimates of vegetation cover.	Exotic	0%	2%
	Native	100%	98%
	UPL	0%	0%
	FACU	0%	0%
	FACW	38%	28%
	FAC	38%	2%
	OBL	23%	70%
	Total % cover	13	115
Proportion of species.	Exotic	0%	17%
	Native	100%	83%
	UPL	0%	0%
	FACU	0%	0%
	FACW	50%	33%
	FAC	25%	17%
	OBL	25%	50%
	Total no. spp	4	6

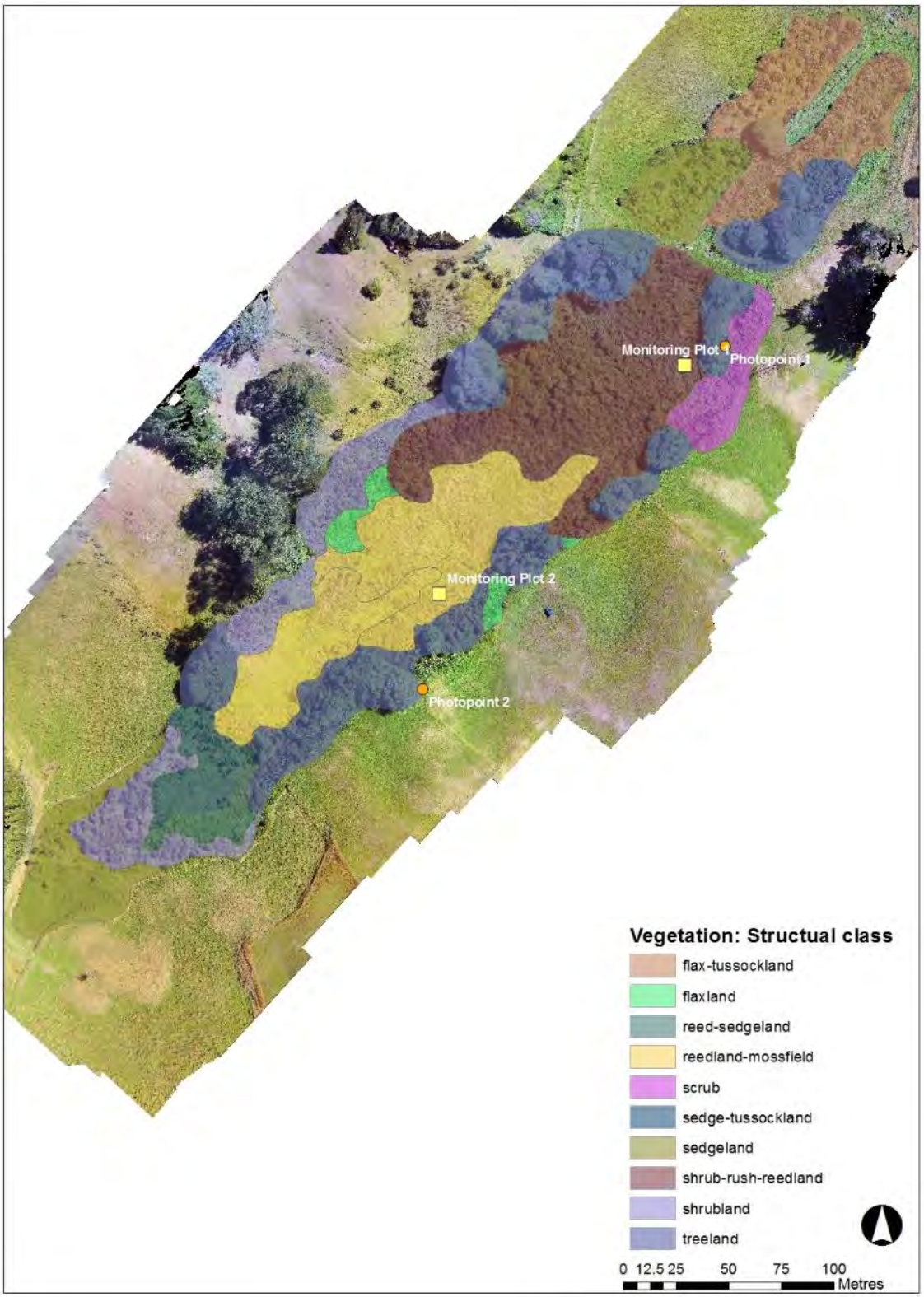

Figure 27. Local wetland vegetation communities of Peka Peka Road swamp over the March 2015 aerial photograph.

3.13.4 Piezometer records

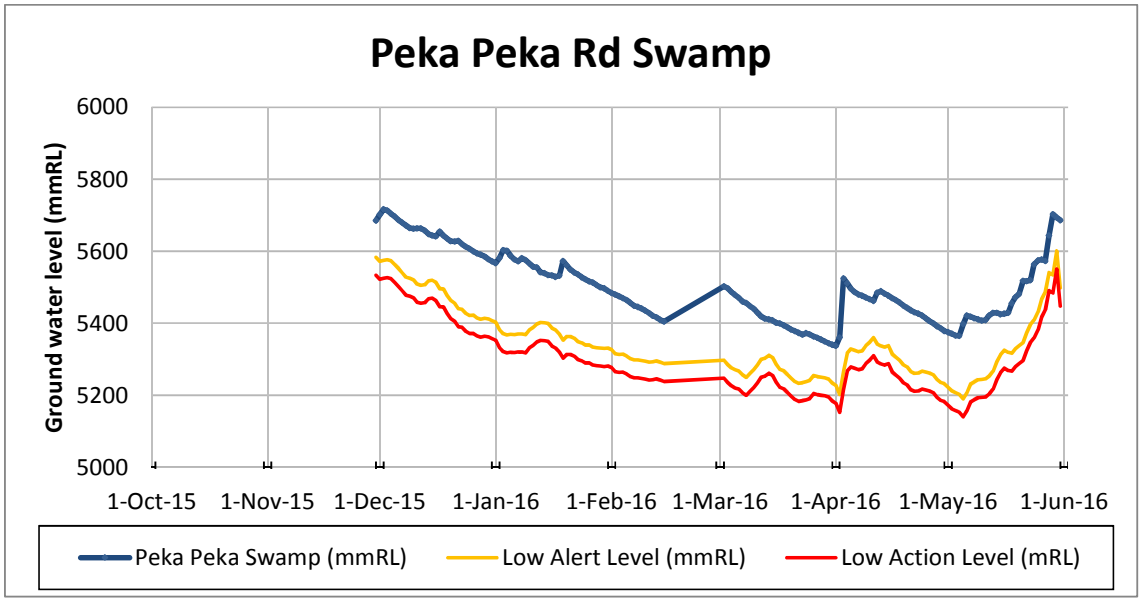

Figure 28 Shallow groundwater levels for Peka Peka Road swamp during the 2015/16 reporting period.

3.14 Te Hapua Swamp Complex A

The property owner Te Haupua swamp complex A changed following the 2014/2015 reporting period. This meant that wetland condition monitoring at Ngarara Bush wetland was slightly delayed, until access permission was granted.

3.14.1 Wetland fauna

No fauna were observed during the vegetation surveys.

3.14.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.14.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 15 summarises the plot vegetation species presence and cover data. Te Haupua swamp complex A Plot 1 is an *Isolepis* reedland. Te Haupua swamp complex A Plot 2 is a *Juncus* reedland with exotic weeds.

The wetland is largely a wet reed and sedgeland with *Isolepis* and *Carex-Juncus* and bracken. The baseline map of Te Haupua swamp complex A, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 29. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable.

Table 15 Showing proportions (as a % of total) of vegetation within permanent plots, classified into wetland fidelity groups, of both plot vegetative cover and species presence for Te Hapua Swamp Complex A.

Parameters		Te Hapua Complex A_1	Te Hapua Complex A_2
Proportion of visual estimates of vegetation cover.	**Exotic**	**92%**	**11%**
	Native	**8%**	**89%**
	UPL	**0%**	**0%**
	FACU	**0%**	**0%**
	FACW	**91%**	**43%**
	FAC	**0%**	**0%**
	OBL	**7%**	**57%**
	Total % cover	**103**	**61**
Proportion of species.	**Exotic**	**57%**	**29%**
	Native	**43%**	**71%**
	UPL	**0%**	**0%**
	FACU	**0%**	**0%**
	FACW	**57%**	**71%**
	FAC	**0%**	**0%**
	OBL	**29%**	**29%**
	Total no. spp	**7**	**7**

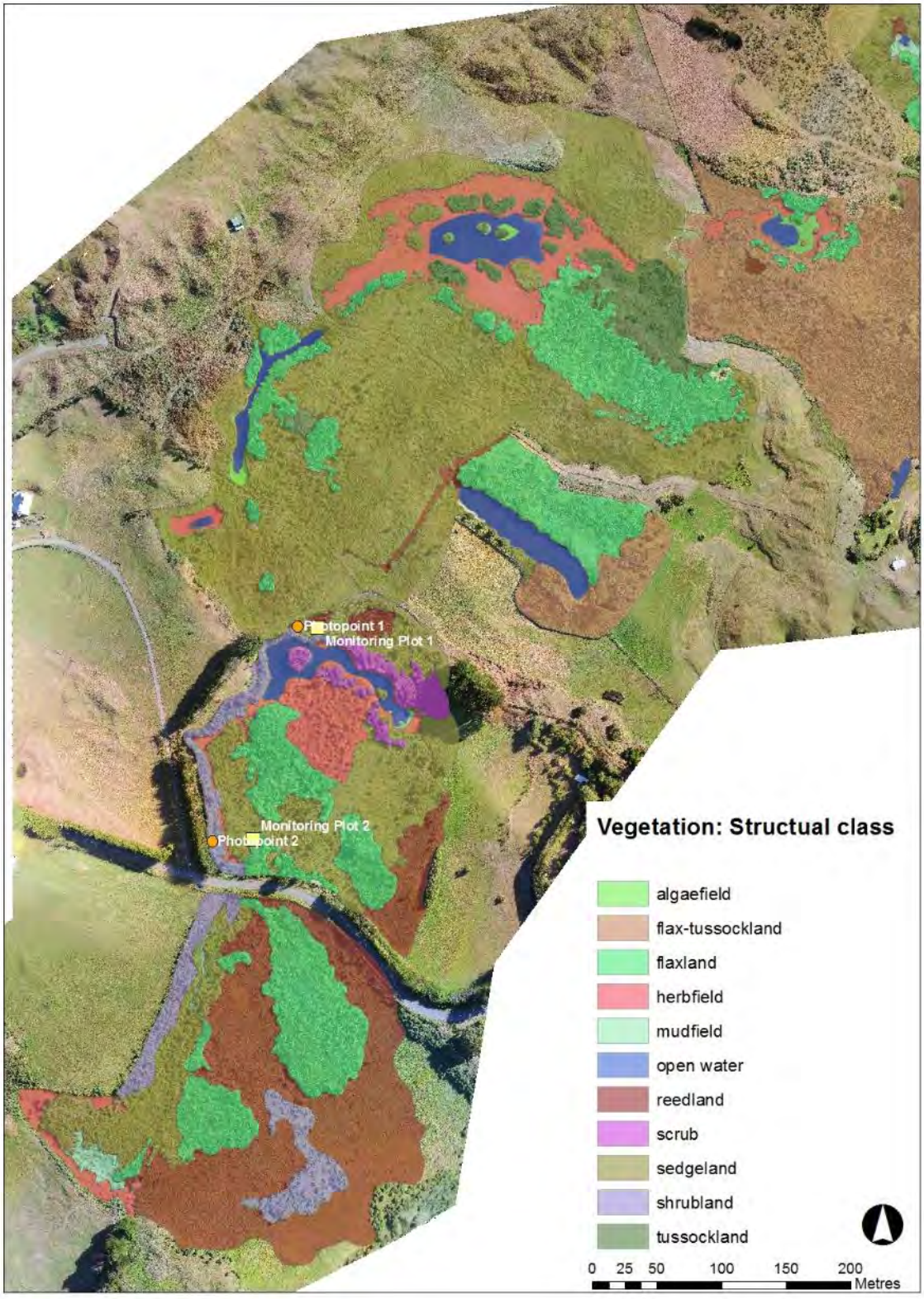

Figure 29. Local wetland vegetation communities of Te Hapua Swamp Complex A over the March 2015 aerial photograph.

3.14.4 Piezometer records

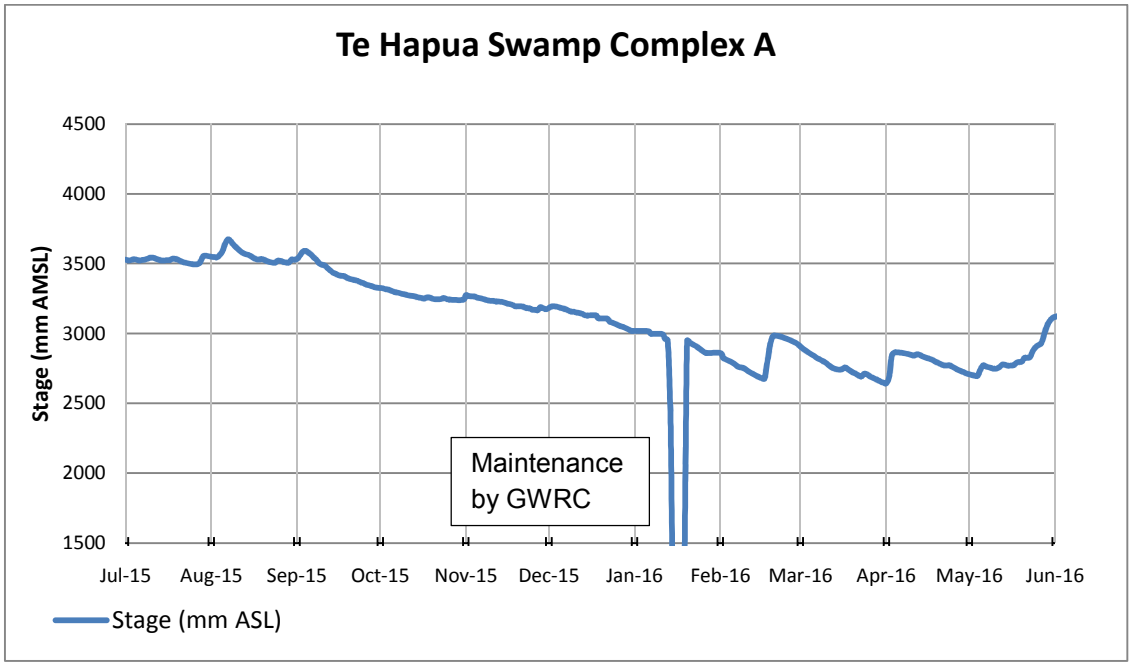

Figure 30: Shallow groundwater levels for Te Hapua Swamp Complex A during the March 2015 – May 2016 reporting period.

3.15 Te Hapua Swamp Complex D

3.15.1 Wetland fauna

Native pukeko were observed on site. Royal spoonbill, also native, was reported as present by the land owner.

3.15.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.15.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 16 summarises the plot vegetation species presence and cover data. Te Haupua swamp complex D Plots 1 and 2 are a sedgelands with a dominance of *Carex geminate.*

There are several wetland types present, ranging from carex sedgeland fen, raupo swamp, to harakeke semi-swamp. The baseline map of Te Hapua Swamp Complex D wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 31. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable

Table 16 Showing proportions (as a % of total) of vegetation within permanent plots, classified into wetland fidelity groups, of both plot vegetative cover and species presence for Te Hapua Swamp Complex D.

Parameters		TeHapua complex D_1	TeHapua complex D_2
Proportion of visual estimates of vegetation cover.	Exotic	43%	0%
	Native	57%	100%
	UPL	0%	0%
	FACU	63%	0%
	FACW	36%	67%
	FAC	1%	0%
	OBL	0%	33%
	Total % cover	96	105
Proportion of species.	Exotic	40%	0%
	Native	60%	100%
	UPL	0%	0%
	FACU	40%	0%
	FACW	40%	50%
	FAC	20%	0%
	OBL	0%	50%
	Total no. spp	5	2

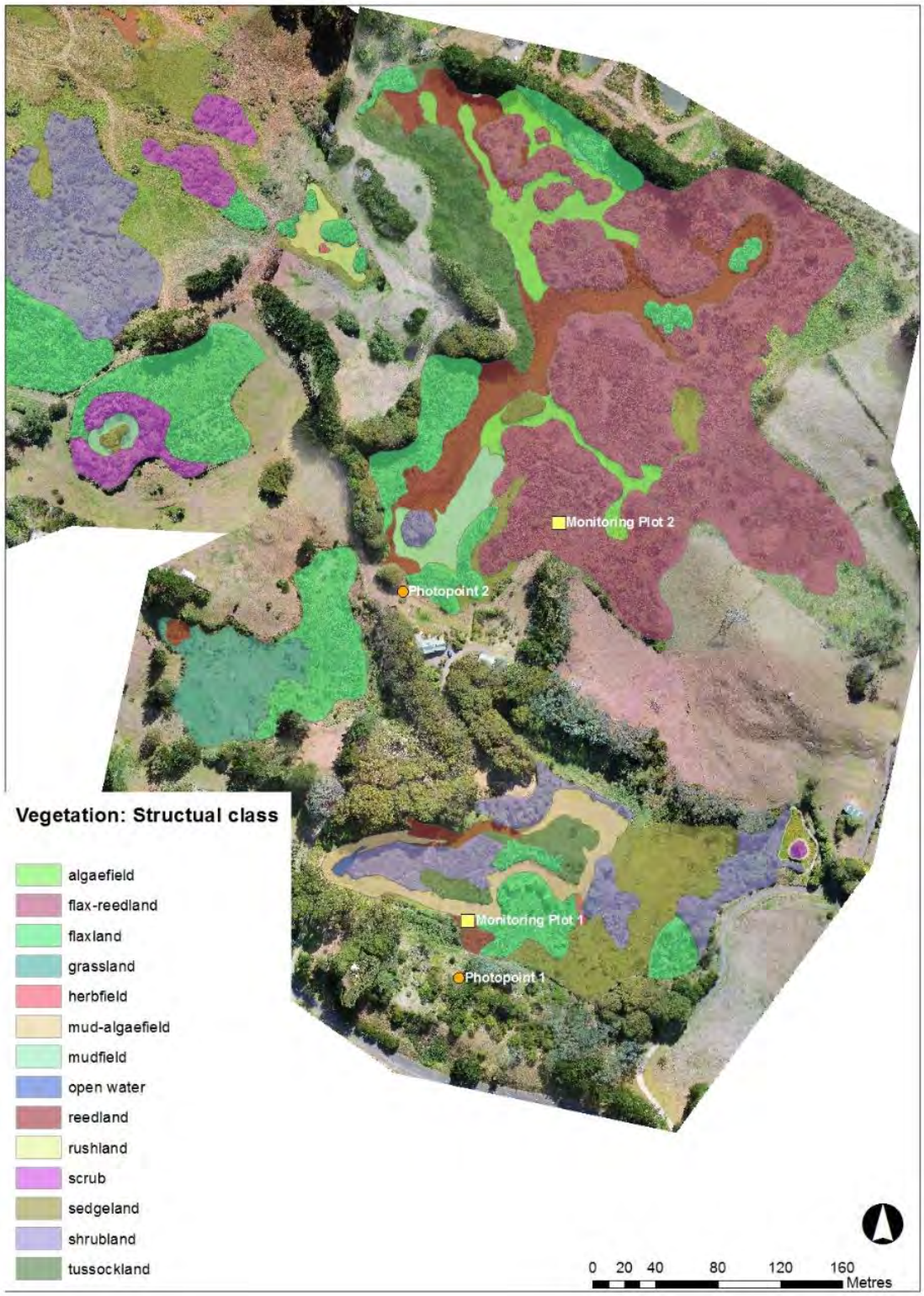

Figure 31. Local wetland vegetation communities of Te Hapua Swamp Complex D over the March 2015 aerial photograph.

3.15.4 Piezometer records

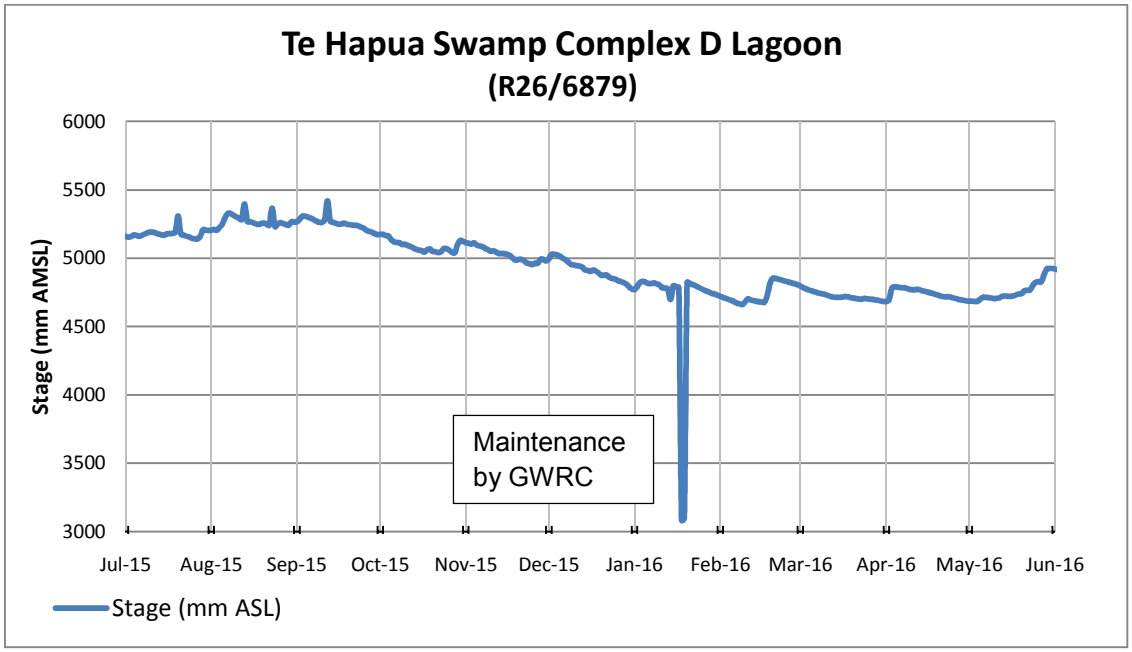

Figure 32 Shallow groundwater levels for Te Hapua Swamp Complex D during the March 2015 – May 2016 reporting period.

4. Wetland classes

For each monitoring period the wetland classification (Johnson & Gerbeaux, 2004) is assessed and reported in the Table 17 below. It compares the wetland classifications from the wetland BMP with the classification determined for the monitoring site following the annual wetland condition monitoring survey. Note that the 2015/16 survey showed no changes to the initial 2014/15 survey.

Table 17: Showing wetland classifications as per (Johnson & Gerbeaux, 2004) for the 2016 wetland monitoring survey.

Wetland name	BMP Wetland class	2014/15 classification	2015/16 classification	Description
Nationally or Regionally Significant Wetland				
Muaupoko Swamp forest	Fen	Fen	Fen	Forest (upper section) with lower wetland dominated by shrubland (swamp Coprosma) with areas of sedgeland.
Nga Manu wetland	Fen	Fen	Fen	Predominantly forest with small, scattered areas of sedgeland dominated by *Carex secta* and *Carex virgata* and areas of shrubland and open water.
Te Hapua Swamp complex A	Swamp	Swamp	Swamp	Tussockland (flaxland) with areas of reedland dominated by raupo. Occasional areas of shrubland.
Te Hapua Swamp complex D	Fen	Fen	Fen	Tussockland (flaxland) with areas of reedland dominated by raupo.
Te Harakeke / Kawakahi wetland	Swamp	Fen	Fen	Tussockland (flaxland) with areas of reedland dominated by raupo.
Locally significant or information deficit wetlands				
El rancho (Weggery) wetland	Fen	Fen	Fen	Shrubland with small, scattered areas of sedgeland dominated by *Carex secta* and *Carex virgata* and occasional rushland dominated by *Baumea.*
Peka Peka Rd swamp	Swamp	Swamp	Swamp	Tussockland (flaxland) with areas of reedland dominated by raupo. Occasional areas of shrubland dominated by swamp Coprosma.

Wetland name	BMP Wetland class	2014/15 classification	2015/16 classification	Description
Tini bush wetland	Fen	Fen	Fen	Forest with small, scattered areas of sedgeland dominated by *Carex secta* and *Carex virgata.*
Ngarara bush wetland	Fen	Fen	Fen	Forest. Small fragment of kohekohe forest and a very small area of swamp forest
Ngarara Road wetland	Fen	Fen	Fen	Shrubland with small, scattered areas of sedgeland dominated by *Carex secta* and *Carex virgata.*
Otaihanga Southern Wetland	Fen	Fen	Fen	Sedgeland dominated by *Carex secta* and *Carex virgata* with small areas of Baumea rushland.
Crown hill manuka bush wetland	Fen	Fen	Fen	Shrubland with small, scattered areas of sedgeland and flaxland.
Poplar Ave wetland	Fen	Fen	Fen	Shrubland dominated by manuka with sedgelands and rushlands.

5. Summary

This report presents the second year of a total three year baseline monitoring period, for wetland condition, pressure and indicator values. Established vegetation plots provide records of species and proportional cover which has been classified into groups of wetland fidelity.

The second year of baseline monitoring for the river recharge with groundwater consent, like the first baseline year, occurred during a relatively warm, dry summer.

The data did not show a significant decline or change in wetland conditions and therefore a new aerial photograph and vegetation map was not triggered.

6. References

Atkinson, I. A. E. (1985). Derivation of vegetation mapping units for an ecological survey of Tongariro National Park North Island, New Zealand. *New Zealand Journal of Botany*, *23*, 361–378.

Clarkson, B. R. (2013). *A vegetation tool for wetland delineation in New Zealand* (No. doi:10.7931/J2TD9V77) (p. 70). Landcare Research for Meridian Energy Ltd.

Clarkson, B. R., Sorrell, B. K., Reeves, P. N., Champion, P. D., Partridge, T. R., & Clarkson, B. D. (2004). *Handbook for monitoring wetland condition: Coordinated monitoring of New Zealand wetlands*. Wellington: Ministry for the Environment.

Johnson, P., & Gerbeaux, P. (2004). *Wetland types in New Zealand*. Wellington: Department of Conservation.

NIWA National Climate Centre. (2016). *New Zealand climate summary: January 2016* (NIWA National Climate Centre Monthly Climate Summary). NIWA. Retrieved from https://www.niwa.co.nz/sites/niwa.co.nz/files/Climate_Summary_January_2016_0.pdf

Appendix A Raw data sheets

Poplar Ave Wetland

WETLAND RECORD SHEET			
Project:	Kapiti water supply	**Date:**	12 Feb 2016
Wetland name:	Poplar ave	**Time:**	8am
Region:	Kapiti Coast	**Personal:**	TR, PE
Altitude:	19m elevation	**# of Plots sampled:**	2

Classification: I System	**IA Subsystem**	**II Wetland Class**	**IIA Wetland Form**
Palustrine	Permanent	Fen	Basin

Indicator	**Indicator components**	**Specify and Comment**	**Score 0– 5[1]**	**Mean score**
Change in hydrological integrity	Impact of manmade structures	Induced historical drainage as part of drain 7 adjacent. Residential and roading construction nearby	2	3.00
	Water table depth	dry summer	3	
	Dryland plant invasion	Minimal, some blackberry and gorse on edges, willow and elder samplings found. Regular control due to being a regional park	4	
Change in physico-chemical parameters	Fire damage	nil	5	4.25
	Degree of sedimentation/erosion	Some runoff noted due to construction of bicyle trail to the south of wetland.	4	
	Nutrient levels	Some farming and stormwater run off presumed.	4	
	Von Post index	scored a 6	4	
	Loss in area of original wetland	Some noted infilling and changed hydrology and	3	2.50

Change in ecosystem intactness		earthworks, fragmented by poplar ave road.		
	Connectivity barriers	Farmland, residential and large areas of gorse and blackberry	2	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Rubbish tipping, Canada geese browsing	4	4.00
	Introduced predator impacts on wildlife	Low, however no control apparent. Domestic and feral cats presumed.	3	
	Harvesting levels	Nil	5	
Change in dominance of native plants	Introduced plant canopy cover	Minimal gorse and blackberry. Purple loosestrife noted in neighbouring wetland.	4	4.00
	Introduced plant understorey cover	Holcus lanatus appearing	4	
Total wetland condition index /25				17.75

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Edge manuka canopy grading internally into a Flax Baumea and Isolepis prolifera and sphagnum community.

Native fauna: Pukeko, spur-wing plover, skylark.

Other comments: Within QE Regional Park - well maintained by volunteers and park staff, newly constructed metalled bicycle path to the western edge of the wetland.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	3	Expressway construction to east and ongoing drain maintenance in Drain 7 and Wharemauku stream, adjacent affecting water levels (same bed of peat). Sand mining with pumping may also impact wetland hydrology.
Water quality within the catchment	3	Some farming and stormwater runoff.
Animal access	2	Fenced from stock. Some rabbit presence noted in area. Domestic cats likely to be main issue
Key undesirable species	3	Willow, elder, Gorse, blackberry, purple loosestrife and weeds from past fly tipping within the area are present.

% catchment in introduced vegetation	4	Much of the catchment in gorse, blackberry and adjacent residential housing.
Other landuse threats	1	Dumping, drainage.
Total wetland pressure index /30	16	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Poplar Ave Wetland

WETLAND PLOT SHEET					
Wetland name:	Poplar Ave	**Date:**	12 Feb 2016	**Plot no:**	1
Plot size:	2mx2m	**Altitude:**	14 masl	**Structure:**	Rushland
Personal:	TR, PE	**Northing** **Easting**	5466148 1766852	**Composition:**	Baumea/ Isolepis/ sphagnum

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H (m)**	**Species**	**%**	**H (m)**	**Species**	**%**	**H (m)**
Open Water	0	0	Holcus lanatus	5	0.7	Hydrocotyle pterocarpa	1	0.05
Leptospermum scoparium	10	1.5	Isolepis prolifera	40	0.4	Sphagnum moss	70	0.05
			Machaerina teretifolia	1	0.8			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Carex virgata, lotus pedunculatus, Blechnum NZ*

Fauna seen: pukeko swallow, thrush, skylark

Comments: A lot of spider nests.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species[2]	0	5	Gorse increasing
Understorey: % cover introduced spp[3]	5	4	-

Total species: % number introduced spp	5	4	Gorse increasing, along with manuka
Total species: overall stress/dieback	20	4	Manuka die-back.
	Total /20	17	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high. [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	**n/a**	Water conductivity uS (if present)	**n/a**
Water pH (if present)	**n/a**	Von Post peat decomposition index	**5**

Plot 2: Poplar Ave Wetland

WETLAND PLOT SHEET					
Wetland name:	Poplar Ave	**Date:**	12.02.2016	**Plot no:**	2
Plot size:	2mx2m	**Altitude:**	12 masl	**Structure:**	Shrubland - sedgeland
Personal:	TR, PE	**Northing** **Easting**	5466195 1766834	**Composition:**	Manuka/baumea/ isolepis

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**h(m)**	**Species**	**%**	**h(m)**	**Spp**	**%**	**h(m)**
Open water	0	0	Machaerina teretifolia	20	2	Nertera scapanioides	1	0.05
Leptospermum scoparium var. scoparium	50	2	Isolepis prolifera	35	0.4	Gonocarpus micranthus subsp. Micranthus	1	0.1
			Hypolepis distans	2	0.5	Sphagnum moss	70	0.05
			Phormium tenax	2	1.6	Holcus lanatus	2	0.05
			Carex virgata	1	0.8			
			Lotus penduculatus	1	0.5			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Gorse

Fauna Seen: Skylark

Comments: Hole in centre of plot.

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	-
Understorey: % cover introduced spp[3]	3	4	Holcus lanatus, lotus
Total species: % number introduced spp	3	4	Gorse increasing, along with manuka
Total species: overall stress/dieback	NA	4	Isolepis decreasing
Total /20		17	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	4

Crown Hill, Manuka Bush Wetland

WETLAND RECORD SHEET			
Project:	Kapiti water supply	**Date:**	12.02.2016
Wetland name:	Crown hill/manuka bush	**Time:**	3.05
Region:	Kapiti Coast	**Personal:**	TR, KS
Altitude:	19	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0–5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures	Small remnant remains, situated within residential area, with houses either side, M2PP expressway construction nearby.	2	2.33
	Water table depth	dry summer	2	
	Dryland plant invasion	Some annual weeds and blackberry invading.	3	
Change in physico-chemical parameters	Fire damage	Nil	5	4.00
	Degree of sedimentation/erosion	Currently nil, past development will of impacted site.	5	
	Nutrient levels	Presumed low (no outside influence).	4	
	Von Post index	Scored 7	2	
Change in ecosystem intactness	Loss in area of original wetland	Due to topography of site and surrounds, this was likely part of a bigger wetland complex	2	2.00
	Connectivity barriers	Housing segments wetland on two sides.	2	
Change in browsing,	Damage by domestic or feral animals	area fenced, possible possum damage	4	3.67

predation & harvesting regimes	Introduced predator impacts on wildlife	Very close to residential area, most likely high cat population. No predator control.	2	
	Harvesting levels	Nil	5	
Change in dominance of native plants	Introduced plant canopy cover	Nil	5	4.50
	Introduced plant understorey cover	Some blackberry and tradescantia and pasture grasses on edge	4	
			Total wetland condition index /25	16.50

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: pukatea-kahikatea Semi-swamp forest, some large hinau present.

Fauna: Sparrow, starling.

Other comments: Small piece of relict vegetation. Margins have been planted with large specimen trees (Kahikatea, Rimu).

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	4	Small area of wetland within built-up residential zone.
Water quality within the catchment	2	Nearby GW monitoring sites read water quality as good or, fair.
Animal access	3	pest animals associated with residential areas (cats, rats etc)
Key undesirable species	2	Blackberry, Willow, climbing asparagus
% catchment in introduced vegetation	4	Most of catchment, residentail or farming.
Other landuse threats	1	Development, dumping of garden waste
Total wetland pressure index /30	16	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1 Crown Hill Manuka Bush

WETLAND PLOT SHEET					
Wetland name:	Crown hill	**Date:**	17.02.2016	**Plot no:**	1

Plot size:	2mx2m	**Altitude:**	12 masl	**Structure:**	semi-swamp forest
Personal:	TR, KS	**Northing** **Easting**	5470433 1769125	**Composition:**	Laurelia novae-zelandiae, Kunzea

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H (m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Coprosma tenuicaulis	*10*	*2*	*Hypolepis ambigua*	15	0.8	*Laurelia novae-zelandiae* seedlings	1	0.1
Kunzea robusta	90	6	*Carex virgata*	15	0.7			
Muehlenbeckia complexa	1	4						
Leptospermum scoparium	1	3						

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Histoptera incisa, Cordyline australis, Myrsine australis, Melicope ternata*

Comments: Very dry, some garden waste / lawn clippings have been dumped nearby

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	1	4	Some dieback in seedlings, carex
Total /20		19	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Plot 2 Crown Hill Manuka Bush:

WETLAND PLOT SHEET					
Wetland name:	Crown hill	**Date:**	17.02.2016	**Plot no:**	2
Plot size:	2mx2m	**Altitude:**	13 masl	**Structure:**	Semi-swamp forest
Personal:	TR, KS	**Northing** **Easting**	5470433 1769125	**Composition:**	Laurelia novae-zelandiae,/broadleaf

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species[1] (or Substrate)	**%**	**H**	**Species**	**%**	**H**	**Species**	**%**	**H**
Leptospermum scoparium	*30*	*5*	*Phormium tenax*	1.00	2	*Carex geminata*	2	0.6
Myrisine australis	35	3.5	*Coprosma tenufolium*	5.00	2	*Laurelia novae-zelandiae seedlings*	2	0.01
Kunzea robusta	5	2.5	*Histiopteris incisa*	30.00	2			
Muehlenbeckia astonii	4	2						

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Aspobl, Carex virgata, kaihikatea, asp pol blackberry on the margins. Bidens present.

Comments: Margins planted - kaihikatea and rimu, vines thick, fern land in centre thick

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	

Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	1	4	Kanuka dieback
Total /20		19	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	b
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Muaupoko Swamp Forest

WETLAND RECORD SHEET			
Project:	Kapiti water supply	**Date:**	12 Feb 2016
Wetland name:	Muaupoko Swamp forest	**Personal:**	TR, PE
Region:	Kapiti Coast	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures	rail runs along NW side of forest, road along SE.	3	3.67
	Water table depth	moderate for this time of year	4	
	Dryland plant invasion	Some blackberry encroaching, some exotic species on SE edge from rubbish tipping.	4	
Change in physico-chemical parameters	Fire damage	Nil	5	4.00
	Degree of sedimentation/erosion	Past road construction of SE sale would have resulted in some sedimentation	4	
	Nutrient levels	Subject to some road runoff	4	
	Von Post index	moderate decomposition	3	
Change in ecosystem intactness	Loss in area of original wetland	reduced from original shape	4	4.00
	Connectivity barriers	SH1, rail and development has reduced connectivity	4	

Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	No stock access.	4	4.33
	Introduced predator impacts on wildlife	Some predator control	4	
	Harvesting levels	Nil	5	
Change in dominance of native plants	Introduced plant canopy cover	Some blackberry in NW edge	5	5.00
	Introduced plant understorey cover	none seen.	5	
			Total wetland condition index /25	**21.00**

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Mature Pukatea-Kahikatea/Nikau-broadleaf.

Native fauna: Kereru, Ruru startled in survey

Other comments: Part of a Paraparaumu Scenic reserve Bait line runs through this area.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	3	Road and rail bordering two sides of wetland forest.
Water quality within the catchment	2	subject to some road runoff
Animal access	2	minimal
Key undesirable species	2	Minimal. Pest control in area.
% catchment in introduced vegetation	2	Upper catchment native reserve.
Other landuse threats	1	Nearby residential area, local bore abstraction.
Total wetland pressure index /30	12	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Muaupoko Swamp Forest

WETLAND PLOT SHEET					
Wetland name:	Muaupoko	**Date:**	12/02/2016	**Plot no:**	1
Plot size:	2m x 2m	**Elevation:**	15m a.s.l	**Northing:**	5470568
Personal:	Pat, Tess	**Structure:**	Coastal swamp forest	**Easting**	1770775

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species[1] (or Substrate)	**%**	**H (m)**	**Species**	**%**	**H (m)**	**Species**	**%**	**H (m)**
Rhopalostylis sapida	60	8	Geniostoma ligustrifolium var. ligustrifolium	1	1.5	Asplenium bulbiferum	2	0.2
Freycinetia banksii	40	8	Dicksonia squarrosa	3	1			
Laurelia novae-zealandiae	1	2.5	Ripogonum scandens	1	0.8			
Melicytus ramiflorus	2	2	Microsorum scandens	1	1.3			
Dysoxylem spectablie	1	0.6	Cyathea medullarsis	2	10			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Pate, cabbage tree, groundfloor covered in pukatea seedlings.

Fauna seen: none

Comments: very wet underfoot, deep muds.

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high. [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	6

Plot 2: Muaupoko Swamp Forest

WETLAND PLOT SHEET					
Wetland name:	Muaupoko	**Date:**	12/02/2016	**Plot no:**	2
Plot size:	2m x 2m	**Elevation:**	15m a.s.l	**Northing:**	5470601
Personal:	Pat, Tess	**Structure:**	Coastal swamp forest	**Easting**	1770715

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species[1] (or Substrate)	**%**	**H (m)**	**Species**	**%**	**H (m)**	**Species**	**%**	**H (m)**
Geniostoma ligustrifolium var. ligustrifolium	60	4	Asplenium buliforum	30	0.8			
Myoporum laetum	20	6	Rhopalostylis sapida	1	1			
Syzgium maire	10	5	Dysoxylem spectablie	10	0.15			
			Ripogonum scandens	1	0.1			
			Piper excelsum subsp. excelsum	2	0.8			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Coprosma robusta Coprosma grandifolia Schefflera digitate, Carex virgata, Phormium tenax. Typha orientalis*

Fauna seen: none.

Comments: Plot in adjacent to running channel and near weedy border of house.

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	

Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	4

Otaihanga South Wetland

WETLAND RECORD SHEET			
Project:	M2PP	**Wetland name:**	Otaihanga South
Date:	9/02/2016	**Region:**	Kapiti Coast, Wellington
Time:	2.53pm	**Altitude:**	8 m.a.s.l
Personal:	Tess + Pat	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures	Landfill nearby. Expressway now dissects this wetland into two parts, with controlled flow between via culvert.	2	2.67
	Water table depth	Lowered flow between each wetland through motorway has altered hydrology	3	
	Dryland plant invasion	Blackberry, bidens, lilies invading centre of the western plot.	3	
Change in physico-chemical parameters	Fire damage	nil	5	4.00
	Degree of sedimentation/erosion	Almost nil. Some dust from construction and sedimentation from landfill capping.	4	
	Nutrient levels	Assumed higher from landfill	3	
	Von Post index	decomposition appears moderate	4	
	Loss in area of original wetland	Past loss from, pine plantations, residential and landfill use. Current	2	2.00

Change in ecosystem intactness		loss through motorway construction		
	Connectivity barriers	Connection has been temporarily severed by motorway construction. Culvert now letting some flow between.	2	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Rabbit scrapping seen on edges. Canadian geese breeding in wetland.	4	4.33
	Introduced predator impacts on wildlife	Possibly feral cats in the area.	4	
	Harvesting levels	nil	5	
Change in dominance of native plants	Introduced plant canopy cover	Bidens and blackberry increasing	2	3.00
	Introduced plant understorey cover	Some Yorkshire fog now present	4	
			Total wetland condition index /25	16

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: *Carex secta, Carex virgata* sedgeland with thining scattered manuka. Mostly overtopped with beggars' tick (Bidens frondosa)

Native fauna: none seen within wetland

Other comments: wetland water levels seem to have recovered since last summer.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	4	Flow from east severed by motorway construction.
Water quality within the catchment	4	Possibly slightly effected by landfill runoff
Animal access	2	Canadian geese. Possibly feral/domestic cats
Key undesirable species	3	Blackberry/Bidens/Canadian geese/Yorkshire fog.
% catchment in introduced vegetation	4	Almost entire catchment in landfill, farming and plantation pine.

Other landuse threats	3	Landfill, is now capped.
Total wetland pressure index /30	20	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Otaihanga South Wetland

WETLAND PLOT SHEET 1.			
Wetland name:	Otaihanga South	**Conditions**	Sunny, calm
Plot no:	1	**Easting**	1770147
Date:	9/02/2016	**Northing**	5471252
Time:	3.20am	**Structure:**	Herbfield
Personal:	Tess, Pat	**Composition:**	Bidens/carex

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H(m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Carex secta	10	1.3	Hypolepis ambigua			Sphagnum moss	2	0.05
Carex virgata	1	1	Holcus lanatus	20	1.3			
Bidens frondosa	50	1.4	Ulex europaeus	1	1			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Cordyline australis, Austroderia fulvida, Leptospermum scoparium, Carex secta, Rubus fruticosus, Ulex europanous, Pinus radiata seedlings, Isolepis proliferata, Hypolepis distans.*

Fauna seen:None

Comments: Bidens frondosa, Ulex europanous and Rubus fruticosus are increasing with the dry conditions. Continued loss of sphagnum and manuka.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	50	2	Bidens frondosa now dominates canopy

Understorey: % cover introduced spp[3]	21	3	Bidens seedlings, Holcus lanatus
Total species: % number introduced spp	71	2	
Total species: overall stress/dieback		3	Starting to see dieback of carex and sphagnum
Total /20		10	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	6

Plot 2: Otaihanga South Wetland

WETLAND PLOT SHEET 2.			
Wetland name:	Otaihanga South	**Conditions**	Sunny, calm
Plot no:	2 (cabbage tree)	**Easting**	1770103
Date:	12/02/2016	**Northing**	5471212
Time:	11.30am	**Structure:**	Sedgeland
Personal:	TR, PE	**Composition:**	Carex

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H(m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Bidens frondosa	6	1.6	Hypolepis ambigua	1	1.4	Rubus fruticosus	1	1
Carex secta	1	1.4	Juncus pallidus	1	1.8			
Carex virgata	50	1.6	Blechnum minus	2	1.4			
Austroderia fulvida	5	2						

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Hypolepis ambigua, Leptospermum scorparium, coprosma robusta, rubus fruticosus*

Fauna seen: none

Comments: Wetland plant dieback/dryland plant encroachment noticeable.

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	6	4	
Understorey: % cover introduced spp[3]	1	4	
Total species: % number introduced spp	7	4	
Total species: overall stress/dieback	10	4	Carex, sphagnum dieback
Total /20		16	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Tini Bush

WETLAND RECORD SHEET			
Project:	Kapiti water supply	**Date:**	17.02.2016
Wetland name:	Tini Bush	**Time:**	11.05
Region:	Kapiti Coast	**Personal:**	TR, PE
Altitude:	19	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures	Road and rail cut through East and West of wetland.	4	4.00
	Water table depth	dry summer	4	
	Dryland plant invasion	kohekohe seedlings	4	
Change in physico-chemical parameters	Fire damage	Nil	5	4.00
	Degree of sedimentation/erosion	Surroundings farmed	4	
	Nutrient levels	Some runoff presumed from farming	4	
	Von Post index	Moderate (5)	3	
Change in ecosystem intactness	Loss in area of original wetland	Originally part of a bigger wetland complex	2	2.50
	Connectivity barriers	Farm drains present.	3	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Fenced. Some rabbit damage noted.	5	4.67
	Introduced predator impacts on wildlife	Pest control carried out.	4	
	Harvesting levels	Nil	5	

Change in dominance of native plants	Introduced plant canopy cover	Nil	5	4.50
	Introduced plant understorey cover	Limited to forest edges	4	
			Total wetland condition index /25	19.67

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: pukatea-kahikatea swamp forest

Native fauna: Tui

Other comments: Some pest control work as area is part of a QE2 covenant.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	3	Farm drainage, bore extraction, motorway construction
Water quality within the catchment	2	Run off from surrounding farms
Animal access	1	Predator pests presummed, fenced
Key undesirable species	2	Pest control carried out.
% catchment in introduced vegetation	3	Majority of catchment in farming
Other landuse threats	1	Expressway construction.
Total wetland pressure index /30	12	
[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none		

Plot 1: Tini Bush

WETLAND PLOT SHEET					
Wetland name:	Tini Bush	**Date:**	17.02.2016	**Plot no:**	1
Plot size (2m x 2m default):	2m x 2m	**Altitude:**	19	**GPS**	1773004.905 5474766.681
Personal:	TR, KS	**Structure:**	Semi swamp forest	**Composition:**	Pukatea - Kahikatea

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species[1] (or Substrate)	**%**	**H**	**Species**	**%**	**H**	**Species**	**%**	**H**
Laurelia novae-zelandiae	40	25	*Coprosma grandifolia*	1	0.6	*Laurelia novae-zelandiae* seedlings	1	0.1
			Freycinetia banksii	40	0.5			
			Dicksonia squarrosa	1	0.3			
			Geniostoma ligustrifolium	2	0.4			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Cyathea medullaris,* pigeonwood, Nikau, *Dacrycarpus dacrydioides*, *Coprosma tenufolium*

Comments: Coastal influenced semi swamp forest

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	below ground level	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	5

Plot 2: Tini Bush

WETLAND PLOT SHEET					
Wetland name:	Tini Bush	**Date:**	17.02.2016	**Plot no:**	2
Plot size	(2m x 2m default):	**Altitude::**	11m	**Northing**	5471425
Personal:	TR, KS	**Structure:**	Shrubland	**Easting**	1771511

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H(m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Cordyline australis	*10*	*3.5*	*Laurelia novae-zelandiae*	2	2	*Deperia petersenii*		
Cyathea medullaris	40	3.5	*Coprosma grandifolia*	1	0.7	*Pyrrosia eleagnifolia*		
Coprosma robusta	5	2	*Carex virgata*	1	1.2	*Lemna disperma*		
Genistoma ligustrifolium	2	1.7	*Blechnum minus*	1	0.5	*Achillea millefolium*		
Melicytus ramiflorus	1	1	*Parsonsia heterophylla*	1	1.5	*Juncos effusus*		
			Dacrycarpus dacrydioides	1	0.4			
			Rubus fruticosus	1	0.6			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Paesia scaberula , Hypolepis ambigua, Carex secta, Piper excelsum. Rubus fruticosus* on the sides

Fauna seen: none

Comments: Set on side of wetland. Some Yorkshire fog, gully fern

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	1	4	Blackberry

Total species: % number introduced spp	1	4	
Total species: overall stress/dieback	0	5	
Total /20		18	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high. [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	5

El Rancho Wetland

WETLAND RECORD SHEET			
Project:	M2PP	**Date:**	12/02/2016
Wetland name:	El Rancho	**Time:**	12.47
Region:	Kapiti Coast	**Personal:**	TR, PE
Altitude:	3	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0–51	Mean score
Change in hydrological integrity	Impact of manmade structures	Expressway construction on the eastern edge.	4	3.33
	Water table depth	Drain cuts through interior of the wetland. Some water abstraction bores.	2	
	Dryland plant invasion	Some pastoral grasses and blackberry establishing on edge.	4	
Change in physico-chemical parameters	Fire damage	Nil	5	4.00
	Degree of sedimentation/erosion	Nil	5	
	Nutrient levels	Some farm runoff	4	
	Von Post index	High peat decomposition.	2	
Change in ecosystem intactness	Loss in area of original wetland	Historic loss through development. Current loss on eastern edge from motorway	3	3.50
	Connectivity barriers	Connected to the Waikanae River through small stream.	4	
Change in browsing, predation	Damage by domestic or feral animals	Little browse seen.	4	4.33

& harvesting regimes	Introduced predator impacts on wildlife	Low.	4	
	Harvesting levels	Nil	5	
Change in dominance of native plants	Introduced plant canopy cover	Blackberry, gorse, on margins	4	4.00
	Introduced plant understorey cover	Violet found	4	
			Total wetland condition index /25	19.17

1 Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Both plots in main wetland were within a regenerating manuka wetland.

Native fauna: None seen

Other comments: Eastern edge of manuka stand has been cut back for expressway construction.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	2	Drainage ditch dug has reduced watertable
Water quality within the catchment	1	Some runoff from farm, rubbish dumping
Animal access	1	fenced
Key undesirable species	3	Next to weedy Waikanae River Corridor
% catchment in introduced vegetation	4	Mainly pasture, weedy scrub.
Other landuse threats	1	Gas pipeline
Total wetland pressure index /30	12	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: El Rancho Wetland

WETLAND PLOT SHEET 1.			
Wetland name:	El Rancho	**Conditions**	Sunny, calm
Plot no:	1	**X coordinates (m):**	1,770,890.714
Date:	12.02.2016	**Y coordinates (m):**	5,473,235.161
Time:	12.46am	**Structure:**	Shrubland

Personal:	TR, PE	**Composition:**	Manuka swamp

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H**	**Species**	**%**	**H**	**Species**	**%**	**H**
Leptospermum scoparium	80	4	Carex dissita	1	0.3	Blechnum minus	1	0.05
			Coprosma tenuicaulis	1	0.2	Viola riviniana	30	0.1
						Galium propinqum	1	0.05
						Hydrocotyle pterocarpa	1	0.05
						Schoenus maschalinus	1	0.05

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Gorse, blackberry, tree fern seedlings starting to pop up in light gaps.

Fauna seen:

Comments: dense uniform canopy of manuka helps to deter weed introductions. Some blackberry is surviving beneath canopy, yet not spreading.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	Thick Manuka Canopy
Understorey: % cover introduced spp[3]	2	4	Violets remain
Total species: % number introduced spp	2	4	
Total species: overall stress/dieback	0	5	
Total /20		18	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	8

Plot 2: El Rancho Wetland

WETLAND PLOT SHEET 1.			
Wetland name:	El Rancho	**Conditions**	Sunny, calm
Plot no:	2	**X coordinates (m):**	1,770,901.668
Date:	12.02.2016	**Y coordinates (m):**	5,473,223.784
Time:	12.46am	**Structure:**	Shrubland
Personal:	TR, PE	**Composition:**	Manuka swamp

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H**	**Species**	**%**	**H**	**Species**	**%**	**H**
Leptospermum scoparium	70	4	Rubus fruticosus	1	0.05	Coprosma tenuicaulis	1	0.2
			Geniostoma ligustrifolium var. ligustrifolium	1	0.05	Blechnum minus	1	0.4
			Microlaena stipoides	1	0.05	Dicondra repens	1	0.1
			Schoenus maschalinus	1	0.05	Asplenium spp	1	0.05
			Melicytus ramiflorus	1	0.5	Dicksonia spp	1	0.2

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: R*ubus fruticosus, Darex dissita,* foxglove, *Geneostima ligustrifolium*

Fauna seen: fantail

Comments: Dryer than plot 1.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	1	4	blackberry present

Total species: % number introduced spp	1	4	
Total species: overall stress/dieback	0	5	
Total /20		18	
[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high [3]Add subcanopy and groundcover % cover for introduced species			
Field measurements:			

Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	8

Te Harakeke - Wetland Record Sheet

Project:	Kapiti water supply	**Date:**	17.02.2016
Wetland name:	Te Harakeke	**Time:**	2.30pm
Region:	Kapiti Coast	**Personal:**	R, KS
Altitude:	5	**# of Plots sampled:**	2

Classification: I System	**IA Subsystem**	**II Wetland Class**	**IIA Wetland Form**
Palustrine	Permanent	Fen	Basin

Indicator	**Indicator components**	**Specify and Comment**	**Score 0– 5[1]**	**Mean score**
Change in hydrological integrity	Impact of manmade structures	drainage, fragmentation from nearby oxidation ponds, residential development and roads have altered original flows of wetland	3	2.5
	Water table depth	Previous studies	n/a	
	Dryland plant invasion	Some blackberry and convolvulus encroaching into wetland.	2	
Change in physico-chemical parameters	Fire damage	nil	5	4.00
	Degree of sedimentation/erosion	nil	5	
	Nutrient levels	n/a	n/a	
	Von Post index	high (score of 7)	2	
Change in ecosystem intactness	Loss in area of original wetland	Originally part of a wider dune complex	4	3.50
	Connectivity barriers	Housing on one side of wetland and M2PP on other. .	3	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Stock has been fenced	4	4.33
	Introduced predator impacts on wildlife	predator control as part of QEII covenant and GW KNE programme	4	

	Harvesting levels	Nil	5	
Change in dominance of native plants	Introduced plant canopy cover	Blackberry/Convolvulus	3	3.50
	Introduced plant understorey cover	Some holcus lanatus	4	
Total wetland condition index /25				17.83

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Differs throughout wetland, ranging from carex sedgeland, raupo rushland, and manuka semi-swamp.

Native fauna: tui, fantail, grey warbler:

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	2	A reduction in flood pulsing
Water quality within the catchment	2	farmed surrounds
Animal access	1	Fenced. Some predator control.
Key undesirable species	2	Willow, Bidens, elder are all found within catchment
% catchment in introduced vegetation	2	Blackberry, convolvulus found in catchment.
Other landuse threats	1	M2PP expressway construction in upper catchment, water abstraction bores
Total wetland pressure index /30	10	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Te Harakeke

WETLAND PLOT SHEET					
Wetland name:	Te harakeke	**Date:**	26.2.2016	**Plot no:**	1
Plot size:	2m x 2m	**Altitude::**		**Northing**	5475012
Personal:	Tess R, Tony P (Boffa Miskell)	**Structure:**	Sedgeland	**Easting**	1772191

Canopy (bird's eye view)	**Subcanopy**	**Groundcover**

Species[1] (or Substrate)	**%**	**H**	**Species**	**%**	**H**	**Species**	**%**	**H**
Carex lessoniana	*50*	*1.7*						
Pteridium esculentum	10	1.8						
Calystegia sepium	30	1.7						
Rubus fruticosus	10	1.6						

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: On higher hummocks and banks- *cabbage trees, Melicytus ramiflorus, Manuka,* Coprosma tenufolium

Comments: Plot is accessed through wire frame gate. To the left. In the middle of two prominent cabbage trees (see phots)

Indicator (use plot data only)	**%**	**Score 0–5**[2]	**Specify & Comment**
Canopy: % cover introduced species	40	3	blackberry increasing
Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	40	3	
Total species: overall stress/dieback	n/a	5	
Total /20		16	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	0	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Plot 2: Te Harakeke

WETLAND PLOT SHEET					
Wetland name:	Te Harakeke	**Date:**	17.02.2016	**Plot no:**	2
Plot size:	2m x 2m	**Altitude::**	10m a.s.l	**Northing**	5474486
Personal:	TR, KS	**Structure:**	Typha reedland	**Easting**	1771925

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H**	**Species**	**%**	**H**	**Species**	**%**	**H**
Typha orientalis	*25*	*2.2*	*Bidens frondosa*	5	0.6	*Isolepis prolifera*	5	0.2

Juncus pallidus	25		Persicaria hydropiper	20	0.5			
Holcus lanatus	15		Galium propinqum	2	0.5			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Carex umbellata* (plot is behind a pocket of this), lots of bidens to the left. Manuka on the left also.

Comments: Plot is found to the right of manuka tree, paper wasps nets were found in the vicinity of plot.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	15	4	
Understorey: % cover introduced spp[3]	27	3	
Total species: % number introduced spp	42	3	
Total species: overall stress/dieback	n/a	2	Some Raupo (*Typha oreintalis*) dieback in areas of Yorkshire Fog (*Holcus lanatus*) establishment
Total /20	12		

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:

Water table cm	**0**	Water conductivity uS (if present)	**n/a**
Water pH (if present)	**n/a**	Von Post peat decomposition index	**6**

Nga Manu Wetland

WETLAND RECORD SHEET			
Project:	Kapiti water supply	**Date:**	12.02.16
Wetland name:	Nga Manu	**Personal:**	TR, TP
Region:	Kapiti Coast	**# of Plots sampled:**	2

Classification: I System	**IA Subsystem**	**II Wetland Class**	**IIA Wetland Form**
Palustrine	Permanent	Fen	Basin

Indicator	**Indicator components**	**Specify and Comment**	**Score 0– 5[1]**	**Mean score**
Change in hydrological integrity	Impact of manmade structures	Some drainage channels/culverting/ constructed ponds can be found within the nature reserve	5	3.67
	Water table depth	expressway excavations may be impacting water table	2	
	Dryland plant invasion	Blackberry	4	
Change in physico-chemical parameters	Fire damage	Nil	5	3.75
	Degree of sedimentation/erosion	low = nature reserve	5	
	Nutrient levels	low , farmed surrounds	4	
	Von Post index	8	1	
Change in ecosystem intactness	Loss in area of original wetland	Originally part of a bigger complex	4	4.00
	Connectivity barriers	Surounded by road and farmlands	4	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Fenced. Possum control	5	5.00
	Introduced predator impacts on wildlife	Predator control	5	
	Harvesting levels	Nil	5	

Change in dominance of native plants	Introduced plant canopy cover	Some climbing weed species (yet controlled)	5	4.50
	Introduced plant understorey cover	Blackberry	4	
			Total wetland condition index /25	20.92

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main vegetation types: *Phormium tenax, Carex secta, Coprosma grandifolia, Coprosma rigida*

Native fauna: Tui, Kereru, large amount of waterfowl

Other comments: diverse and high bird life (nature reserve). Large degree of management.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	1	Some drainage channels, constructed ponds
Water quality within the catchment	3	Farmland surrounds
Animal access	1	intensive trapping
Key undesirable species	3	Willow, large amounts of Blackberry, Bidens are found in the surrounding area.
% catchment in introduced vegetation	4	Mostly farmland/residential
Other landuse threats	0	
Total wetland pressure index /30	12	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Nga Manu (south)

WETLAND PLOT SHEET					
Wetland name:	Nga Manu	**Date:**	17.02.2016	**Plot no:**	1
Plot size:	2m x 2m	**Elevation:**	15m a.s.l	**Northing:**	5474506
Personal:	TR, KS	**Structure:**	Carex sedgeland	**Easting**	1773506

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species1 (or Substrate)	**%**	**H (m)**	**Species**	**%**	**H (m)**	**Species**	**%**	**H (m)**
Carex lessonia	5	4.5	*Muehlenbeckia australis*	5	1.8	*Rubus fruticosus*	1	0.7

Phormium tenax	2	2.4	*Carex virgata*	60	1.8	*Juncus pallidus*	2	0.8
Typha oreintalis	5	2.3	*Pteridium esculentum*	15	2			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: some mistletoe seen in Manuka (planted).

Fauna seen: Tui abundant

Comments: ground soggy but no surface water.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	1	4	Blackberry
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
	Total /20	19	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	5

Plot 2: Nga Manu (south)

WETLAND PLOT SHEET					
Wetland name:	Nga Manu	**Date:**	17.02.2016	**Plot no:**	2
Plot size:	2m x 2m	**Elevation:**	10m a.s.l	**Northing:**	5474372
Personal:	TR, KS	**Structure:**	Manuka – broadleaved / flax	**Easting**	1773492

Canopy (bird's eye view)	**Subcanopy**	**Groundcover**

Species[1] (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Carex lessoniana	2	1.7	*Rubus australis*	1	0.2	*Hisiopteris incisa*	2	0.7
Phormium tenax	25	2.4	*Pseudopanax arboreus*	2	1.4	*Coprosma lucida.*	2	0.8
Geniostoma ligustrifolium	10	2.5	*Rubus fruticosus*	5	1.3	*Blechnum minus*	2	0.8
Leptospermum scoparium	10	5	*Piper excelsum*	5	1.6			
Coprosma grandifolia	15	3	*Myrsine australis*	5	0.7			
Coprosma rigida	10	3	*Coprosma tenuicaulis*	2	1.7			
			Melicytus ramifllorus	1	0.4			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Cordyline australis*

Fauna seen: Tui abundant, fantail.

Comments: 10m east of track, Drainage ditch nearby

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	5	4	Blackberry
Total species: % number introduced spp	5	4	
Total species: overall stress/dieback	0	5	
	Total /20	18	

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			

Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Ngarara Road

WETLAND RECORD SHEET			
Project:	Kapiti Water Supply	**Wetland name:**	Ngarara Road Wetland
Date:	12/02/2016	**Region:**	Kapiti Coast, Wellington
Time:	2.53pm	**Elevation (**m.a.s.l)	10 m.a.s.l
Personal:	Tess + Pat	**# of Plots sampled:**	1

Classification: I System	**IA Subsystem**	**II Wetland Class**	**IIA Wetland Form**
Palustrine	Permanent	Fen	Basin

Indicator	**Indicator components**	**Specify and Comment**	**Score 0– 5[1]**	**Mean score**
Change in hydrological integrity	Impact of manmade structures	Possible impact by local borefields	4	2.67
	Water table depth	Below surface	3	
	Dryland plant invasion	High - blackberry is the dominant plant	1	
Change in physico-chemical parameters	Fire damage	Nil	5	4.00
	Degree of sedimentation/erosion	Minimal from surrounding farm	4	
	Nutrient levels	Stock and peat changes with lack of water	4	
	Von Post index	Moderate (6)	3	
Change in ecosystem intactness	Loss in area of original wetland	Historical extent diminished most likely due to bore use and farming. M2PP motorway construction has also reduced size	2	2.50
	Connectivity barriers	Close to Nga Manu. Large areas of blackberry with surrounding farmland.	3	
Change in browsing, predation &	Damage by domestic or feral animals	Wetland exterior reasonably fenced. Some sheep and cattle grazing on outside	4	4.00

harvesting regimes		edges, yet interior protected by thick blackberry.		
	Introduced predator impacts on wildlife	With fernbird being observed in area this is presumed to be low to moderate. Close to Waikanae.	3	
	Harvesting levels	Nil	5	
Change in dominance of native plants	Introduced plant canopy cover	Blackberry and Gorse cover is increasing	1	1.5
	Introduced plant understorey cover	Pasture weeds, Beggars' tick, Blackberry and gorse encroaching.	2	
			Total wetland condition index /25	15.17

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Sedgeland (Carex secta, Carex virgata and Cyperus ustulatus) with blackberry and ferns. Some manuka in wetter areas, kanuka on raised mounds and wetland edges,

Native fauna: Tui, Kereru (close to Nga Manu)

Other comments: Monitoring focused on native sedgeland in wetland interior. Based on a review of historic photos, sedgeland and manuka were dominant habitat types. However, blackberry and gorse invasion in wetland edges and interior has resulted in rapid loss of these communities and blackberry the dominant vegetation community.

Pressure	Score[2]	Specify and Comment
Modifications to catchment hydrology	3	Farm drainage, bore extraction
Water quality within the catchment	2	Run off from surrounding farms
Animal access	2	Predator pests presumed, fenced
Key undesirable species	3	Blackberry now dominate vegetation in wetter interior
% catchment in introduced vegetation	3	Majority of catchment in farming. Nga Manu found nearby
Other land use threats	3	Expressway construction, subdivision introducing garden weed species.
Total wetland pressure index /30	15	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Ngarara Road

WETLAND PLOT SHEET 1			
Wetland name:	Ngarara Road	**Conditions**	Sunny, calm
Plot no:	1	**Easting**	1773006
Date:	10/02/2016	**Northing**	5474765
Time:	10.40am	**Structure:**	shrub/sedge
Personal:	TR, KS	**Composition:**	blackberry/carex

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H(m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Carex virgata	40	1.5				Agrostis stolonifera	2	0.4
Carex secta	5	1.7						
Cyprus ustulatus	5	1.5						
Rubus fruticosus	60	1.8						

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Dominated by blackberry, with kanuka broadleaved shrub present on raised margins. Gorse also entering from margins

Fauna seen: fantail

Comments: Take machete and insect repellent with next time. Enter between Kanuka and lancewood on Northern bank. Pasture grass encroachment suggest continued decline in water table.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	60	2	Blackberry cover more than doubled since last summer survey.
Understorey: % cover introduced spp[3]	2	4	pasture grass invasion suggests permanently lowered water table.
Total species: % number introduced spp	62	2	

Total species: overall stress/dieback	n/a	4	Sedges reduced in extent.
Total /20		12	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Ngarara Bush

WETLAND RECORD SHEET			
Project:	Kapiti Water Supply	**Wetland name:**	Ngarara Bush
Date:	26/02/2016	**Region:**	Kapiti Coast, Wellington
Time:	2.30pm	**Altitude:**	14 m
Personal:	Tess R and Tony P	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures	Some Cut and fill around house/driveway.	4	3. 33
	Water table depth	Nearby Smithfield wetland construction may have influenced	3	
	Dryland plant invasion	Yes kohekohe pasture grasses and some solanum weed.	3	
Change in physico-chemical parameters	Fire damage	nil	5	3.75
	Degree of sedimentation/erosion	almost none, some off farmland surrounding property	4	
	Nutrient levels	almost none, some off farmland surrounding property	4	
	Von Post index	High	2	
Change in ecosystem intactness	Loss in area of original wetland	would have been part of larger wetland complex	2	2.5
	Connectivity barriers	Driveway, road will have some effect on connectivity	3	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Possums	4	4
	Introduced predator impacts on wildlife	Some cats, possums, rats, mustaileds, presummed present. No trapping	4	

	Harvesting levels	Nil	4	
Change in dominance of native plants	Introduced plant canopy cover	Some climbing pest plants	4	4
	Introduced plant understorey cover	pasture grasses, exotic herbs	4	
			Total wetland condition index /25	17.58

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: pukatea, kahikatea, Semi-swamp forest, with kohekohe on margins.

Native fauna: Tui, fantail (near Nga Manu)

Other comments: Kohekohe on surrounding higher points, increased pastoral grass growth.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	4	Most of the Catchment is in drained farmland,
Water quality within the catchment	3	mostly farmed
Animal access	4	No impediment to access, no control carried out.
Key undesirable species	2	
% catchment in introduced vegetation	4	Farmed and forested with pockets of native bush.
Other landuse threats	1	M2PP expressway construction nearby
Total wetland pressure index /30	18	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Ngarara Bush (north)

WETLAND PLOT SHEET 1.			
Wetland name:	Ngarara Bush	**Conditions**	Sunny, calm
Plot no:	1	**X coordinates (m):**	1773006
Date:	26/02/2016	**Y coordinates (m):**	5474765
Time:	2.30pm	**Structure:**	Pukatea-kahikatea swamp forest

Canopy (bird's eye view)	**Subcanopy**	**Groundcover**

Species1 (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Melicytus ramiflorus	40	3.5	*Dysoxylum spectiabile*	25	1.4	*Muehlenbeckia australis*	1	0.1
Dacrycarpus dacrydioides	5	3.5	*Geniostoma ligustrifolium*	2	1			
			Histiopteris incisa	5	0.7			
			Hedycarya arborea	1	0.4			
			Laurelia novae-zelandiae	1	0.2			
			Parsonsia capsularis	2	0.4			
			Beilschmiedia tawa	1	0.2			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Laurelia novae-zealandiae, Hinau on margins, coastal kohekohe forest on higher terrace

Fauna seen: None

Comments: Plot corners not marked - mahoe x2 kahikatea, kohekohe. See photos for ref.

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Plot 2: Ngarara Bush (South)

WETLAND PLOT SHEET 2.			
Wetland name:	Ngarara Bush	**Conditions**	Sunny, calm
Plot no:	2	**Easting**	1773829
Date:	26.06.2016	**Northing**	5475040

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H(m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Melicytus ramiflorus	15	4.5	*Histiopteris incisa*	30	1.8	*Digitalis purpurea*	20	0.4
			Geniostoma ligustrifolium	5	0.6	*Dacrycarpus dacrydioides*	1	0.1
			Laurelia novae-zelandiae	8	0.8	*Cyathea sp*	1	0.1
			Dysoxylum spectabile	1	0.2	*Rubus fruticosus*	2	0.6
			Hedycarya arborea	4	0.5			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Two large kaihiatea to the north. Large mamaku surrounding.

Fauna seen: none.

Comments: Plot corner is Melicytus ramiflorus marked then from that 90 degrees west and south for 2m. See pics for ref.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	22	4	
Total species: % number introduced spp	22	4	
Total species: overall stress/dieback	10	5	
	Total /20	18	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	7

Peka Peka Rd Wetland

WETLAND RECORD SHEET			
Project:	Kapiti Water Supply	**Wetland name:**	Peka Peka Rd Wetland
Date:	11/02/2016	**Region:**	Kapiti Coast, Wellington
Time:	11.15am	**Altitude:**	14m
Personal:	TR, TP	**# of Plots sampled:**	2

Classification: I System	**IA Subsystem**	**II Wetland Class**	**IIA Wetland Form**
Palustrine	Permanent	Fen	Basin

Indicator	**Indicator components**	**Specify and Comment**	**Score 0– 5[1]**	**Mean score**
Change in hydrological integrity	Impact of manmade structures	Surrounding farmland drained, some impact of road to the north.	4	4
	Water table depth	20cm below surface	4	
	Dryland plant invasion	Blackberry on margins, 1 poisoned willow	4	
Change in physico-chemical parameters	Fire damage	nil	5	3.75
	Degree of sedimentation/erosion	Surrounding farmland	4	
	Nutrient levels	Surrounding farmland	4	
	Von Post index	scored high (7)	2	
Change in ecosystem intactness	Loss in area of original wetland	originally part of a bigger wetland complex	3	3.5
	Connectivity barriers	Road, pasture	4	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	No sign of browse	5	4.33
	Introduced predator impacts on wildlife	Cats, rats, stoats	3	
	Harvesting levels	nil	5	
	Introduced plant canopy cover	Blackberry, willows 15%	4	4

Change in dominance of native plants	Introduced plant understorey cover	Some herbaceous weeds present.	4	
			Total wetland condition index /25	19.58

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: *Austroderia toetoe,* Raupo, *Coprosma tenuiculis, Comprosma ridgia, Carex secta, Phormium tenax*

Native fauna: Grey warbler.

Other comments: Access > enter wetland at fence line then walk south under tree canopy, plot is 5m in from the end of this row of trees/willows. Sand replacement with peat as part of the M2PP expressway construction has occurred to the east of the wetland.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	2	Most of catchment in drained farmland, forestry.
Water quality within the catchment	2	Runoff from farming.
Animal access	3	Fenced
Key undesirable species	1	Willow within catchment (and wetland)
% catchment in introduced vegetation	4	Kapiti Coast developed into farmland/forestry and residential
Other landuse threats	3	Development occurring to the east of the wetland. Expressway peat replacement works.
Total wetland pressure index /30	15	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Peka Peka Road (north)

WETLAND PLOT SHEET 1			
Wetland name:	Peka Peka	**Conditions**	Sunny, calm
Plot no:	1	**X coordinates (m):**	1773808
Date:	12.02.2016	**Y coordinates (m):**	5477103
Time:	3.06	**Structure:**	Raupo, sedgeland
Personal:	TR, PE	**Composition:**	Raupo Carex

Canopy (bird's eye view)	**Subcanopy**	**Groundcover**

Species[1] (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Typha orientalis	30	2.5	Blechnum minus	4	0.6			
Coprosma propinqua var. propinqua	25	2.1	Hypolepis distans	5	0.4			
Carex secta	3	2	Coprosma tenuicaulis	1	0.25			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: willow, blackberry, Austroderia fulvida outside plot.

Fauna seen:

Comments: Carex secta within plot dead

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm (in relation to soil surface)	30cm	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	4

Plot 2: Peka Peka Road (south)

WETLAND PLOT SHEET 2.			
Wetland name:	Peka Peka Road	**Conditions**	Sunny, calm
Plot no:	2	**X coordinates (m):**	1774481

Date:	11/02/2016	**Y coordinates (m):**	5476995
Time:		**Structure:**	Shrubland/sedgeland
Personal:		**Composition:**	Comprosma/Flax/Isolepis

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H(m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Phormium tenax	2	2.8	Holcus lanatus	2	0.8	Eleocharis acuta	40	0.5
Coprosma propinqua var. propinqua	3	2.8	Leptospermum scoparium	1	1.1	Blechnum minus	30	0.4
Salix spp	4	1.4	Agrostis solonifera	1	0.6	Typha orientalis	2	1.5
			Isolepis prolifera	40	0.4	Seniceo gromeratus	1	
			Carex secta	1	1			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Sphagnum, *Juncus pallidus,* Hypolepis distans, toetoe, epilobium pullidum, crepis capillaris, Bidens, blackberry

Fauna seen:

Comments: Salix spp rapidly increasing in extent and needs controlling

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp[3]	0	4	Occasional gorse and grasses
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	5	5	
	Total /20	19	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:

Water table cm (in relation to soil surface)	14	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	4

Te Hapua Complex A

WETLAND RECORD SHEET			
Project:	Kapiti water supply	**Date:**	30.03.2016
Wetland name:	Te Hapua Complex A	**Personal:**	TR, KdS
Region:	Kapiti Coast, Wellington	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures	Wetland disected by Te Haupua road.	4	3.67
	Water table depth	surrounding farmland drained	3	
	Dryland plant invasion	Pasture grass species	4	
Change in physico-chemical parameters	Fire damage	nil	5	3.75
	Degree of sedimentation/erosion	mimimal off surrounding farm	4	
	Nutrient levels	farmland surrounds	4	
	Von Post index	Sandy peat soils (8)	2	
Change in ecosystem intactness	Loss in area of original wetland	was once part of a larger complex	4	4.00
	Connectivity barriers	roads, farming, residental devolpment has fragmented wetland	4	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Rabbit sign. Fenced from stock	4	3.67
	Introduced predator impacts on wildlife	Trapping carried out	2	
	Harvesting levels	None	5	
	Introduced plant canopy cover	some woody weeds (gorse, blackberry)	4	3.50

Change in dominance of native plants	Introduced plant understorey cover	Lotus, hydropiper, forget me not, beggars tick	3	
			Total wetland condition index /25	18.58

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Wetland complex of varying degrees of coprosma/flax/carex/Isolepis/standing water

Native fauna: none

Other comments: Majority of wetland planted. Boardwalk running through. Both weed and pest mammals controlled.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	4	Majority of the catchment in forestry, farming or residential.
Water quality within the catchment	3	farming runoff presumed
Animal access	3	Fenced, some predator control.
Key undesirable species	3	Willow in catchment.
% catchment in introduced vegetation	4	Most of catchment farmed.
Other landuse threats	1	Groundwater abstraction.
Total wetland pressure index /30	18	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Te Haupua Complex A (south)

WETLAND PLOT SHEET					
Wetland name:	Te Haupua Complex A	**Date:**	30.03.2016	**Plot no:**	1
Plot size:	2m x 2m	**Elevation:**	10m a.s.l	**Northing:**	5479213
Personal:	TR, KdS	**Structure:**	Juncus-carex – sedgeland, herbfield	**Easting**	1774728

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species1 (or Substrate)	**%**	**H(m)**	**Species**	**%**	**H(m)**	**Species**	**%**	**H(m)**
Juncus pallidus	2	1.7	Bidens frondosa	2	0.4	Isolepis prolifera	2	0.2

Carex secta	5	1.6	Persicaria hydropiper	90	0.4	Myosotis arvensis	2	0.15
			Juncus australis	1	0.7	Rumex obtusa	1	0.2
						Agrostis stolonifera	1	0.12

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Isolepis,* forget me not, *Carex virgata, Austroderia toetoe, Cyprus australi*s

Fauna seen: Pukeko

Comments: Plot to the west of boardwalk, adjacent to the Waimeha river, by Cabbage tree.

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	95	1	increase in hydropiper
Total species: % number introduced spp	95	1	increase in hydropiper
Total species: overall stress/dieback	0	0	
Total /20		**6**	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high. [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	0	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	8

Plot 2: Te Haupua Complex A (south)

WETLAND PLOT SHEET					
Wetland name:	Te Haupua Complex A	**Date:**	30.03.2016	**Plot no:**	2
Plot size:	2m x 2m	**Elevation:**	10m a.s.l	**Northing:**	5479378
Personal:	TR, KdS	**Structure:**	Juncus-carex rush-sedgeland	**Easting**	1774778

Canopy (bird's eye view)	**Subcanopy**	**Groundcover**

Species1 (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Open Water	0	0	*Pteridium esculentum*	20	1.4	*Holcus lanatus*	1	0.5
Phormium tenax	5	2	*Carex geminata*	30	1.5			
Typha orientalis	2	2	*Rubus fruticosus*	40	1.6			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: flax, raupo.

Fauna seen: none

Comments: Appears to be particularly dry (no groundcover suggests, normally quite wet).

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	Blackberry
Understorey: % cover introduced spp[3]	41	2	
Total species: % number introduced spp	41	2	
Total species: overall stress/dieback	20	2	Carex being smothered by blackberry.
	Total /20	11	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	5

Te Hapua Complex D (Pateke Lagoon)

WETLAND RECORD SHEET			
Project:	Kapiti water supply	**Date:**	30.03.2016
Wetland name:	Te Hapua Complex D	**Personal:**	TR, KdS
Region:	Kapiti Coast, Wellington	**# of Plots sampled:**	2

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures	Roadway and housing has constrained this wetland a little.	4	3.67
	Water table depth	Surrounding farmland drained	3	
	Dryland plant invasion	Blackberry, Yorkshire fog	4	
Change in physico-chemical parameters	Fire damage	Nil	5	4.25
	Degree of sedimentation/erosion	Some from surrounding farmland	4	
	Nutrient levels	Some presumed from farm	4	
	Von Post index	Moderate	4	
Change in ecosystem intactness	Loss in area of original wetland	Some loss through farming, road and residential development.	3	3.00
	Connectivity barriers	Culverted under road.	3	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	minimal	4	4.00
	Introduced predator impacts on wildlife	minimal	3	
	Harvesting levels	nil	5	

Change in dominance of native plants	Introduced plant canopy cover	Blackberry, tasmainian blackwood	4	4.00
	Introduced plant understorey cover	Holcus lanatus	4	
			Total wetland condition index /25	18.92

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Harakeke, raupo, *Carex lessoniana,* Blackberry

Native fauna: Swamp harrier

Other comments: Wetland has been restored.

Pressure	**Score[2]**	**Specify and Comment**
Modifications to catchment hydrology	3	Majority of the catchment in forestry, farming or residential.
Water quality within the catchment	3	Some of the catchment farmed.
Animal access	2	Fenced, some predator control.
Key undesirable species	2	Willow in catchment.
% catchment in introduced vegetation	4	Most of catchment in farmland.
Other landuse threats	1	M2PP motorway construction.
Total wetland pressure index /30	15	

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Te Haupua Complex D (Pateke Lagoon) (north)

WETLAND PLOT SHEET					
Wetland name:	Te Haupua Complex D	**Date:**	30.03.2016	**Plot no:**	1
Plot size:	2m x 2m	**Elevation:**	10m a.s.l	**Northing:**	5479221
Personal:	TR, KdS	**Structure:**	Juncus-carex rush-sedgeland	**Easting**	1775818

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species1 (or Substrate)	**%**	**H (m)**	**Species**	**%**	**H (m)**	**Species**	**%**	**H (m)**

Open Water	0	0	Pteridium esculentum	20	1.4	Holcus lanatus	1	0.5
Phormium tenax	5	2	Carex geminata	30	1.5			
Typha orientalis	2	2	Rubus fruticosus	40	1.6			

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Dicksonia squarrosa, Muehenbeckia complexa, convolvulus* , Ragwort, Blackwood

Fauna seen: Swamp Harrier.

Comments: Plot located North of house between pine shelter belt and tree group containing *Dicksonia squarrosa* and Blackwood,

Indicator (use plot data only)	**%**	**Score 0–5[2]**	**Specify & Comment**
Canopy: % cover introduced species	0	5	Blackberry
Understorey: % cover introduced spp[3]	41	2	
Total species: % number introduced spp	41	2	
Total species: overall stress/dieback	20	2	Carex being smothered by blackberry.
	Total /20		

[2] 5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

[3] Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	Not for a metre	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	5

Plot 2: Te Haupua Complex D (Pateke Lagoon) (south)

WETLAND PLOT SHEET					
Wetland name:	Te Haupua Complex D	**Date:**	30.03.2016	**Plot no:**	2
Plot size:	2m x 2m	**Elevation:**	10m a.s.l	**Northing:**	5479476
Personal:	TR, KdS	**Structure:**	Juncus-carex rush-sedgeland	**Easting**	1775876

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species1 (or Substrate)	**%**	**H (m)**	**Species**	**%**	**H (m)**	**Species**	**%**	**H (m)**
Carex virgata	35	1.4						
Carex lessoniana	70	1						

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Ink weed to the north of plot, *Muehlenbeckia australis* to the east. Bracken to the west. Bidens and Raupo also nearby.

Fauna seen: Pukeko

Comments:

Indicator (use plot data only)	%	Score 0–5[2]	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp[3]	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
	Total /20	20	

5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high. [3]Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	**Water conductivity uS (if present)**	n/a
Water pH (if present)	n/a	**Von Post peat decomposition index**	6

Appendix B: Photo Points

Poplar Ave Wetland

Photo 1 Poplar Ave photopoint 1 looking eastwards across wetland.

Photo 2 Poplar Ave photopoint 2 looking northward along edge of pond.

Photo 3: Crown Hill Manuka Bush wetland photopoint 1 (north) Looking from stake northwest to the outer edge of bush.

Photo 4 Crown Hill Manuka bush photopoint 2 (south) Looking northeast towards monitoring plot 2.

Photo 5: Muaupoko Swamp Forest Photopoint 1 (east).

Photo 6: Muaupoko Swamp forest photopoint 2 (west)

Photo 20: Otaihanga Southern wetland Photopoint 1, looking from cycleway looking West into northern end of wetland

Photo 21Otaihanga Southern Wetland Photopoint 2, looking from cycleway southwest into the southern end of wetland.

Photo 7 (right): Tini Bush photopoint 1 (south) looking north from southern edge of swamp forest (can see permanent monitoring plot in background.

Photo 8 (Left): Tini Bush photopoint 2 (north) looking Southwest from under trees, across ditch.

Photo 9 El Rancho wetland photopoint 2. Looking from expressway north into Manuka stand.

Photo 10: El Rancho Wetland photopoint 1. Looking from M2PP expressway road West into Manuka stand. Note this photopoint has relocated to a position which will record a greater amount of change

Photo 11: Te Harakeke photopoint 1 (south). Looking from marked fencepost on top of null South

Photo 12 Te Harakeke photopoint 2 (north). Looking from top of null north towards Macrocarpa in background.

Photo 13 Nga Manu photooint 1 (north). Looking south towards viewing area along pond shoreliine

Photo 14 Nga Manu photopoint 2 (south). Looking south towards waterlevel/pond edge from piezometer.

Ngarara Wetland

Photo 15 Ngarara Rd wetland, photopoint looking from northern bank southeast into the wetland.

Photo 17 Ngarara Bush Photopoint 1, Looking Southeast from Post alongside driveway.

Photo 18 Ngarara Bush Photopoint 2, looking Northeast from bank in front of house.

Photo 16 Peka Peka Road Swamp photopoint 2 (south). Looking Northeast at edge of wetland under willow tree.

Photo 17:Peka Peka Road Swamp photopoint 1 (north), looking south.

Photo 18: Te Hapua swamp complex A photopoint 1, looking NE towards monitoring plot 1 to the east of the boardwalk

Photo 19: Te Hapua swamp complex A photopoint 2, looking NE towards monitoring plot 2 between cabbage tree and pittosporum

Photo 20 Te Hapua swamp complex A photopoint 1, Looking NE towards house.

Photo 21 Te Hapua swamp complex A photopoint 1, taken from corner of front garden looking NW towards pond edge along fence

Appendix F

Small Coastal Streams Baseline Monitoring Annual Report 2015/16

Small Coastal Streams Annual Aquatic Baseline Monitoring Report

A report on 2015/2016 aquatic data collection for water permit WGN130103 [33759]

Prepared for Kapiti Coast District Council

22nd July 2016

Bibliographic reference for citation:
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Prepared by:	Katherine de Silva Ecologist Boffa Miskell Limited	
Reviewed by:	Dr Vaughan Keesing Senior Ecologist, Assoc Partner Boffa Miskell Limited	
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Cover photograph: Lower Muaupoko Stream monitoring site, © Boffa Miskell, 2014

CONTENTS

1.0 Introduction

1.1 Background

Resource consent condition 33 of Consent WGN130103 [33759] for the River Recharge with Groundwater Project (RRwGW Project) requires a baseline monitoring programme of small coastal streams to be carried out, following the methods approved in the revised Small Coastal Streams (SCS) Baseline Monitoring Plan (BMP) (Boffa Miskell Ltd, 2014b & Addendum to Small Coastal Stream BMP dated 22nd September 2015).

That plan, re-certified by Greater Wellington Regional Council (GWRC), requires the collection of continuous[1] shallow ground water depth adjacent to each monitored stream, continuous instream water depth (by pressure inducer), instream continuous temperature, and instream continuous dissolved oxygen.

Each month manual measurements are also taken in conjunction with the logger data to highlight any calibration issues with equipment, these include: instream water level, groundwater level and point measures of conductivity and temperature.

Following the 2014/2015 monitoring season, the requirement to provide monthly reporting, monthly cross sectional water depth measurements, assessments of macroinvertebrate and fish biota was removed as agreed with GWRC and AMG.

Following the findings of the 2014/2016 SCS monitoring, two small stream sites were removed from the monitoring programme going forward as agreed with GWRC. These sites were Kowhai Stream and Paetawa.

Full details of the consent conditions and the initial parameters and requirements for monitoring can be found in the Boffa Miskell (BML) report “Small coastal Streams Baseline Aquatic Monitoring Plan” dated 21st May 2014 (prepared for KCDC) and Addendum to Small Coastal Stream BMP dated 22nd September 2015.

1.2 Scope

This report outlines the 2015-2016 season of data collection for the baseline monitoring programme for small coastal streams. Recommendations for amendments to the monitoring programme are made.

[1] Where “continuous” means a recorded reading every 15 minutes.

2.0 Methodology

2.1 Monitoring Locations

The monitoring locations have been determined in the SCS BMP and consist of five sites (refer to Map 1 for locations and Section 2.3 for site photographs):

- Hadfield Stream;
- Ngarara Stream;
- Kakariki Stream;
- Lower Muaupoko Stream;
- Upper Muaupoko

The reasoning behind each location of these streams can be found in the scoping document characterising small coastal streams (Boffa Miskell Ltd, 2014a) and specific monitoring locations are described in full in the SCS BMP (Boffa Miskell Ltd, 2014b). At each site, a piezometer has been installed near to the stream bank. Upper Muaupoko stream has an automated logging device installed which automatically sends data to Kapiti Coast District Council SCADA - and is therefore not included in the monthly field monitoring programme.

2.2 Monitoring Methods

The SCS BMP (Boffa Miskell Ltd, 2014b) and Addendum to SCS BMP 22 September 2015 provides the detail, but in summary the following parameters are required to be measured at each site for the period 1 December 2015 to 1 May 2016:

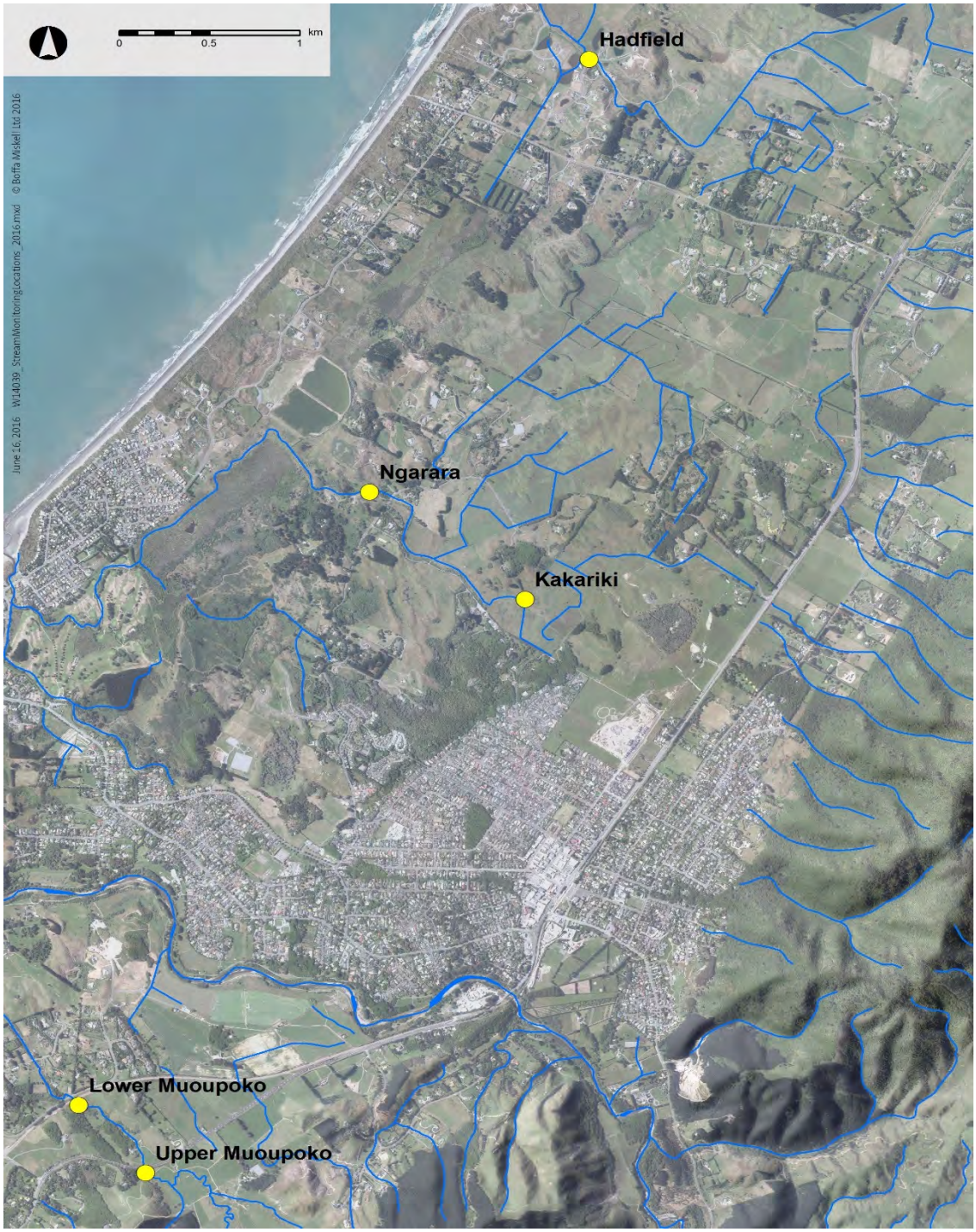
- Ground water level (mm)
  - Every 15 minutes via in-situ piezometer and logger
  - Manual measurements taken monthly by ecologists
- Stream water level (mm)
  - Every 15 minutes via in-situ pressure inducer and logger
  - Manual measurements taken monthly by ecologists
- Temperature (°C)
  - Every 15 minutes via in-situ temperature probes
  - Manual measurements taken monthly by ecologists
- Dissolved oxygen (mg/L)
  - Every 15 minutes via in-situ DO probes
  - Manual measurements taken monthly by ecologists

Once a month the four monitoring sites (excluding Upper Muaupoko) were visited, manual measurements conducted by ecologists and data downloaded from in-situ Almeno 2590 data loggers. Manual measurements were taken using a Horiba U-50 hand held water quality meter (for temperature and dissolved oxygen readings), Solinst 101 water level meter (for

groundwater level readings) and a Fatmax measuring tape (for stream water level measurement). The Horiba U-50 hand held water quality meter was calibrated immediately before each monthly visit, using automated calibration protocols outlined in the Horiba U-50 manual.

Data downloaded from the Almeno 2590 data loggers and results of the monthly manual measurements were uploaded into WaterOutlook (KCDC data management and reporting system).

Map 1: Map showing locations of small coastal stream monitoring sites



2.3 Site Photos

Photo 1: Hadfield Stream monitoring site

Photo 2: Ngarara Stream monitoring site

Photo 3: Kakariki Stream monitoring site

Photo 4: Upper Muaupoko Stream monitoring site

Photo 5: Lower Muaupoko Stream monitoirng site

3.0 Results

The results for the 2015/ 2016 season are provided in the following section.

Following the review of the 2014/2015 Baseline monitoring data and Annual Report by GWRC, no further baseline data needs to be collected for the following parameters:

- Cross sections
- Macroinvertebrates
- Fish biota

For details see 2014/2015 Annual Report and Compliance documents.

Seasons rain fall and average flow of the Waikanae River (as a proxy for all streams on the Kapiti Coast) is shown for context below (Figure 1).

Two flood events occurred during the monitoring season. On the 19th February 2016 67.9mm fell over the previous 24hrs and on the 2nd April 2016, 33.6mm of rain fell the previous day (Figure 1).

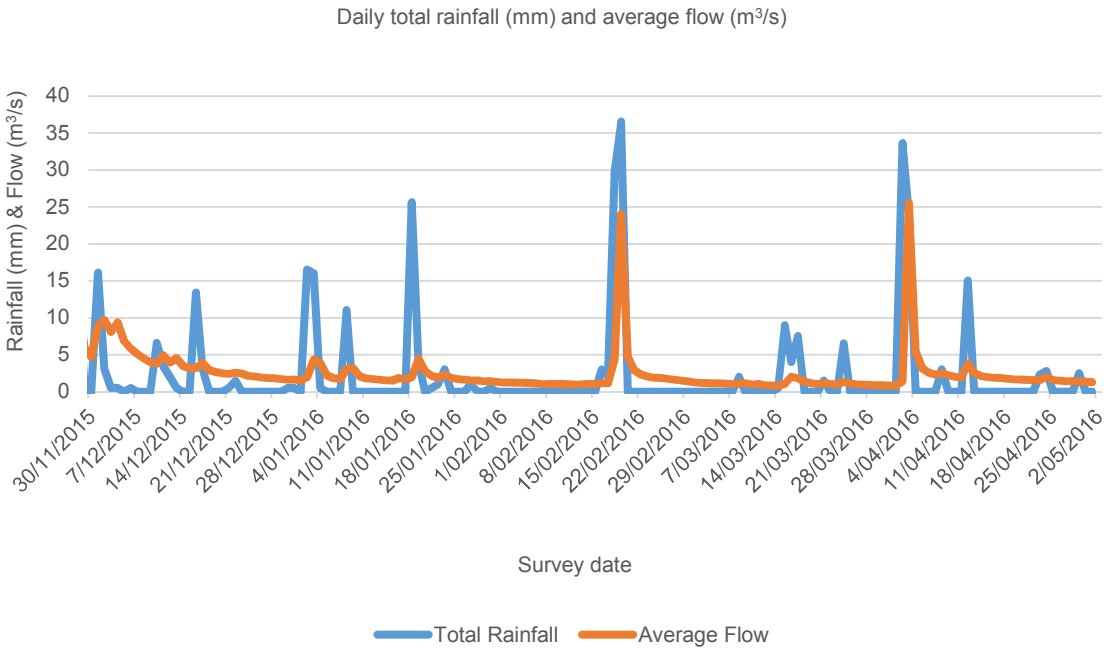


Figure 1: Daily rainfall (mm) and flow (m^3/s) recorded for Waikanae River at the Waikanae Water Treatment Plant

3.1 Peizometer and Instream Data Logger Results

Below (Sections 3.1.1 to 3.1.5) are a compilation of graphs showing the data collected for each "continuously" measured parameter (groundwater level (mm), instream water level (mm), temperature (°C) and dissolved oxygen (mg/L)), at each monitoring site during the period of 1st December 2015 to 1st May 2016.

These charts are automatically compiled from the WaterOutlook website from which all data downloaded from monitoring sites is uploaded.

At some of the monitoring sites, there are data gaps between the end of February to early March due to equipment failure. These sites underwent maintenance to resolve the issues.

3.1.1 Hadfield Stream

Groundwater levels between December to February were consistently around 2000mm AMSL. Stream level is consistent with the trend in groundwater level, with a peak occurring in February. However, there was a small gradual incline in surface water from December to February. The difference between daily min-max oxygen levels increased gradually between December and the start of February.

Please note the following comments provided by KCDC technical staff on 16tht March 2016 following a suspected lighting strike:

"Hadfield logger has been swapped 16/3/2016 as the old one stopped reading the inputs. Scaling and zero point of ground level corrected so now the logged value agrees within 10mm of the manual value".

Please note the following comments provided by KCDC technical staff on 31st March 2016:

"A digger clearing weed from the stream on 24 March destroyed the DO probe and moved the level sensor and its mounting post. This has now been re-instated and, in future, the council officer responsible, will notify us prior to any stream work so we can highlight the location of any equipment. The position of the level sensor has been changed. The data shows the event when DO and temperature failed but the level sensor appears to have been pushed sideways. Prior to re-mounting it and the DO probe, level was 473mm and is now 340mm".

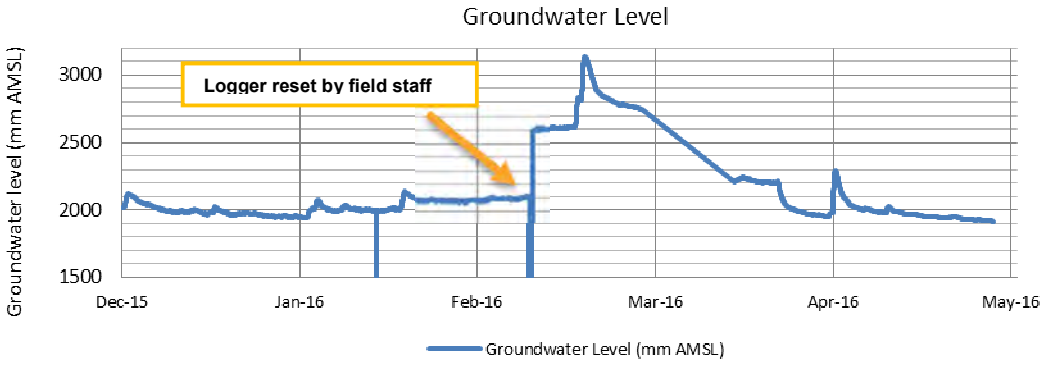


Figure 2: Ground water levels at Hadfield Stream throughout the monitoring period December 2015 to May 2016

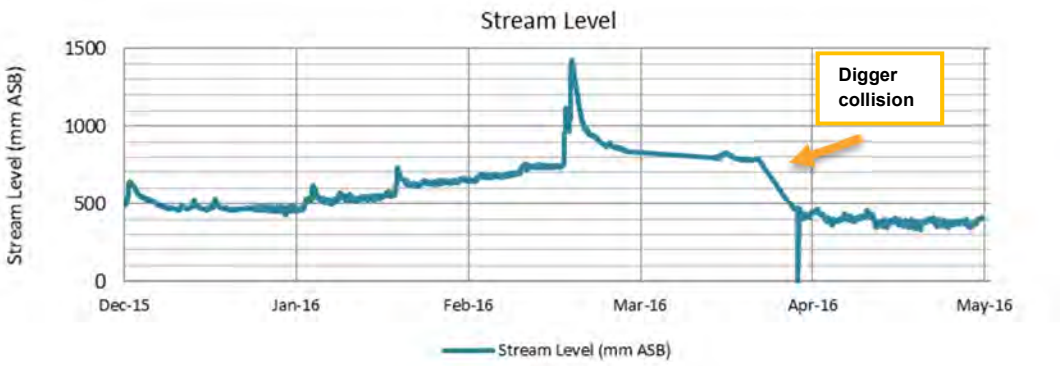


Figure 3: Stream levels at Hadfield Stream throughout the monitoring period December 2015 to May 2016

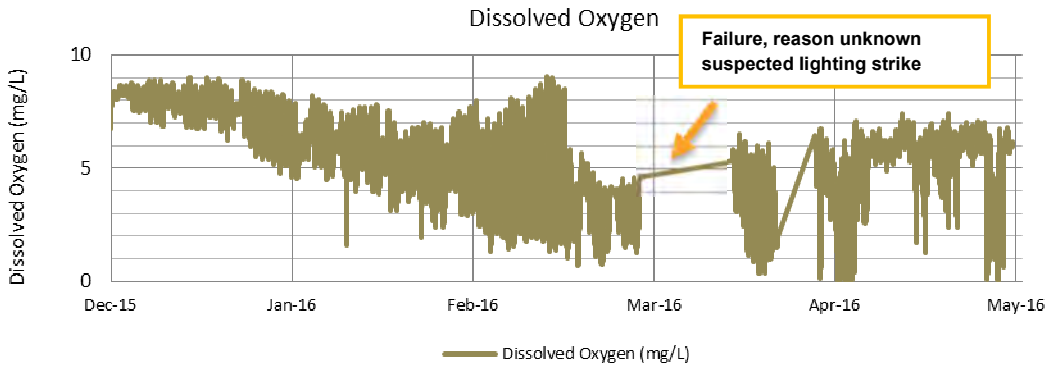


Figure 4: Dissolved oxygen levels at Hadfield Stream throughout the monitoring period December 2015 to May 2016

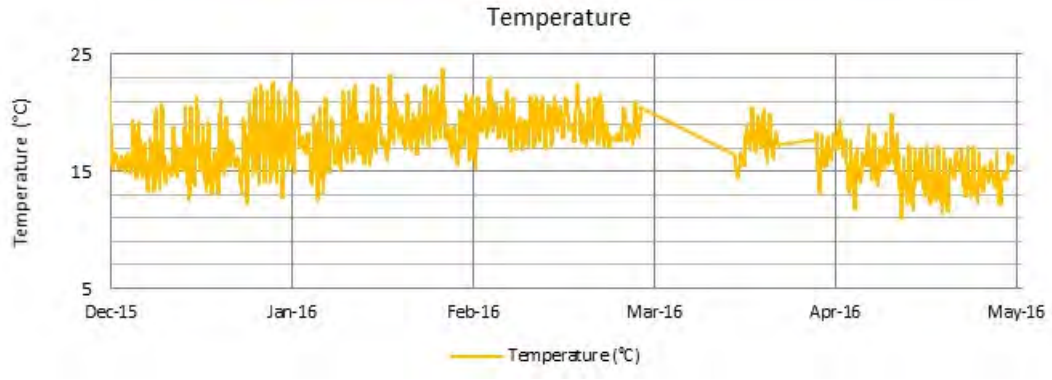


Figure 5: Temperature levels at Hadfield Stream throughout the monitoring period December 2015 to May 2016

3.1.2 Ngarara Stream

Groundwater level between December to February were consistently between 3200mm – 3400mm AMSL. Stream level is consistent with the trend in groundwater. A number of probe issues were related to high bed sediment level changes and probes were often buried.

Please note the following comments provided by KCDC technical staff on 31st March 2016:

"Sensor raised 250mm but there was an offset in the logger that made it difficult to calibrate. Have removed the offset and now made the level sensor, in its new position, the zero stream level. Prior to the change the level was reading 862 and is now reading 385mm. The faulty DO probe has been substituted with a spare and the display on the logger agrees with the newly calibrated value".

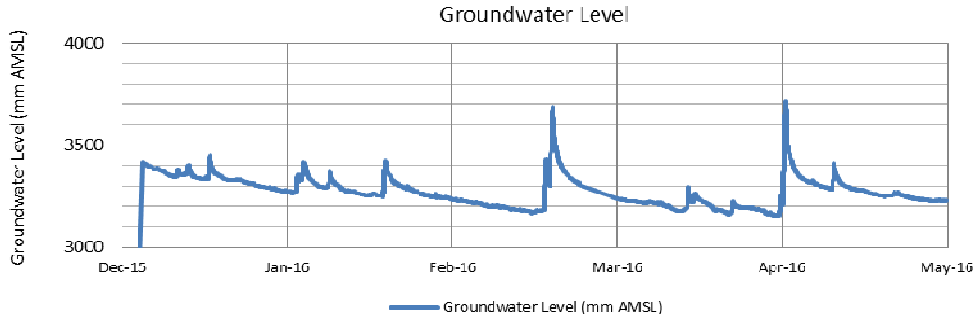


Figure 6: Ground water levels, Ngarara stream through the monitoring period December 2015 to May 2016

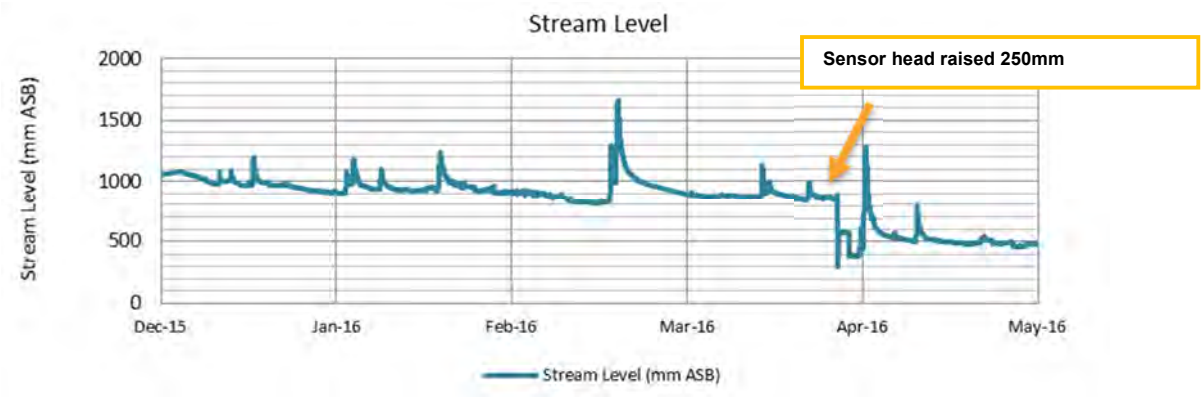


Figure 7: Stream levels, Ngarara Stream through the monitoring period December 2015 to May 2016

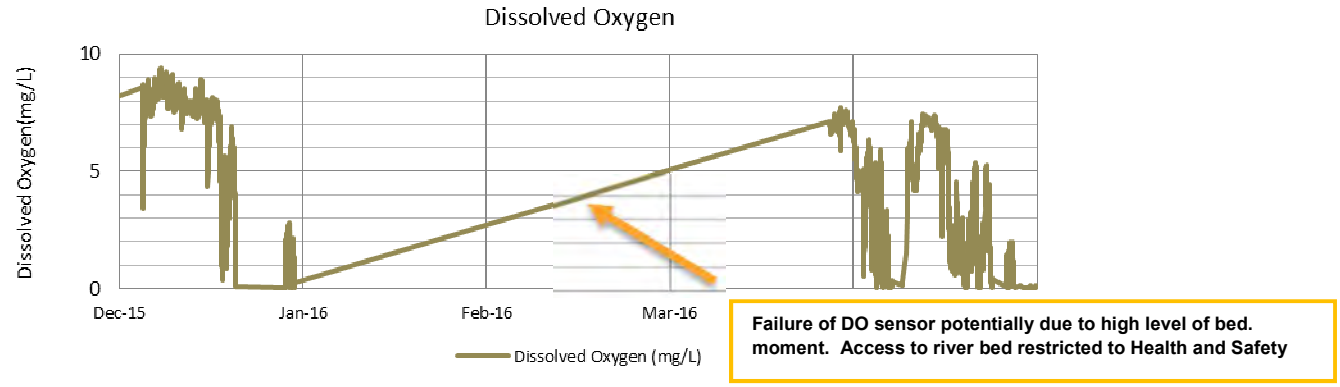


Figure 8: Dissolved oxygen levels, Ngarara Stream through the monitoring period December 2015 to May 2016

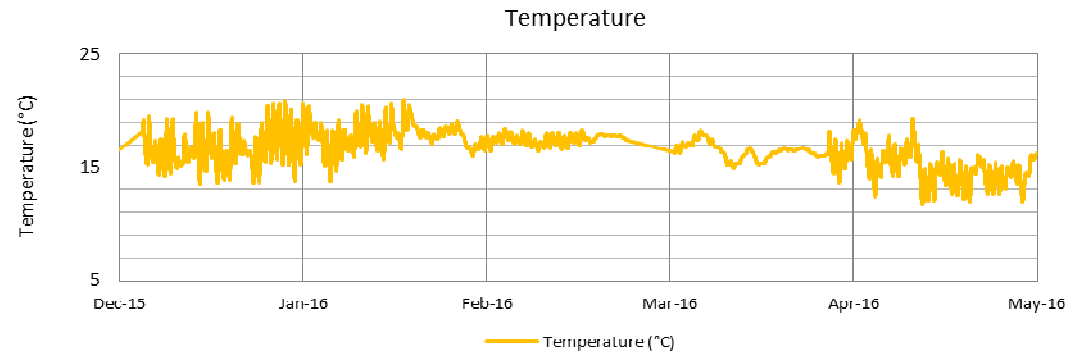


Figure 9: Temperature levels, Ngarara Stream through the monitoring period December 2015 to May 2016

3.1.3 Kakariki Stream

Groundwater levels stayed within 6700 – 7000 mm AMSL for the whole season. The stream level sensor became buried within sediment and was not taking accurate readings until the sensor was re-calibrated in February. Dissolved oxygen levels were consistently between 8-10mg/L up until mid-January to mid-February where DO dropped to 6-8mg/L. Temperature increased gradually throughout the season until mid-February where temperatures declined.

Figure 10: Ground water levels, Kakariki Stream through the monitoring period December 2015 to May 2016

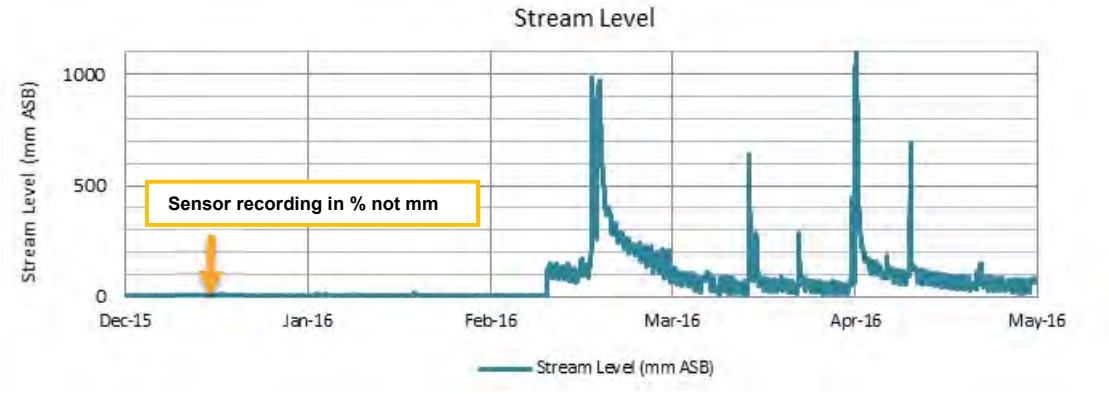


Figure 11: Stream levels, Kakariki Stream through the monitoring period December 2015 to May 2016

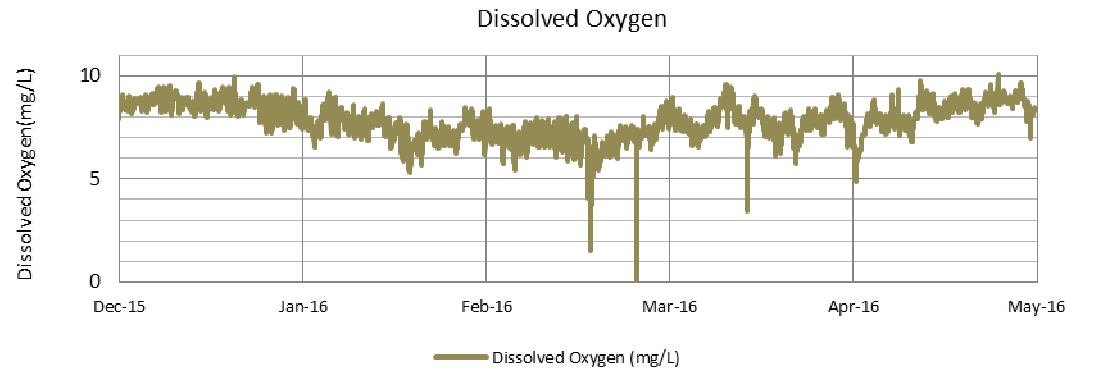


Figure 12: Dissolved oxygen levels, Hadfield Stream through the monitoring period December 2015 to May 2016

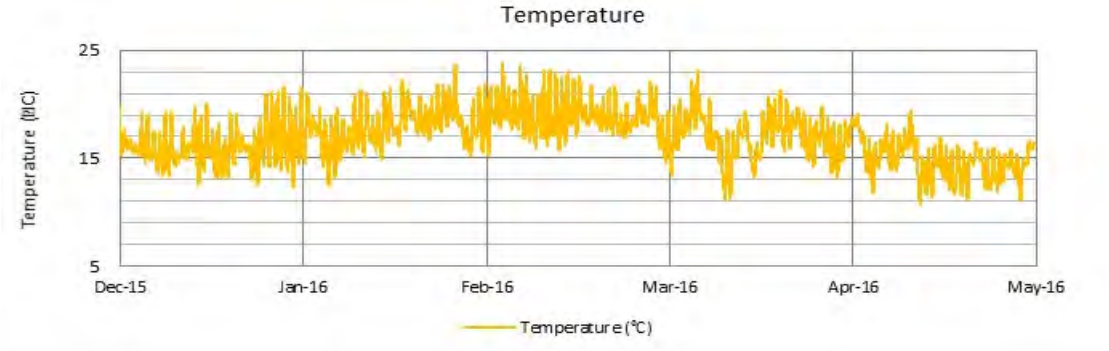


Figure 13: Temperature levels, Kakariki Stream through the monitoring period December 2015 to May 2016

3.1.4 Lower Muaupoko

Groundwater dropped slowly from 6000mm AMSL in November to almost 5500mm AMSL at the end of April. Stream level was consistently at 300mm throughout the season. Oxygen levels were between 7.50 - 11.50mg/L throughout the season. A drop in dissolved oxygen levels occurred in March to 4mg/L.

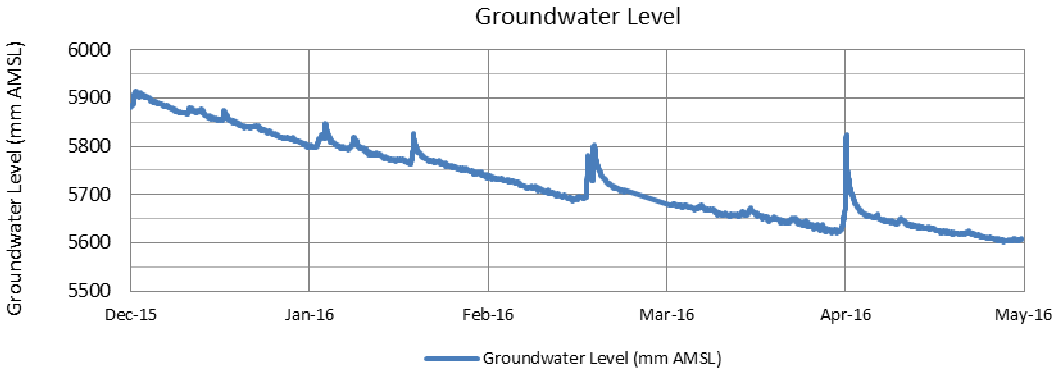


Figure 14: Ground water levels, Lower Muaupoko Stream through the monitoring period December 2015 to May 2016

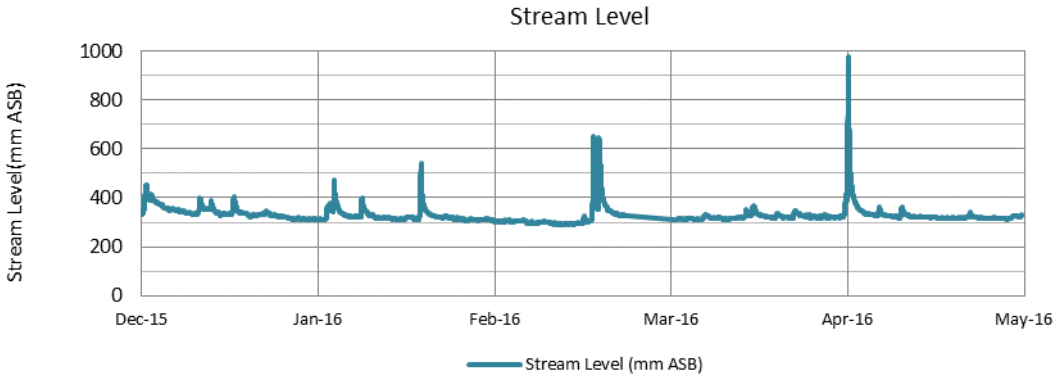


Figure 15: Stream levels, Lower Muaupoko Stream through the monitoring period December 2015 to May 2016

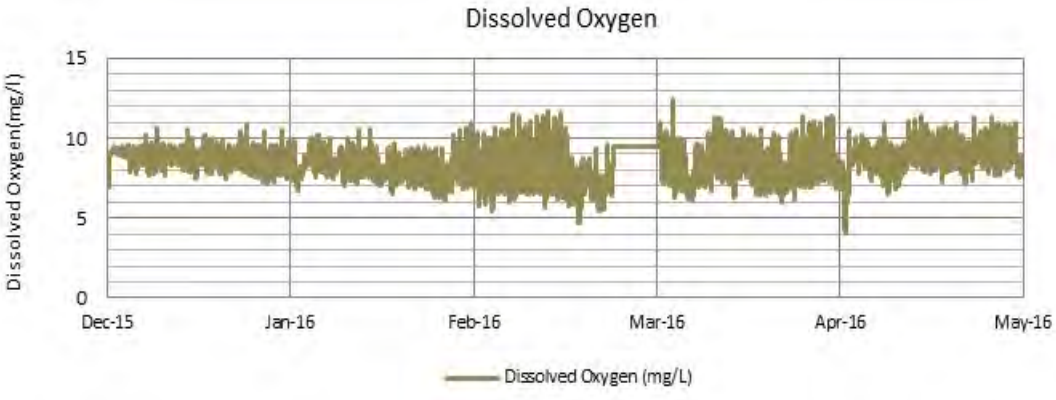


Figure 16: Dissolved oxygen levels, Lower Muaupoko Stream through the monitoring period November 2015 to May 2016

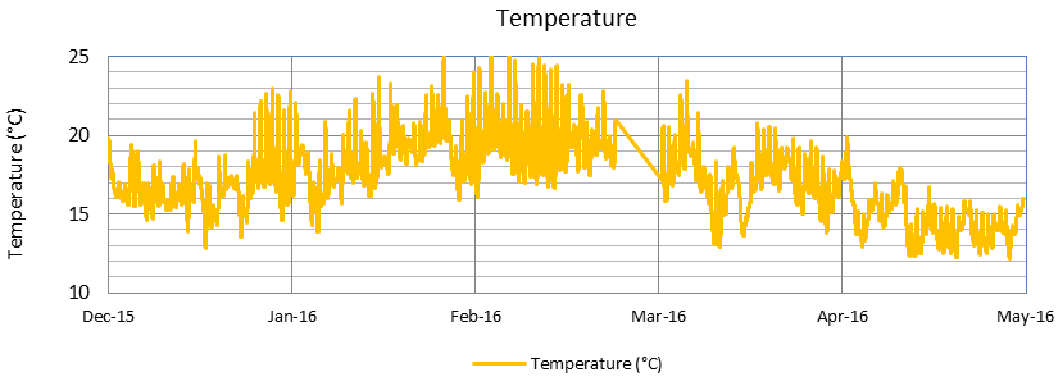


Figure 17: Temperature levels, Lower Muaupoko Stream through the monitoring period December 2015 to May 2016

3.1.5 Upper Muaupoko

Groundwater consistently sat at 14400mm from December to April. Stream surface water levels sat at 600mm from December to March, then dropped suddenly in March to 200mm. The dissolved oxygen sensor became partially buried in January, good recordings began again in March.

Please note the following comments provided by KCDC technical staff on 31st March 2016: "*Sensor raised by 100mm and the DO probe has come back to life now that is not buried. DO probe re-calibrated. Raising the level sensor has highlighted an error. This stream sensor has been set up in the telemetry as a 10 m probe when it is a 5m one. All readings prior to March 30 have been double what they should be. This has now been corrected in the SCADA*".

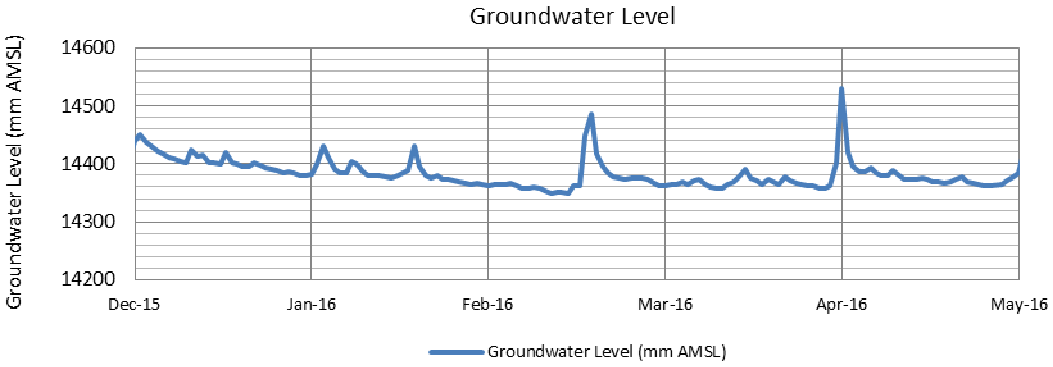


Figure 18: Ground water levels, upper Muaupoko Stream through the monitoring period December 2015 to May 2016

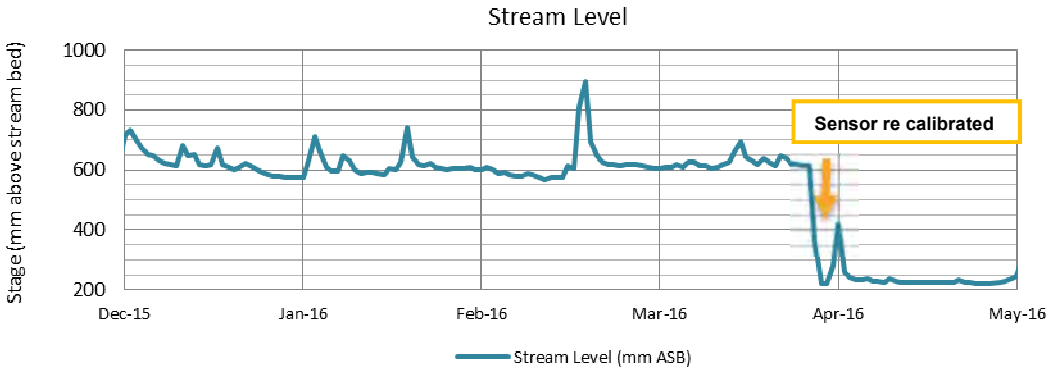


Figure 19: Stream levels, upper Muaupoko Stream through the monitoring period December 2015 to May 2016

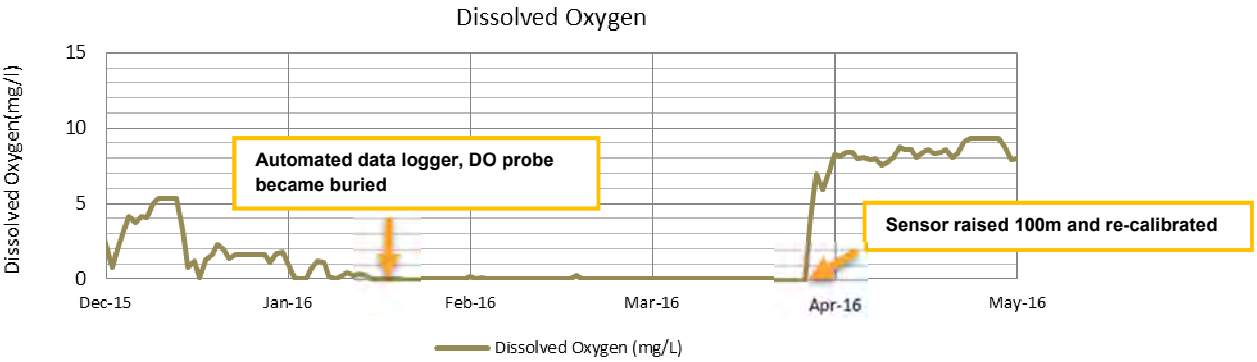


Figure 20: Dissolved oxygen levels, upper Muaupoko Stream through the monitoring period December 2015 to May 2016

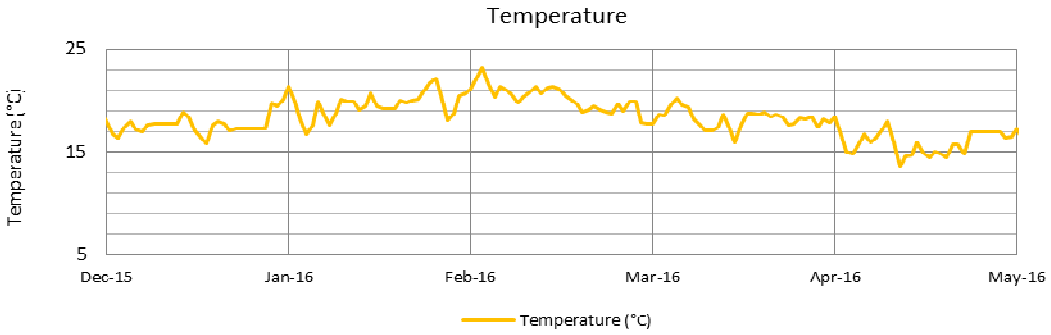


Figure 21: Temperature levels, upper Muaupoko Stream through the monitoring period December 2015 to May 2016

4.0 Discussion

Attaining uninterrupted data was affected by various issues resulting in some data gaps. Given that the baseline data set is for three years and that the recordings are over 5 months of the year at 15 minute intervals these data gaps are of little consequence in being able to look at the longer term (three year) patterns to eventually determine normal state “trigger” alert levels.

When comparing the shallow groundwater level changes with the instream water depth changes it is observable that there are roughly parallel responses of groundwater level and instream water depth to rain. The stream water depth increase response is ahead of the increase in groundwater level (responding first to rain fall) at almost all sites. However, Kakariki groundwater levels increased almost immediately with rainfall and peaks appear at the same time as surface water levels.

The declines in water depth are less in-sync. Kakariki and Hadfield both had declines in surface water levels from February onwards. Both Lower Muaupoko and Upper Muaupoko stream levels stayed level throughout the monitoring season. Lower Muaupoko was the only site where the groundwater consistently dropped and few peaks are observed.

More detailed analysis is needed in clarifying the relationship between groundwater level change and instream water level. This analysis should be carried out by hydrologists once the 3-year baseline monitoring period is complete. At this stage we suggest the surface water in streams is not governed by ground water, but by rainfall.

Dissolved oxygen fluctuates daily and the magnitude of that fluctuation can be large but was typically between 5 and 10 mg/L. There is also a wider trend which appears to follow in reverse the temperature trend. Hadfield was the only site where the dissolved oxygen levels regularly dropped to very low levels between 0-5mg/L.

A conversion process to dissolved oxygen was explored. However, there is no local air pressure data, important for the conversion. We also feel that the consent condition requiring mg/L oxygen is appropriate and allows the collection of suitable data to see the dissolved oxygen variation trend through summer and will allow the setting of ongoing triggers at the end of baseline monitoring if appropriate.

Temperature generally rises to a “peak” around February for all sites and drops away towards April ranging generally between 10-20 degrees Celsius.

Due to very high bed movement we suggest removal of the Ngarara site as the probes instream were often buried and the amount of data gained was marginal. Access to the in stream sensor can be restricted by high water levels. The Kakariki monitoring site is not far up stream on the same water body and considered a better potential indicator of potential effects going forward.

5.0 Summary

Despite some data gaps due to equipment failure, the data collected from the small coastal streams between 1 December 2015 and 1 May 2016 is adequate in providing the second of three years of baseline monitoring measures of relevant instream habitat parameters and potentially associated ground water levels.

We recommend that the dissolved oxygen monitoring be continued given its importance as a measure of aquatic health. The best measures of potential effect will be the measures of stream water depth and shallow groundwater levels. Development of evidence of the connection between the streams surface water and groundwater should be priority for the baseline monitoring period.

We recommend removing the Ngarara monitoring site based on the data collected to date and, as the Kakariki monitoring site is on the same water way and considered a better potential indicator of potential effects going forward.

6.0 References

Addendum to Small Coastal Streams Baseline Monitoring Plan dated 22nd September 2015)..

Boffa Miskell Ltd. (2014a). Characterisation of small coastal streams: identifying monitoring locations (Report No. W13118_20140307). Kapiti Coast District Council.

Boffa Miskell Ltd. (2014b). Small coastal streams baseline monitoring plan (Report No. W13118). Kapiti Coast District Council.

Goodman, J; Dunn, N; Ravenscroft, P; Allibone, R; Boubee, J; David, B; Griffiths, M; Ling, N; Hitchmough, R; and Rolfe, J. 2014. Conservation Status of NZ freshwater fish, 2013. Department of Conservation, NZ threat classification series.