Motutangi-Waiharara Water Users Group

Groundwater Management and Contingency Plan

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Contents

1. Introduction

This document comprises a groundwater monitoring and contingency plan (GMCP) for the operation and management of the groundwater takes. The GMCP has the overarching objectives of:

- ensuring compliance with the consent conditions for members of the Motutangi-Waiharara Water Users Group (MWWUG); and
- providing early detection of any impact to the Motutangi-Waiharara groundwater system associated with the exercise of the groundwater take consents.

Extensive environmental monitoring is required to ensure the effects on the environment are no greater than those anticipated in the AEE, and to support the proposed 'adaptive management' approach involving a staged implementation of groundwater extraction. The purpose of the GCMP is to formalise specific monitoring requirements, establish groundwater level and groundwater quality monitoring triggers and outline a process for implementation of appropriate mitigation measures in the event that nominated trigger values are exceeded.

The GCMP is intended to allow the early detection of any impact to the Motutangi-Waiharara groundwater system associated with the exercise of groundwater take consent(s), by:

- Ensuring regular monitoring of the groundwater system both on and off-site;
- Setting monitoring criteria to indicate potential impact on the groundwater system;
- Informing the Northland Regional Council when changes in the pumping regime are required;
- Reviewing monitoring data after a step level increase in pumping rate;
- Ensuring that the monitoring data is available for regular review by the Northland Regional Council; and
- Detailing a Contingency Plan to be implemented if an unanticipated impact(s) is identified.

The GMCP also provides information as to the actual effects of the abstraction on the groundwater resource and will enable validation of the numerical model by the Consent Holders for any replacement groundwater take consent applications.

1.1 Scope and Purpose of the GMCP

The GMCP addresses the potential effects on groundwater, saline intrusion, and water levels within the shallow aquifer and the Kaimaumau wetland. Specifically, the GMCP is aimed at:

a) Providing procedures to avoid, remedy and mitigate changes in groundwater and wetland water levels, and salinity concentrations in the aquifer at the coast;

b) Ensuring the owners and operators of the consents understand their legal responsibility and how to go about implementing their consents within the legal limits; and

c) Providing all stakeholders and the Regional Council assurance that the Consent will be exercised in compliance with the conditions.

2. Framework for Adaptive Management

The uptake of water under the MWWUG consents will steadily increase over time in accordance with the following factors:

- ***Level of current orchard development*** – noting the following orchards are already well established:
  - APP.027391.01.02 – Stanisich;
  - APP.038650.01.01 – Hewitt;
  - APP.039345.01.01 – McLarnon;
  - APP.038380.01.01 – Huanui Orchards (Holloway);
  - APP.038589.01.01 – Thompson;
  - APP.038591.01.01 – Cypress Hills Ltd;
- ***Rate of orchard development*** - will occur at differing rates depending on the owner's cashflow and access to plants; and
- ***Tree maturity*** - approximately 9 years to full maturity and plant water usage[1], hence irrigation requirements commensurately increase with tree growth.

The steady progressive development of the orchards, particularly the new large developments, provides an opportunity to apply an adaptive management approach that establishes a baseline and allows potential groundwater, wetland and coastal salinity effects to be checked against the predictions made in the AEE, specifically the following:

- The groundwater drawdown predictions in both the shallow and deep aquifer;
- Impacts on wetland water levels by inference from shallow ground monitoring adjacent to the wetland; and
- Salinity at key coastal locations.

The management approach provides a series of responses to be taken should effects develop or trend outside those predicted in the AEE, as discussed in **Section 2.2**.

2.1 Staged Implementation

To allow for the establishment of baseline monitoring conditions the uptake of the water volumes granted under these consents will be permitted in three stages over nine years, with each stage of three years in duration. For the purposes of the staged implementation, it has been assumed that:

- For new orchards - full uptake for new orchards will be required at the end of the nine years and applicants have agreed to the following schedule (subject to Regional Council approval):
  - Years 1-3 – 50% uptake;
  - Years 4-6 – 80% uptake; and
  - Year 7-9 – 100% uptake.
- For established orchards – full uptake is required immediately (**Table 2**).

[1] Kaneko, T., 2016. Water requirements for 'Hass' avocado flowering and fruit development in New Zealand. A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Biological Sciences at The University of Waikato.

Table 1. Summary of staged implementation annual volumes.

Application Number	Consent Holder	Consented Annual Volume (m^3)	Allowable Annual Volume (m^3)		
			Stage 1 (Year 1-3)	Stage 2 (Year 4-6)	Stage 3 (Year 7-9)
APP.038610.01.01	Mapua Avocados Ltd, C/o Murray Forlong	745,000 **624,000**	372,500 **312,000**	596,000 **499,200**	745,000 **624,000**
APP.038471.01.01	Honeytree Farms Limited, C/o Tony Hayward	372,000 **200,000**	186,000 **100,000**	297,600 **160,000**	372,000 **200,000**
APP.038410.01.01	Georgina Tui and Mate Nickolas Covich	223,500	111,750	178,800	223,500
APP.038420.01.01	Largus Orchard Ltd Partnership, C/o Murray Forlong (Changed from Matijevich)	193,700	96,850	154,960	193,700
APP.038513.01.01	Te Runanga o Ngai Takoto, C/o Rangitane Marsden	193,700	96,850	154,960	193,700
APP.038454.01.01	Elbury Holdings Limited, C/o Kevin and Fiona King	113,700	56,850	90,960	113,700
APP.039332.01.01	Candy Corn Ltd, C/o Bryan Candy	80,000	40,000	64,000	80,000
APP.027391.01.02	Ivan Anthony Stanisich*	64,070	64,070	64,070	64,070
APP.039244.01.01	Kevin and Dani Thomas	59,600	29,800	47,680	59,600
APP.038589.01.01	Neil & Alma Violet Thompson and Steven & Josephine Suzanne Thompson*	39,350	39,350	39,350	39,350
APP.038591.01.01	Cypress Hills Ltd, C/o Alan Anderson & Carolyn Dawn Smith*	41,720	41,720	41,720	41,720
APP.038650.01.01	Tony and Diane Hewitt*	40,230	40,230	40,230	40,230
APP.038328.01.01	Bernard Kim & Sheryl Dianne Shine	50,184 **40,000**	25,092 **20,000**	40,147 **32,000**	50,184 **40,000**
APP.039345.01.01	Ian McLarnon & Jason McLarnon*	24,000 **23,370**	24,000 **23,370**	24,000 **23,370**	24,000 **23,370**
APP.038732.01.01	Kathy Valadares	48,000 **22,350**	24,000 **11,175**	38,400 **17,880**	48,000 **22,350**
APP.038380.01.01	Daimen & Katherine Holloway*	14,900	14,900	14,900	14,900
APP.039381.01.01	Johno and Carol Brien (Lamb Road)	14,900	7,450	11,920	14,900
TOTAL		**2,318,554** **1,989,090**	**1,251,737** **1,106,365**	**1,891,827** **1,636,000**	**2,318,554** **1,989,090**
% of Total			**55%**	**82%**	**100%**
Note: *orchards already significantly developed					

Commented [L1]: Figures in red are the equivalent volumes based on recommended annual volumes in the Officers Report

Commented [JW2]: The annual volumes are disputed. Shown here are the volumes from Mr Williamson's evidence.

2.2 Trigger Level System

Trigger levels (TLs) will be established to set up an early warning system that provides a response mechanism when differences between predicted and actual water levels, and/or salinity concentrations occur. A trigger level is an environmental criterion that if reached or met, requires a certain response to be actioned.

A two-tier trigger level system will be implemented in this GCMP:

- **TL1** - The first-tier trigger level establishes whether the parameter of concern is approaching outer limits of background data (e.g. median ±3 times the standard deviation);
- **TL2 -** The second-tier trigger level is set at a threshold defining a 'significant' departure from background conditions and/or conditions where the risks of adverse environmental effects such as saline intrusion are increased.

The TLs required under this GMCP for the various suites are summarised in **Table 2**.

Table 2. Summary trigger level parameters by monitoring suite.

Monitoring Suite	Parameters
Groundwater level and salinity monitoring	Groundwater level, electrical conductivity
Saline intrusion monitoring	Electrical conductivity, chloride, sodium, total dissolved solids.
Water quality monitoring	Electrical conductivity, dissolved reactive phosphorus, nitrate, ammonium, total nitrogen, pesticide suite.

Commented [JW3]: This monitoring suite is disputed.

2.2.1 Timeframe for setting of trigger levels

The setting of TL1 and TL2 trigger levels values for each parameter (where TBC is indicated in the monitoring plan tables in the **Section** 3) will be undertaken during the first implementation stage after 12 months of monitoring data has been collected and within 15 months of the granting of the consents. This approach recognises that:

- in some areas no baseline data has been established by the applicants or any of the key stakeholders in the area; and that
- the manifestation of any effects from the exercising of these consents will steadily progress with time in accordance with the stages of orchard developments and age of the crop. The scale of abstraction during the background data collection period will not vary significantly from existing conditions.

2.2.2 Response to monitoring results

The monitoring results are to be compared against the TLs after each round of monitoring by an independent hydrogeologist. The actions required should TLs be exceeded are summarised in **Section 4** (Contingency Plan) and shown in **Figure 3**.

2.3 Environmental Monitoring Report

The MWWUG must commission the preparation of an Environmental Monitoring Report (EMR) by a suitably qualified Hydrogeologist at the end of each irrigation season and this must be submitted to the Regional Council by 30 June each year.

The EMR must provide an analysis and interpretation of the results of bore water meter (use) records, groundwater level and water chemistry monitoring data, and compare the monitoring data to predicted impacts within the AEE.

The EMR must submitted to the Regional Council following the cessation of the irrigation season associated with each implementation stage (i.e. three, six and nine years after granting of the consent). The Regional Council will respond to conclusions reached in the EMR, particularly regarding the implementation of staged development, in a timely manner prior to the subsequent irrigation season following submission of the EMR.

2.4 Staged Implementation and Monitoring Programme Review

At the following times the volume of abstraction authorised will be reviewed against the staged implementation outlined in **Section 2.1**:

- End of Stage 1 - after three years from granting of the consents;
- End of Stage 2 - after six years from granting of the consents; and
- End of Stage 3 - after nine years from granting of the consents.

The review will include a detailed assessment of all environmental monitoring data including groundwater levels, salinity indicators, and water quality. An increase in the volume of abstraction to the next development stage will only occur if the Regional Council is satisfied that environmental effects resulting from abstraction are no more than those anticipated in the AEE.

The review may also consider the nature and scope of continued monitoring (i.e. monitoring frequency, intensity (type and number of samples)) and associated trigger levels.

Review of the monitoring programme may also occur to incorporate new or replacement consents that have overlapping and/or additional monitoring requirements or which are subject to different trigger levels.

2.5 Timeline of Management Actions

Figure 1 provides a timeline indicating when reporting and management decisions are required.

Figure 1. Timeline of reporting and management decisions.

3. Monitoring Plan

3.1 Bore Locations and Details

A consolidated summary of the schedule of bores that are required to be monitored as part of this GMCP is provided in **Table 3**. Along with the bores identified for monitoring, the table provides key details relating to the bores physical attributes and monitoring to be undertaken. The following sections provide monitoring schedules (frequency and trigger levels) for the relevant bores under each suite of monitoring bore.

The locations of the bores are show in **Figure 2**, which also shows the location of the MWWUG bores for reference.

Table 3. Schedule of bores and monitoring details.

Bore Name		Bore Owner	Coordinates (NZTM 2000)		Depth (m)	Dia. (mm)	Piezo. No.	Target aquifer	Purpose*
Generic	NRC ref.		Easting	Northing					
Fishing Club	LOC.200250	NRC	1611411	6146928	79			Deep shellbed	SI; MI
Waterfront	LOC.200210	NRC	1611712	6146689	19	32	1	Shallow sand	GL
			1611712	6146689	37	32	2	Intermediate	
			1611712	6146689	57	32	3	Intermediate	
			1611712	6146689	74	32	4	Deep shellbed	
Motutangi	TBC	TBC	1615707	6139818	<10	50	1	Shallow sand	GL; EC
			1615707	6139818	80-100 (TBC)	50	2	Deep shellbed	GL; EC
Norton Road	TBC	TBC	1619772	6134408	<10	50	1	Shallow sand	GL; EC; N; P
	TBC	TBC	1619772	6134408	80-100 (TBC)	50	2	Deep shellbed	GL; EC
Kaimaumau	LOC.316222	NRC	1622445	6134482	20		1	Shallow sand	GL; EC; SI; MI; N; P
	LOC.315766	NRC	1622426	6134466	72		2	Deep shellbed	GL; EC; SI; MI
Kaimaumau Settlement	LOC.200097	Private (Wilson Kaimaumau)	1624293	6135696	<20 (12)		1	Shallow sand	SI
	TBC	TBC	1624253	6135897	>50 (TBC)		2	Deep shellbed	SI
Lamb Road	TBC	J. & C. Brien	1610222	6147542	TBC		1	Deep shellbed	GL
Valadares	TBC	K. Valadares	1611284	6144679	TBC		1	Deep shellbed	GL
McLarnon	TBC	I. & J. McLarnon	1610058	6147313	TBC		1	Deep shellbed	GL
Elbury Holdings	TBC	Elbury Holdings Limited	1611872	6142927	TBC		1	Deep shellbed	GL; SI
Holloway	TBC	Huanui Avocados Ltd	1610366	6143906	TBC		1	Deep shellbed	GL; SI
Ngai Takoto	TBC	Te Runanga o Ngai Takoto	1611284	6144679	TBC		1	Deep shellbed	GL
			1619904	6133984	TBC		1	Deep shellbed	GL
Cypress Hills	TBC	Cypress Hills Ltd	1619097	6135520	TBC		1	Deep shellbed	GL
Stanisich	TBC	I.A. Stanisich	1618987	6135795	95	104	1	Deep shellbed	GL
Honeytree	TBC		1617128	6136793	112	310	1	Deep shellbed	GL

Bore Name		Bore Owner	Coordinates (NZTM 2000)		Depth (m)	Dia. (mm)	Piezo. No.	Target aquifer	Purpose*
Generic	NRC ref.		Easting	Northing					
		Honeytree Farms Limited	1617128	1617128	6	50	2	Shallow sand	GL; N; P
			1614898	6138495	111	310	3	Deep shellbed	GL
Thompson	TBC	N. & A. V. Thompson and S. & J.S. Thompson	1617846	6133480	TBC		1	Deep shellbed	GL
Candy Corn	TBC	Candy Corn Ltd	1618903	6136060	TBC		1	Deep shellbed	GL
Mapua	TBC	Mapua Avocados Ltd	1618611	6136321	111	100	1	Deep shellbed	GL
			1614798	6138773	122	100	2	Deep shellbed	GL
			1614723	6139203	97	100	3	Deep shellbed	GL
Hewitt	TBC	T. & D. Hewitt	1612541	6141795	TBC		1	Deep shellbed	GL
Shine	TBC	B. K. & S. D. Shine	1612979	6142360	TBC		1	Deep shellbed	GL; SI
Largus	TBC	Largus Orchard Ltd Partnership	1612784	6142645	94	100	1	Deep shellbed	GL
			1617436	6132318	TBC	100	2	Deep shellbed	GL
Covich	TBC	G.T. & M. N. Covich	1619411	6134224	TBC		1	Deep shellbed	GL
			1619702	6134754	TBC		1	Deep shellbed	GL
Thomas	TBC	K. & D. Thomas	1618003	6133379	TBC		1	Deep shellbed	GL

* Purpose key: GL = Groundwater Level; EC = Electrical Conductivity; SI = Salinity Indicators; MI = Major Ions; N = nutrients; P = pesticides.

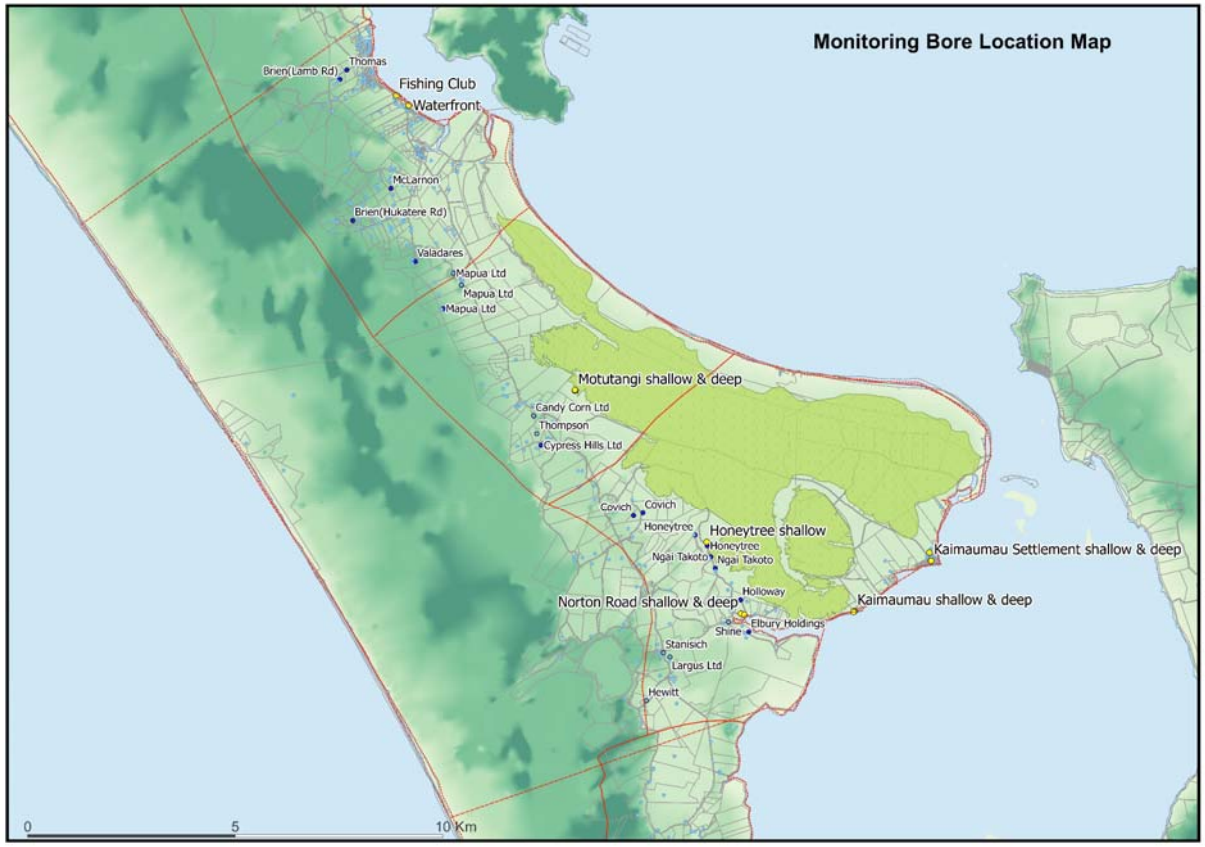

Figure 2. Monitoring Bore Location Map.

3.2 Groundwater Level and Salinity Monitoring

Sentinel bores are monitoring bores located near a discharge boundary or in close proximity to a discharge receptor, and therefore provide early detection or warning of potential concerns. In this GCMP sentinel bores will be utilised as the primary reference sites for regional groundwater levels and salinity monitoring.

Sentinel bores will collect data continuously (daily basis) for water levels and electrical conductivity in individual piezometers to provide an indication of:

- drawdown in shallow groundwater levels in the vicinity of Kaimaumau Wetland attributable to abstraction of deeper groundwater authorised by MWWUG consents;
- groundwater levels around the coastal margin lowering and approaching a threshold that could indicate a greater risk of saline intrusion; and
- any reduction in water quality that could indicate the landward migration of the saline interface.

Checking of the datalogging sensors required for continuous monitoring shall be undertaken during the irrigation season on a monthly basis. The data will be reviewed and any faults shall be reported to the Regional Council and remedied immediately, and TL exceedances should follow the procedures in the Contingency Plan described in **Section 4**.

For sentinel bores that are to be installed, the TLs for groundwater level will be determined once the bore is constructed and level surveyed. TL1 will be based on the baseline data, while TL2 will be no less than 0.5 mAMSL in the shallow aquifer and 1.0 mAMSL in the deep aquifer (noting that changes in EC are also a key indicator).

Electrical conductivity triggers for the sentinel bores will be established as follows:

- **TL1** - Median (weekly rolling average) EC from baseline monitoring period +25%
- **TL2** - Median (weekly rolling average) EC from baseline monitoring period + 50%

Details of the sentinel bores to be used as groundwater level and salinity reference points are summarised in **Table 4**.

Table 4. Schedule of sentinel monitoring bores for groundwater level and salinity indicators.

Bore Name	Depth (m)	Piezo. No.	Target aquifer	Purpose*	Units	Frequency	Trigger Levels	
							TL1	TL2
Waterfront	19	4	Shallow sand	GL	mAMSL	Continuous	2.3	0.5
	37	3	Intermediate	GL	mAMSL	Continuous	2.9	0.6
	57	2	Intermediate	GL	mAMSL	Continuous	4.5	1.1
	74	1	Deep shellbed	GL	mAMSL	Continuous	4.4	1.8
Motutangi sentinel	<10	1	Shallow sand	GL	mAMSL	Continuous	TBC	TBC
				EC	µS/cm	Continuous	TBC	TBC
	80-100 (TBC)	2	Deep shellbed	GL	mAMSL	Continuous	TBC	TBC
				EC	µS/cm	Continuous	TBC	TBC
Norton Road sentinel	<10	1	Shallow sand	GL	mAMSL	Continuous	TBC	TBC
				EC	µS/cm	Continuous	TBC	TBC
	80-100 (TBC)	2	Deep shellbed	GL	mAMSL	Continuous	TBC	TBC
				EC	µS/cm	Continuous	TBC	TBC
Kaimaumau sentinel	20	1	Shallow sand	GL	mAMSL	Continuous	TBC	TBC
				EC	µS/cm	Continuous	TBC	TBC
	72	2	Deep shellbed	GL	mAMSL	Continuous	TBC	TBC
				EC	µS/cm	Continuous	TBC	TBC

* Purpose key: GL = Groundwater Level; EC = Electrical Conductivity; SI = Salinity Indicators; MI = Major Ions.

Notes:

TBC = to be confirmed within 15 months of granting of the consents.

GL TL1s (where provided) have been calculated from longterm monitoring data.

GL TL2s (where provided) have been interpolated from Table F1, WWA Groundwater Modelling Report.

3.2.1 Shallow Groundwater Levels

The purpose of shallow groundwater level monitoring in sentinel bores is to specifically address concerns related to water level reductions in shallow groundwater and potential effects on the Kaimaumau wetland.

The existing conceptual understanding in the shallow groundwater regime is that groundwater levels within the wetland are higher than groundwater levels in the shallow aquifer outside of the wetland, due to land drainage of adjacent farm land.

Following installation of the sentinel bores, groundwater levels around the wetland margin (at the Motutangi, Norton Road and Honeytree Farms monitoring sites) will be compared to the wetland ground levels in the wetland to assess any difference in relative water levels. Depending on results of this assessment, monitoring and reporting of shallow groundwater levels will be undertaken as follows:

- If comparison of relative groundwater levels indicates clear separation between standing water levels in the wetland and the regional piezometric surface, it will be assumed the potential for hydraulic connection with the wetland is limited. In this case, no specific assessment of shallow groundwater levels will be required.
- If comparison of relative groundwater levels indicate standing water levels in the wetland are close to, or below the regional piezometric surface, it will be assumed the potential for hydraulic connection between the wetland and aquifer exists. In this case, assessment of localised and sub-regional trends

in shallow groundwater (including groundwater levels recorded by DOC in the Kaimaumau Wetland) will be provided in the Environmental Monitoring Report (**Section 2.3**), and evaluation of the potential magnitude and significance of effects will be a consideration for the review and approval of the proposed staged development (outlined in **Section 2.4**).

3.2.2 Production Bore Groundwater Levels

Monthly water level monitoring is required in all MWWUG production bores during the winter months (nominally May to September) to provide information to identify any inter-annual variations in aquifer storage which may be anomalous compared to regional trends (**Table 5**).

However, no specific trigger level will be established for groundwater levels in the production bores as the manifestation of saline intrusion is dependent on both time and magnitude of groundwater level reduction. Short periods of groundwater levels significantly below sea level (large drawdown) will not induce saline intrusion as the process requires significant time to initiate.

Continuous water level monitoring is also required in a shallow observation bore adjacent to the APP.038471.01.01 production bore (Honeytree Farms) to quantify any localised drawdown effects in the shallow sand aquifer in the vicinity of a relatively large abstraction proximal to Kaimaumau Wetland.

This shallow aquifer monitoring will enable comparison between the area of maximum shallow aquifer impact modelled in the AEE, with the shallow piezometers in the four sentinel bores (**Table 4**) distributed across the wider Aupōuri Aquifer.

Table 5. Proposed Monitoring Schedule – Production Bore Water Levels.

Bore Name	Depth (m)	Piezo. No.	Target aquifer	Parameter*	Units	Frequency	Trigger Levels	
							TL1	TL2
Lamb Road	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Valadares	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
McLarnon	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Elbury Holdings	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Holloway	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Ngai Takoto	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Cypress Hills	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Stanisich	95	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Honeytree	112	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
	6	2	Shallow sand	GL	mAMSL	Continuous	n/a	n/a
	111	3	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Thompson	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Candy Corn	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Mapua	111	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
	122	2	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
	97	3	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Hewitt	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Shine	TBC	1	Deep shellbed	GL; SI	mAMSL	Monthly	n/a	n/a
Largus	94	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Covich	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a
Thomas	TBC	1	Deep shellbed	GL	mAMSL	Monthly	n/a	n/a

* Purpose key: GL = Groundwater Level; EC = Electrical Conductivity; SI = Salinity Indicators; MI = Major Ions.

3.3 Saline Intrusion Monitoring

Quarterly monitoring of key salinity indicators in new or existing bores at key locations around the northern margin of Rangaunu Harbour is required. This area is adjacent to the largest concentration of proposed abstraction, in an area where the potential for saline intrusion is elevated due to a flat hydraulic gradient (particularly toward Kaimaumau settlement where groundwater is used for potable and farm water supply). Reference to the existing NRC state of the environment monitoring sites at Houhora and Kaimaumau which are monitored quarterly is also required.

Proposed monitoring sites include:

- the existing Fishing Club bore at Houhora (monitored quarterly by NRC).
- the existing shallow and deep Kaimaumau sentinel bores (monitored quarterly by NRC).
- a new or existing bore in or near the Kaimaumau settlement accessing the shallow sand aquifer (<20 metres).
- a new or existing bore in or near the Kaimaumau settlement accessing the shellbed aquifer (>50 metres).
- proposed production bores in the Norton Road area located within 1 km of the coastal marine area.

Salinity indicators and major ions monitored shall include:

- Electrical conductivity.
- Chloride.
- Sodium.
- Total Dissolved Solids.

Trigger levels for individual determinants will be established as follows:

- **TL1** - Median (weekly rolling average) concentration from baseline monitoring +25%
- **TL2** - Median (weekly rolling average) concentration from baseline monitoring + 50%

The monitoring schedule is set out in **Table 6**.

Table 6. Proposed Monitoring Schedule – Saline Intrusion.

Bore Name	Depth (m)	Piezo. No.	Target aquifer	Parameter*	Units	Frequency	Trigger Levels	
							TL1	TL2
Fishing Club	79	1	Deep shellbed	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
Kaimaumau	20	1	Shallow sand	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
	72	2	Deep shellbed	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
Kaimaumau Settlement	<20 (12)	1	Shallow sand	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
	>50 (TBC)	2	Deep shellbed	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
Elbury Holdings	TBC	1	Deep shellbed	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
Holloway	TBC	1	Deep shellbed	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
Shine	TBC	1	Deep shellbed	EC	µS/cm	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC

* Parameter key: GL = Groundwater Level; EC = Electrical Conductivity; SI = Salinity Indicators; MI = Major Ions.

3.4 Water Quality Monitoring

Water quality monitoring shall be established in shallow piezometers located down-gradient of representative orchard areas in the Motutangi and Waiparera sub-areas.

Piezometers shall be sampled:

- On a six-monthly basis for representative nutrients.
- On an annual basis for any pesticides identified in the GCMP which exhibit characteristics which increase the potential to leach to groundwater (e.g. persistent, soluble, mobile).

Commented [JW4]: This is a point of contention with the applicant. See the supplementary evidence of Ms Letica.

As indicated in **Section 2.4**, periodic review of groundwater quality monitoring results as well as the nature and scope of continued monitoring.

Table 7. Proposed Monitoring Schedule – Water Quality Monitoring.

Bore Name	Depth (m)	Piezo. No.	Target aquifer	Parameters*	Frequency	Trigger Levels	
						TL1	TL2
Motutangi	<10	1	Shallow sand	EC	Six monthly	TBC	TBC
				DRP	Six monthly	TBC	TBC
				NO_3	Six monthly	TBC	TBC
				NH_4	Six monthly	TBC	TBC
				TN	Six monthly	TBC	TBC
				PS	Annually	TBC	TBC
Norton Road	<10	1	Shallow sand	EC	Six monthly	TBC	TBC
				DRP	Six monthly	TBC	TBC
				NO_3	Six monthly	TBC	TBC
				NH_4	Six monthly	TBC	TBC
				TN	Six monthly	TBC	TBC
				PS	Annually	TBC	TBC
Kaimaumau	20	1	Shallow sand	EC	Six monthly	TBC	TBC
				DRP	Six monthly	TBC	TBC
				NO_3	Six monthly	TBC	TBC
				NH_4	Six monthly	TBC	TBC
				TN	Six monthly	TBC	TBC
				PS	Annually	TBC	TBC
Kaimaumau Settlement	<20 (12)	1	Shallow sand	EC	Six monthly	TBC	TBC
				DRP	Six monthly	TBC	TBC
				NO_3	Six monthly	TBC	TBC
				NH_4	Six monthly	TBC	TBC
				TN	Six monthly	TBC	TBC
				PS	Annually	TBC	TBC
Honeytree	6	2	Shallow sand	EC	Six monthly	TBC	TBC
				DRP	Six monthly	TBC	TBC
				NO_3	Six monthly	TBC	TBC

Bore Name	Depth (m)	Piezo. No.	Target aquifer	Parameters*	Frequency	Trigger Levels	
						TL1	TL2
				NH_4	Six monthly	TBC	TBC
				TN	Six monthly	TBC	TBC
				PS	Annually	TBC	TBC
* Parameter key: EC = Electrical Conductivity; DRP = Dissolved Reactive Phosphorus; NO3 = Nitrate; NH4 = Ammonium; TN = Total Nitrogen; PS = Pesticide Screen.							

4. Contingency Plan

Exercising of the consents is subject to maintenance of aquifer conditions that do not indicate on-going unsustainable groundwater level decline or increase in salinity at the coastal margins (saline intrusion).

As described in **Section 2.2**, a trigger level system is used to define environmental criteria that signals changes may be occurring outside of what is normal (TL1) or at a point where mitigation is required (TL2). This section details the responses that that will be undertaken where TLs are exceeded under any of the monitoring suite discussed in **Sections 3.2, 3.3, and 3.4**.

Figure 3 provides an overview diagram of the contingency plan.

4.1 Exceedance of TL1

In the event of a TL1 exceedance, which may represent declining groundwater levels or rising salinity indicators, the following actions must be undertaken:

a) Notify the Regional Council within 5 working days of when the TL1 exceedance became known.

b) Sampling of the monitoring bore(s) in exceedance shall immediately be upgraded to a weekly frequency for four weeks following the first exceedance of the TL1 and results reported to the Regional Council at weekly intervals.

c) If after four weeks following the first exceedance of the TL1, the initiation of seawater intrusion and/or water level decline cannot be discounted to the satisfaction of the Regional Council, then within three months of the initial breach, the MWWUG shall prepare and submit to the Regional Council a Groundwater Trigger Exceedance Report (GTER).

d) The GTER shall assess the significance of the exceedance in terms of saline intrusion of the aquifer, effects on the Kaimaumau wetland or ongoing declining groundwater levels. The GTER shall assess why TLs have been breached, identify the pumping bores in the area of effect, and include a review of all of the available data, including groundwater levels, groundwater use and groundwater quality, and shall be completed by a suitably qualified Hydrogeologist.

4.2 Exceedance of TL2

In the event of a TL2 exceedance, which represents significant departure from normal groundwater conditions, with either continuously declining groundwater levels or rising salinity indicators, the members of the MWWUG identified as being in the area of effect through the GTER review process, shall:

a) Implement an interim schedule of pumping restrictions commensurate with **Table 8**.

b) Review and update the GTER report within 20 working days with a longer-term programme of recommended responses incorporating observed response to interim pumping rate reductions. The updated GTER will include a specific programme (including timeframes) of remedial actions to mitigate saline intrusion risk over the medium and long term. The remedial actions may include, but not be limited to incremental reductions in the daily quantity of groundwater taken as a percentage of the allowable daily pumped volume, as well as testing of domestic/stock water supplies in bores potentially impacted by saline intrusion and, if necessary, provision of temporary water supplies to effected parties outside of the MWWUG in the event water quality exceeds MAVs or aesthetic guidelines prescribed in NZDWS (potable supplies).

c) Actions from the GTER shall continue as long as the issue continues.

Table 8. Interim pumping restrictions following TL2 exceedance.

Piezometer where TL2 water level/salinity exceedance recorded	Priority 1 Consents (50% reduction in maximum daily rate of take)	Priority 2 Consents (25% reduction in maximum daily rate of take)
Waterfront	Brien Thomas McLarnon	Valdares Mapua Ltd
Motutangi	Candy Corn Thompson Cypress Hills	Mapua Ltd Covich Honeytree
Norton Road/Kaimaumau	Elbury Shine Holloway Ngai Takoto Honeytree	Covich Stanisich Largus Hewitt

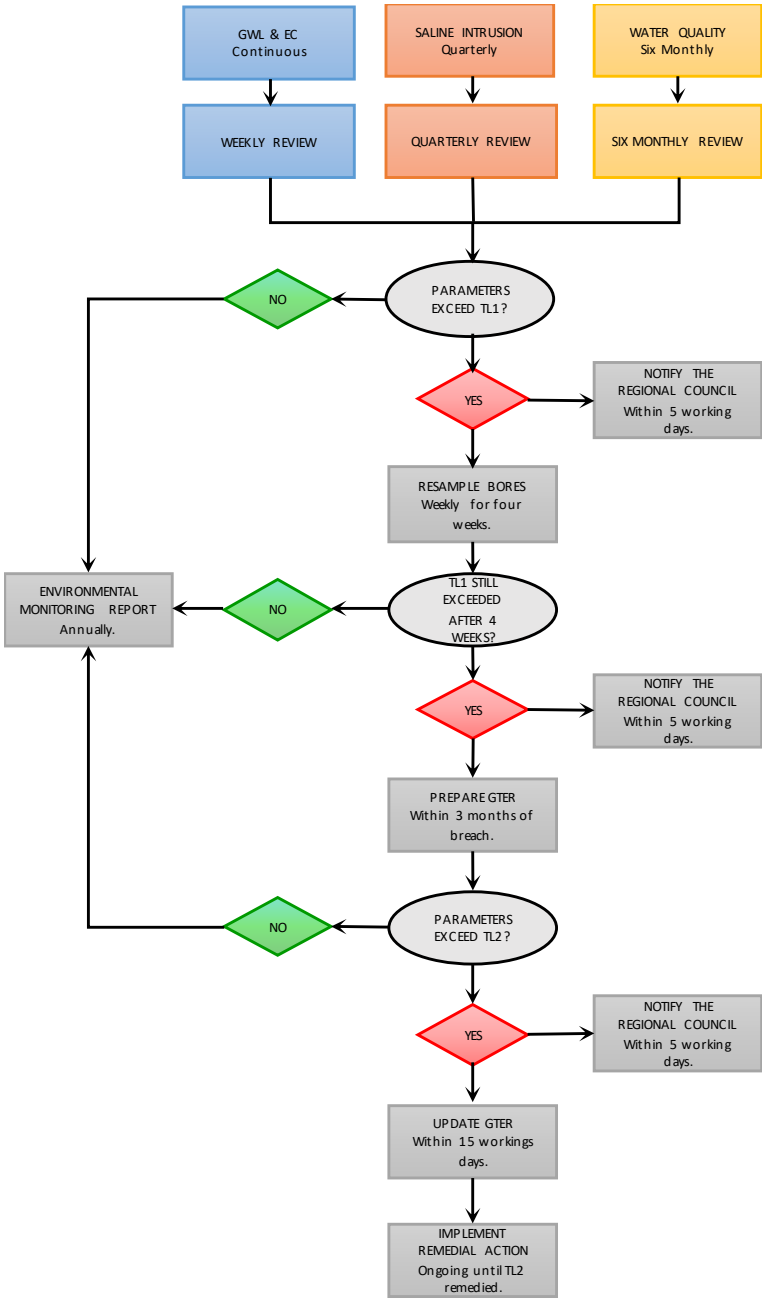

Figure 3. Overview diagram of the Contingency Plan.