Groundwater Monitoring and Contingency Plan for the Other, Waihopo and (northern) Houhora sub-aquifers of the Aupōuri Aquifer Management Unit

May 2021

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GLOSSARY OF TERMS

Saline/saltwater intrusion	For the purposes of this Groundwater Monitoring and Contingency Plan, saline/saltwater intrusion refers to changes in salinity at nominated monitoring locations that exceed thresholds established to indicate elevated potential for adverse effects on groundwater quality for potable supply and/or irrigation use and ~~consequential~~ effects on freshwater ecosystems.
Efficient bore takes	An efficient bore take is when a bore fully penetrates the water bearing layer and takes water from the base of the aquifer.
Sub-aquifer	The Aupōuri Aquifer system is divided into 12 separate sub-aquifer units for the purposes of setting tailored aquifer-specific allocation limits.[1]
First in-first served	Under the Resource Management Act 1991, applications for water takes are processed in the order in which they are lodged. The rights of parties associated with this Groundwater Monitoring and Contingency Plan are prioritised according to the order in which their permits are granted and added to this Plan.
Stage 1	The period up to the point that trigger levels have been set and irrigation has occurred for one full irrigation season, as applied for each individual take/consent
Full irrigation season	Irrigation that occurs within the entire period of a water year, being 1 July to 30 June, when irrigation is required, whether or not the full allocation for a stage is irrigated during a water

[1] Policy H.4.4 of the Proposed Regional Plan for Northland (Appeals Version) June 2020.

	year.
Sentinel bore	A monitoring bore specifically established to monitor groundwater levels and salinity indicators in a specified location. For the purposes of this Groundwater Monitoring and Contingency Plan, sentinel bores are those established and/or proposed monitoring bores (not production bores) in which piezometers are installed to measure groundwater levels and salinity indicators in the deep shellbed aquifer and/or the shallow sand aquifer.

1. INTRODUCTION

1.1 Scope and Objective of the GMCP

This document comprises a groundwater monitoring and contingency plan for the Other, Waihopo and (northern) Houhora sub-aquifers of the Aupōuri aquifer management unit ("the GMCP"). Much of the approach outlined in this GMCP has been informed by the technical assessment presented in the *Aupouri Aquifer Groundwater Model, Factual Technical Report – Modelling – Aupouri Aquifer Water User Group. WWLA0184, Rev 3*, dated 5 February 2020 and prepared by Williamson Water & Land Advisory Ltd (hereafter referred to as the AAGWM Report).

The GMCP covers the implementation and monitoring of the groundwater take consents listed in **Table 1** (the Consent Holders) and is a programme of adaptive management that is suitable to provide a platform for the implementation of the abstractions listed in **Table 1**.

An adaptive management regime requires reasonably clear objectives against which the effects and management progress may be evaluated. The objective of this GMCP is that;

Objective 1: **The abstractions must, individually and cumulatively, avoid:**

(a) **adverse effects of saltwater intrusion into the Aupōuri aquifer;**

(b) **adverse effects on the hydrological functioning, including changes to water levels[2], of natural wetlands, springs and dune lakes;**

(c) **alterations to the extents of rivers, natural wetlands, springs and/or dune lakes;**

(d) **adverse effects on the significant indigenous vegetation and habitats in (terrestrial and freshwater environments of) dune lakes, springs and natural wetlands;**

(e) **Adverse effects on the flow levels and flow variability of rivers and streams and springs so that their habitat quality and sustainable mahinga kai, recreational, and other social and cultural values, are maintained (including sufficient flows and flow variability to maintain their habitat quality, including to flush rivers of deposited sediment and nuisance algae and macrophytes and support the natural movement of indigenous fish and valued introduced species such as trout; and**

(f) **lowering of the groundwater levels of the Aupouri aquifer such that existing efficient bore takes operating as a permitted activity or in accordance with resource consent conditions cannot access the authorised volume of groundwater.**

Extensive environmental monitoring is required to confirm avoidance of the effects listed above, and to facilitate an 'adaptive management' approach including the staged implementation of groundwater extraction. The purpose of the GMCP is to provide a framework that meets the requirements and principles of adaptive management. The GMCP provides a methodology for implementing adaptive management and prescribes specific monitoring requirements, establishes groundwater level and groundwater quality monitoring triggers and outlines a process for implementation of appropriate

Commented [SK1]: DOC seeks removal "adverse effects of" or use natural levels of intrusion as qualifier; consistency with the Burgoyne decision

[2] Avoiding "change" means that as a result of the abstraction of water; median water levels, mean annual water level fluctuations and patterns of water level seasonality (relative summer vs winter) remain unchanged.

mitigation and remediation measures if nominated trigger values are exceeded.

The GMCP is intended to allow the early detection of any impact to the Other, Waihopo and (northern) Houhora sub-aquifers of the Aupōuri aquifer management unit and surface water bodies associated with the exercise of groundwater take consent(s), by:

- Requiring regular monitoring of the groundwater system both on and off-site;
- Setting monitoring criteria to indicate potential adverse impacts on the groundwater system and surface water bodies;
- Implementing mitigation measures including changes to the pumping regime if trigger levels are reached to ensure that Objective 1 continues to be met;
- Reviewing monitoring data before and after a step level increase in pumping rate;
- Ensuring that the monitoring data is available for regular review by the Council;
- Detailing a Contingency Plan to be implemented if an unanticipated impact(s) is identified;
- Providing information to quantify the actual effects of the abstraction on the groundwater resource; and
- Enabling validation of the numerical model by the Consent Holders for any replacement groundwater take consent applications.

1.2 Parties Associated with this GMCP

The parties who have been deemed to be associated with this GMCP at its inception are the Northland Regional Council ("the Council"), the Consent Holders in **Table 1**, and the Director-General of Conservation.

The following sections provide a brief description of the roles and responsibilities of each party associated with this GMCP.

Should any of these parties change during the implementation of this GMCP, either through addition or removal, the process as set out in **Section 1.3** below shall be applied.

The rights of Consent Holders associated with this GMCP are prioritised according to the order in which their consents are granted and added to this GMCP, in accordance with the first in-first served approach to water allocation under the Resource Management Act 1991.

1.2.1 Northland Regional Council

The Council will undertake the ongoing monitoring requirements of the GMCP on behalf of the Consent Holders. The actual and reasonable cost of undertaking the ongoing monitoring of these consents will be charged to each Consent Holder in accordance with Council's Charging Policy.

The installation of sentinel bores and monitoring equipment is the responsibility of the Consent Holders.

1.2.2 Consent Holders

The Consent Holders identified in **Table 1** of this GMCP are required to exercise their consents in accordance with this GMCP.

The exercise of the consents will be in accordance with Council-initiated instructions which will be issued once the actions and process established through this GMCP have been undertaken.

The Consent Holders may seek changes to the GMCP through either of the processes set out in **Section 1.3**.

Commented [SK2]: DOC does not support processes for changes.

1.2.3 Director-General of Conservation

The Director-General of Conservation is responsible for administering land and waterbodies subject to reserve status under the Reserves Act 1977 and conservation or stewardship area status under the Conservation Act 1987, along with native fish and functions relating to protected species under the Wildlife Act 1953. Within the Other, Waihopo and (northern) Houhora sub-aquifers of the Aupōuri Aquifer management units these areas include:

- The Te Ramanuka Conservation Area.

The Director-General of Conservation is a party to this GMCP to ensure that the relevant provisions of these Acts, which the Director-General of Conservation administers, in particular that matters identified in Objective 1 of the GMCP are to be met.

It is also relevant to note that the Ngāti Kuri Claims Settlement Act 2015, NgāiTakoto Claims Settlement Act 2015, and the Te Aupōuri Claims Settlement Act 2015 all contain provisions relating to a 'korowai redress' which set-out co-governance arrangements for conservation land known as the 'Korowai for Enhanced Conservation'. The Korowai for Enhanced Conservation recognises the historical, spiritual and cultural association NgāiTakoto, Te Aupōuri, Te Rarawa and Ngāti Kuri iwi have with conservation land and the roles that the hapū and marae of each undertake as kaitiaki of the whenua and taonga of the conservation estate.

1.3 Changes to the GMCP

This GMCP may be amended at any time to:

Commented [SK3]: DOC fundamentally disagrees regarding what should be included in conditions and what can be deferred to a GMCP, and how amendments may be made to both/either.

DOC has concerns with the processes for changes, including amendments to the GMCP, trigger level setting processes and responses, and the SIMPR process, including:

High trust model that defers Council's decision making to outside the consent process
Complexities around response capabilities and timeframes for DOC District offices

DOC proposes a technical review panel made up of representatives from parties to the GMCP. Stipulations around representation, roles and scope would need to be included in the conditions.

- Incorporate new or replacement water permits, or remove water permits, within the Other, Waihopo and (northern) Houhora sub-aquifers of the Aupōuri aquifer management unit that have overlapping and/or additional monitoring requirements or which are subject to different trigger levels or trigger levels based on monitoring described in this GMCP;
- Alter the nature and scope of the required monitoring (i.e. monitoring frequency and intensity (type and number of samples)) and associated trigger levels;
- Incorporate or remove parties who are, or may need to be, a part of this GMCP to ensure Objective 1 is met.

If either the Council or a Consent Holder wishes to amend the GMCP, then it must provide notice in writing of the proposed changes, along with any supporting technical documents, to the other Consent Holders, and the Director-General of Conservation.

Parties, given notice by Council of a change to the GMCP, have 20 working days to provide a response to the Council on the proposed changes to the GMCP.

Commented [SK4]: Concern re unreasonable timeframes for direct comment from DOC District offices. Would be more reasonable it a technical review panel was implemented.

If no response is received from a party within the stated timeframe, then Council will consider that the party has no concerns with the conclusion of the written notice.

Commented [SK5]: DOC does not support default approval. Applicants and NRC consistent on need to have an end point to the process; possibly less of an issue if tied to a technical review panel

If any party does not agree with the proposed change, that party shall engage a suitably qualified hydrogeologist and/or an ecologist to prepare a report detailing the reasons for the disagreement which shall be provided to Council, the other Consent Holders, and the Director-General of

Conservation within 30 working days from the date that the written notice of the proposed changes was sent to the party.

Any change to the GMCP will only be authorised by Council if the technical or administrative assessment of the proposed change clearly indicates that the change will meet Objective 1 of the GMCP.

The Council will provide a report to the Consent Holders detailing the reasons for its decision, including the identification and discussion of areas of agreement and disagreement. The report will also be provided to the Director-General of Conservation.

If any changes are made to the GMCP, then a copy of the amended GMCP will be provided to the Consent Holders and the Director-General of Conservation.

Commented [SK6]: As above re DOC's concerns around timeframes

Commented [SK7]: DOC notes that Objective 1 is an 'avoid' provision and fundamentally disagrees that the level of information provided adequately ensures that Objective 1 will be/has been/can be/is met.

2. FRAMEWORK FOR ADAPTIVE MANAGEMENT

In summary, the following adaptive management techniques are applied in this GMCP;

(a) Baseline monitoring – a monitoring programme has been developed for Stage 1 of the **Table 1** abstractions to establish a robust existing environment baseline. This monitoring programme is contained in this GMCP, however, some monitoring detail is still required and this is indicated by the acronym 'TBC'.

(b) Early warning systems – 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.

(c) Staged development – abstraction volumes will progressively be increased in a staged manner, with expansion contingent on compliance with yet to be established trigger levels and on regular reviews of groundwater level, freshwater and wetland ecology, hydrology, and salinity monitoring results. It is noted that the consent documentation requires that all development starts at Stage 1 volumes whether or not others have progressed to Stage 2 or further, and that takes must be implemented for the minimum period of Stage 1 before progressing to Stage 2. This is an essential mechanism for staging as an adaptive management response.

(d) Management of consents being exercised immediately after commencement – until such time as there is adequate data to base the adaptive management on actual data and for Objective 1 of this GMCP to be achieved, the abstractions that will occur immediately after commencement (i.e., in the first year) will be subject to interim groundwater level and saline trigger levels and Trigger Exceedance Report procedures;

(e) Tiered approach to monitoring – monitoring requirements will increase if trigger levels are exceeded. Likewise, monitoring intensity may decrease with evidence of sustained compliance and stability or to reflect improved characterisation of the hydrogeological environment by way of the process outlined in **Section 1.3** of this GMCP; and

(f) Ongoing adaptive management – the abstractions will be managed adaptively within the term of consent and, in the event of trigger level exceedance, through the implementation of the recommendations of a Groundwater Trigger Exceedance Report ("GTER") prepared by Council.

(g) Suspension of abstractions – should compliance with Objective 1 of this GMCP not be achieved, then the exercise of some or all of the consents to abstract and use groundwater will be suspended until such time as Council confirms in writing that compliance can be achieved.

(h) Consent review – this GMCP does not override the ability for consents and/or consent conditions to be reviewed in circumstances stipulated in section 128 of the Resource Management Act 1991.

The following sections provide detailed information relating to the adaptive management framework to be imposed for the exercise of the consents listed in **Table 1**.

Commented [SK8]: Noted by both DOC and NRC that the SIMPR process does not provide certainty that all takes will reach maximum or be exhausted before moving to the subsequent level and this (a) leaves potential for 'leapfrogging' from 15% to 50% take etc and (b) a lag or lack of gradual increase in effects as per the intended scaling-up of takes.

2.1 Staged Implementation

The uptake of water by the Consent Holders will be over four (4) stages in accordance with the following factors:

- ***Level of current orchard development*** – where existing consents authorising the take and use of water are proposed to be replaced or varied.
- ***Rate of orchard development*** – will occur at differing rates depending on the owner's cashflow and access to plants; and
- ***Tree maturity*** – approximately nine years to full maturity and plant water usage, hence irrigation requirements commensurately increase with tree growth.

The progressive increase in irrigation requirements on developing orchards provides an opportunity to apply an adaptive management approach that establishes a baseline and allows the original hypotheses of avoidance of effects to be periodically re-evaluated to ensure Objective 1 of this GMCP continues to be met as development occurs.

The management approach provides a series of responses to be taken based on the monitoring results, including where monitoring shows that Objective 1 of this GMCP is not being met, as discussed in **Section 2.2**.

The uptake by Consent Holders of the consented total authorised water volumes will be permitted in four stages over ~~seven~~ nine years, as shown in **Table 1** below, unless the outcome of the Staged Implementation and Monitoring Programme Review detailed in **Section 2.1.1** shows that there should be a delay in moving to the next stage, or that the next stage should not occur.

The development stages reflect:

- A combination of horticultural and pasture irrigation development for APP.039859.01.01
- Anticipated planting schedules and resultant increases in water demand for horticultural irrigation associated with remaining water permit applications.

Commented [SK9]: DOC notes that whilst the initial delay in takes coming online and/or reaching the full stage 1 allocation is beneficial for establishing a more conservative baseline, but this approach presents risk in being able to monitor and respond to effects as they are realised.

Table 1. Summary of staged implementation annual volumes

Application Number	Consent Holder	Indicated year of irrigation start	Allowable Annual Volume (m^3)			
			Stage 1 (Year 1)[1]	Stage 2 (Year 2-3)[1]	Stage 3 (Year 4-86)[1]	Stage 4 (Year 97- full consent term)[1]
Other sub-aquifer						
APP.039859.01.01	TE AUPŌURI COMMERCIAL DEVELOPMENT LTD	2021/2022	43,750	96,500	152,350	175,000
		Total (m^3/year)	**43,750**	**96,500**	**152,350**	**175,000**
		Total (% allocated per stage)	**25%**	**50%**	**75%**	**100%**
Waihopo sub aquifer						
APP.039859.01.01	TE AUPŌURI COMMERCIAL DEVELOPMENT LTD	2021/2022	120,000[2]	120,000	120,000	120,000
APP.040601.01.01	WAIKOPU AVOCADOS LTD	2020/2021	20,840	41,680	62,520	83,360
APP017428.02.01[3]	HENDERSON BAY AVOCADOS LTD	2020/2021	6,840	11,780	14,250	19,000
APP.040600.01.01[3]	FAR NORTH AVOCADOS LTD	2021/2022	8,000	16,000	24,000	32,000
APP.041211.01.01[4]	P MCLAUGHLIN	2022/2023	19,600	39,200	58,800	78,400
		Total (m^3/year)	**175,280**	**228,660**	**279,570**	**332,760**
		Total (% allocated per stage)	**53%**	**69%**	**84%**	**100%**
Houhora sub-aquifer						
APP.039859.01.01	TE AUPŌURI COMMERCIAL DEVELOPMENT LTD	2021/2022	218,750	437,500	656,250	875,000
APP.040121.01.01	NE EVANS TRUST & WJ EVANS & J EVANS	2021/2022	40,000	80,000	160,000	160,000
APP 040231.01.01[4]	P & G ENTERPRISES (PJ & GW MARCHANT)	2023/2024	7,000	14,000	21,000	28,000
APP 040652.01.01	SE & LA BLUCHER	2020/2021	24,000	48,000	72,000	96,000
APP.039644.01.01	MP DOODY & DM WEDDING	2021/2022	76,000	152,000	228,000	304,000
APP.040397.01.01	A MATTHEWS	2020/2021	2,400	6,000	9,000	12,000
APP.040558.01.01[4]	MV EVANS (1)	2020/2021	22,000	26,000	36,400	36,400
APP040979.01.01	MV EVANS (2)	2020/2021	31,500	63,000	93,500	126,000
		Total (m^3/year)	**442,250**	**866,500**	**1,297,150**	**1,717,400**
		Total (% allocated per stage)	26%	50%	76%	100%

Application Number	Consent Holder	Indicated year of irrigation start	Allowable Annual Volume (m^3)			
			Stage 1 (Year 1)[1]	Stage 2 (Year 2-3)[1]	Stage 3 (Year 4-86)[1]	Stage 4 (Year 97- full consent term)[1]

Notes:

[1]The staged implementation is based on years when irrigation occurs following the granting of the consents. This differs between individual consent holders.

[2]The allocation from these bores is intended for a mixture of pasture and market gardening which will require the full amount of allocation dependent on the areas planted in each crop.

[3]Well-established orchards.

[4] Trees were planted in 2019/2020 or have to be planted in the 2020/2021 period due to ordering system.

2.1.1 Staging: Implementation and Monitoring Programme Review

A Staged Implementation and Monitoring Programme Review ("the SIMPR") will be required for Council to decide whether Consent Holders proceed to the next allocation stage. At the following times, the volume of abstraction authorised will be reviewed against the staged implementation outlined in **Section 2.1** at the minimum intervals of:

- End of Stage 1: A period where all or part abstraction of the Stage 1 annual volume is taken after commencement of the consent and after which a full 12 months of baseline monitoring data has been collected;
- End of Stage 2: 3 irrigation seasons following date of commencement of the consents; and
- End of Stage 3: 6 irrigation seasons following date of commencement of the consents.; and
- ~~End of Stage 4: 9 irrigation seasons following date of commencement of the consents.~~

The main purpose of the SIMPR is to assess whether proceeding to the next stage would comply with Objective 1 of the GMCP.

The SIMPR will be commissioned by the Council and shall be prepared by a suitably qualified hydrogeologist with experience and knowledge of the locality.

The SIMPR shall include a detailed assessment of all environmental monitoring data including groundwater levels, salinity indicators, and water quality, and include consideration of spatial and temporal trends including potential effects of groundwater abstraction on water levels in a dune lake or natural wetland. If the potential for more than minor effects on a dune lake or natural wetland is identified, then the SIMPR will also include assessment of the likely significance of those effects prepared by a suitably qualified ecologist. The SIMPR shall assess whether Objective 1 of this GMCP is being met at the current level of abstraction, and whether Objective 1 will be met at the next stage level of abstraction. The SIMPR may also consider the nature and scope of continued monitoring (i.e. monitoring frequency and intensity (type and number of samples)) and associated trigger levels.

The SIMPR will provide recommendations based on the assessment of the environmental monitoring data to date on:

- the setting or alteration of the trigger levels;
- whether any changes to the monitoring programme are required; and
- whether to advance to the next stage of abstraction or to remain at the current level of abstraction, or to reduce the level of abstraction.

A copy of the SIMPR will be provided to the Consent Holders listed in **Table 1** and the Director-General of Conservation a minimum of three (3) months prior to the anticipated commencement of the subsequent irrigation season utilising volumes defined for the subsequent development stage as stated in **Table 1**.

The Consent Holders and Director-General of Conservation have 20 working days to provide a response to the Council on the conclusions and recommendations of the SIMPR.

If no response is received from a party within the stated timeframe, then the Council will consider that the party has no concerns with the conclusions of the review.

If any party does not agree with the conclusions and recommendations of the SIMPR, then a report by a suitably qualified hydrogeologist and/or ecologist, both with experience and knowledge of the

Commented [SK10]: As noted, DOC has a fundamental disagreement re timing, allocation exhaustion and potential lag in effects being realised.

locality if possible, detailing the reasons for the disagreement shall be provided to Council within 30 working days from the date that the review was sent to the party.

An increase in the volume of abstraction to the next development stage and any change to the monitoring programme will only be authorised by Council if the technical assessment of the monitoring data clearly indicates that the increase in the allocation and any necessary change to the GMCP would meet Objective 1 of this GMCP.

Council will provide a report to the Consent Holders and the Director-General of Conservation detailing the reasons for its decision, including the identification and discussion of areas of agreement and disagreement.

If any changes are made to the GMCP, then a copy of the amended GMCP will be provided to the Consent Holders and the Director General of Conservation within five (5) working days of the change being authorised as final.

A summary of the above process is also included in the conditions of each consent that is covered by this GMCP.

2.1.2 Stage 1 (Year 1) Management Regime

Stage 1, from a management perspective, is the initial development stage following commencement of the consents listed in **Table 1**. During this development stage abstraction will be less than the full volume sought while baseline information is collected to enable monitoring of groundwater levels and quality (at monitoring sites not already established) to enable setting of trigger levels. It is important to note that while Stage 1 volumes in **Table 1** slightly exceed 25% in Stage 1 in some sub-aquifers, actual uptake by consent holders will occur at different times as some consent holders are not looking to develop their land and/or orchards immediately upon commencement of their consents. As such, actual abstraction during the first 12 months of the consents being granted will be much less than that stated in **Table 1**.

During Stage 1 interim triggers for groundwater levels and salinity indicators will be established at all monitoring sites following the methodology outlined in Section 2.1.2.1 (for new monitoring bores) as well as those trigger levels that have already been established in existing monitoring bores **(Table 6**).

The Council is to notify the Consent Holders and the Director-General of Conservation of the interim trigger levels (and default management parameters) for Stage 1 (Year 1) three (3) months prior to the commencement of abstraction. The Consent Holders and Director-General of Conservation have 10 working days to provide responses to the Council on the default management parameters once notified.

The monitoring specified in Section 2.1.2 will be undertaken during Stage 1 to ensure interim triggers are not exceeded (i.e., to ensure compliance with Objectives 1(a), (b), and (c)). Exceedance of interim trigger levels during Stage 1 will result in the implementation of the trigger level exceedance measures outlined in **Section 4** below.

2.1.2.1 Saline Intrusion & Groundwater Level: Monitoring and Triggers

Saline intrusion monitoring for Stage 1 (Year 1) is proposed within the sentinel and monitoring bores identified in **Table 5** of this GMCP. As each sentinel or monitoring bore is drilled, groundwater level and salinity indicators will be measured and recorded. This information will be used to set interim trigger levels for these parameters as per the methodology established in **Section 2.2** below. Interim trigger levels must be set prior to exercise of any of the consents subject to this GMCP.

The saline intrusion and groundwater level monitoring trigger levels for Stage 1 (Year 1) shall be inserted into the GMCP through the process set out in **Section 1.3** of this GMCP prior to the exercise of any consents.

2.1.2.2 Trigger Level Responses

In the event of an exceedance of a trigger level applicable in Stage 1 (Year 1), the Trigger Level Exceedance response plan contained in **Section 4** of this GMCP shall apply.

2.1.2.3 Ceasing Interim Stage 1 (Year 1) Management Regime

This interim management regime shall remain in place until such time as the setting of trigger levels as per **Section 2.2** below has been given effect to through amendment to this GMCP in accordance with the change process established in **Section 1.3** above.

2.2 Trigger Level System

2.2.1 Timeframe for setting of trigger levels

The setting of trigger level values for each parameter (where TBC is indicated in the monitoring plan tables in **Section 3** Monitoring Programme) will be based either on current baseline data (for sites with existing monitoring) or data collected during the first implementation stage after 12 months of monitoring data has been collected and within 15 months of the date of commencement of these consents. This approach recognises that:

- There is historical monitoring data available for some parameters to characterise the response of groundwater levels and quality to current levels of abstraction.
- In some areas, no baseline data has been established by the Consent Holders or any of the key stakeholders in the area; and
- The manifestation of any effects from the exercising of these consents will steadily progress with time in accordance with the staged development process outlined in **Table 1**. The scale of abstraction during the baseline data collection period (i.e. generally 12 months following commencement of consent) will not vary significantly from existing conditions.

2.2.2 Method for setting of trigger levels

A two-tier trigger level system will be implemented on the consents:

- **TL1** – The first-tier trigger level establishes when an individual monitoring parameter is exhibiting a departure from baseline conditions (e.g. median ±2 times the standard deviation, or some other criteria determined with agreement of the Council). If this trigger level is breached, then additional monitoring will be undertaken by the Council. This additional monitoring will assist characterisation of the nature and significance of changes to the baseline condition of the groundwater resource.
- **TL2** – The second-tier trigger level is set at a threshold defining a 'significant' departure from baseline conditions and/or conditions where the risks of adverse environmental effects are increased. If this trigger level is breached, then the Consent Holders will be required to reduce their daily water take volume in a staged manner over a set period of time.

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

Table 2: Summary trigger level parameters by monitoring suite

Commented [SK11]: DOC considers that this is not a precautionary approach as investigation does not provide an initial response (ie reduction or cessation) to a lower-level effect.

Applicant maintains that TL1 is an indicator that an adverse effect may occur as TLs are set near baseline to determine **potential** for effect, not necessarily effect.

Monitoring Suite	Parameters
Groundwater level and salinity monitoring	Groundwater level, electrical conductivity
Saline intrusion monitoring	Electrical conductivity, chloride, sodium, total dissolved solids.

2.2.3 Response to exceeding trigger levels

The actions required should trigger levels be exceeded are set out in **Section 4** (Contingency Plan).

3. MONITORING PROGRAMME & TRIGGER LEVEL SETTING

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 parameters to be monitored. The locations of the monitoring bores are shown on **Figure 1.** The following sections of the GMCP provide the monitoring schedules (frequency and trigger levels) for the bores. The monitoring schedule comprises three components:

- Two sentinel monitoring sites along the coastal margin, seaward of areas where abstraction is concentrated. The sentinel bores will provide the primary reference sites for monitoring and management of potential saline intrusion effects. Each sentinel bore will comprise two piezometers, accessing the shallow unconfined aquifer and the deep shellbed aquifer respectively. Instrumentation in each piezometer will enable continuous monitoring of groundwater levels and electrical conductivity (EC), and provide for telemetry of monitoring data to the Council.
- Manual monitoring of groundwater levels in the unconfined and shellbed aquifers on a monthly basis at selected locations inland of Pukenui and in the Waihopo area. This monitoring will be undertaken either in existing bores (if suitable sites can be identified and access obtained) or in new piezometers. These sites will enable ongoing monitoring of groundwater levels and provide data to characterise both localised and cumulative drawdown in response to abstraction and be used to inform the staged implementation process.
- Measurement of salinity indicators on a quarterly basis in each piezometer at the two sentinel bores, augmented by an additional monitoring bore in the Waihopo area. These sites will be monitored on a quarterly basis for the parameters listed in **Table 2** and provide a secondary baseline to characterise any changes in aquifer salinity along the coastal margin.

The locations of the production bores in **Table 3** are also shown in **Figure 1**. An error accuracy level of +/- 50 metres is applicable to these bore locations. Any differentiation in the location by greater than 50 metres will result in a requirement for an application to the Council for a change of consent condition pursuant to Section 127 of the Resource Management Act 1991 (RMA). Assessment of the effects on the environment of the change will be required pursuant to Schedule 4 of the RMA.

Table 3: Schedule of monitoring facility and production bore details.

MONITORING BORES									
Bore Details		**Bore Owner**	**Coordinates (NZTM 2000)**		**Depth (m)**	**Dia. (mm)**	**Piezo. No.**	**Target aquifer**	**Purpose***
Name (Fig 1)	**NRC ref.**		**Easting**	**Northing**					
Fishing Club	LOC.200250	NRC	1611411	6146928	79			Shellbed	SI;
Waterfront	LOC.200210	NRC	1611712	6146689	19	32	1	Unconfined	GL_c, EC
Waterfront	LOC.200210	NRC	1611712	6146689	74	32	4	Shellbed	GL_c, EC_c
Houhora Sentinel (shallow)	TBC	NRC	1609900	6149600	<10	50	1	Unconfined	GL_c; EC_c, SI
Houhora Sentinel (deep)	TBC	NRC	1609900	6149600	80-100 (TBC)	50	2	Shellbed	GL_c; EC_c, SI
Lamb Road (shallow)[a]	TBC	NRC	1609750	6147300	<20	50	1	Unconfined	GL_m
Lamb Road (deep)[a]	TBC	NRC	1609750	6147300	80-100	50	2	Shellbed	GL_m
Burnage Road	LOC.200209	NRC	1611325	6145090	17	50	1	Unconfined	GL_m
			1611325	6145090	97	50	4	Shellbed	GL_m
Browne	LOC.200208	NRC	1610733	6144031	16	50	1	Unconfined	GL_m
			1610733	6144031	59	50	4	Shellbed	GL_m
Waihopo Level/Quality[a]	TBC	TBC	1606950	6153600	TBC	TBC		Shellbed	GL_m, SI
Houhora Heads[b]	LOC.200068	Private	1613368	6146558	21.3	100		Unconfined	GL_m, SI
PRODUCTION BORES									
Bore Details		**Bore Owner**	**Coordinates (NZTM 2000)**		**Depth (m)**	**Dia. (mm)**	**Piezo No.**	**Target**	**Purpose**
Name (Figure 1)	**NRC Ref.**		**Easting**	**Northing**					
Henderson Bay Avocados	TBC	Henderson Bay Avocados	1605623	6154872				Shellbed	GL_m, EC_m
Far North Avocados	TBC	Far North Avocados	1605981	6154581				Shellbed	GL_m, EC_m

Waikopu Avocados	TBC	Waikopu Avocados	1603347	6153388				Shellbed	GL_m, EC_m
Te Raite Station - Other	TBC	Te Aupōuri commercial development ltd	1603898	6151179				Shellbed	GL_m, EC_m
Te Raite Station - Waihopo 1	TBC		1605333	6151462				Shellbed	GL_m, EC_m
Te Raite Station - Waihopo 2	TBC		1607102	6150752				Shellbed	GL_m, EC_m
McGlaughlin	TBC	McGlaughlin	1606049	6150294				Shellbed	GL_m, EC_m
P&G Enterprises	TBC	P & G Enterprises (PJ & GW Marchant)	1609182	6148952				Shellbed	GL_m, EC_m
Te Raite Station - Houhora 1	TBC	Te Aupōuri Commercial Development Ltd	1608383	6148854				Shellbed	GL_m, EC_m
Te Raite Station - Houhora 2	TBC		1607182	6148084				Shellbed	GL_m, EC_m
Te Raite Station - Houhora 3	TBC		1609287	6148271				Shellbed	GL_m, EC_m
Te Raite Station - Houhora 4	TBC		1609016	6147852				Shellbed	GL_m, EC_m
Te Raite Station - Houhora 5	TBC		1607771	6147949				Shellbed	GL_m, EC_m
Te Raite Station - Houhora 6	TBC		1609655	6147078				Shellbed	GL_m, EC_m
Te Raite Station - Houhora 7	TBC		1609296	6147373				Shellbed	GL_m, EC_m
Evans Trust	TBC	NE Evans Trust & WJ Evans & J Evans	1609492	6148850				Shellbed	GL_m, EC_m
S&L Blucher	TBC	S. & L. Blucher	1610145	6148091				Shellbed	GL_m, EC_m
A. Matthews	TBC	A. Matthews	1611038	6146087				Shellbed	GL_m, EC_m
Wedding & Doody	TBC	MP Doody & DM Wedding	1610297	6145328				Shellbed	GL_m, EC_m

M Evans 1 & 2	TBC	MV Evans	1610554	6145121				Shellbed	GL_m, EC_m

Notes:

[a] Nominal location only

[b] Private bore subject to access agreements

TBC = to be confirmed within 15 months of the date of commencement of these consents.

* Purpose key:

GL_c = Continuous Groundwater Level;

GL_m = Manual (monthly) Groundwater Level;

EC_c = Continuous Electrical Conductivity;

EC_m = Manual (monthly) Electrical Conductivity;

SI = Salinity Indicators (quarterly);

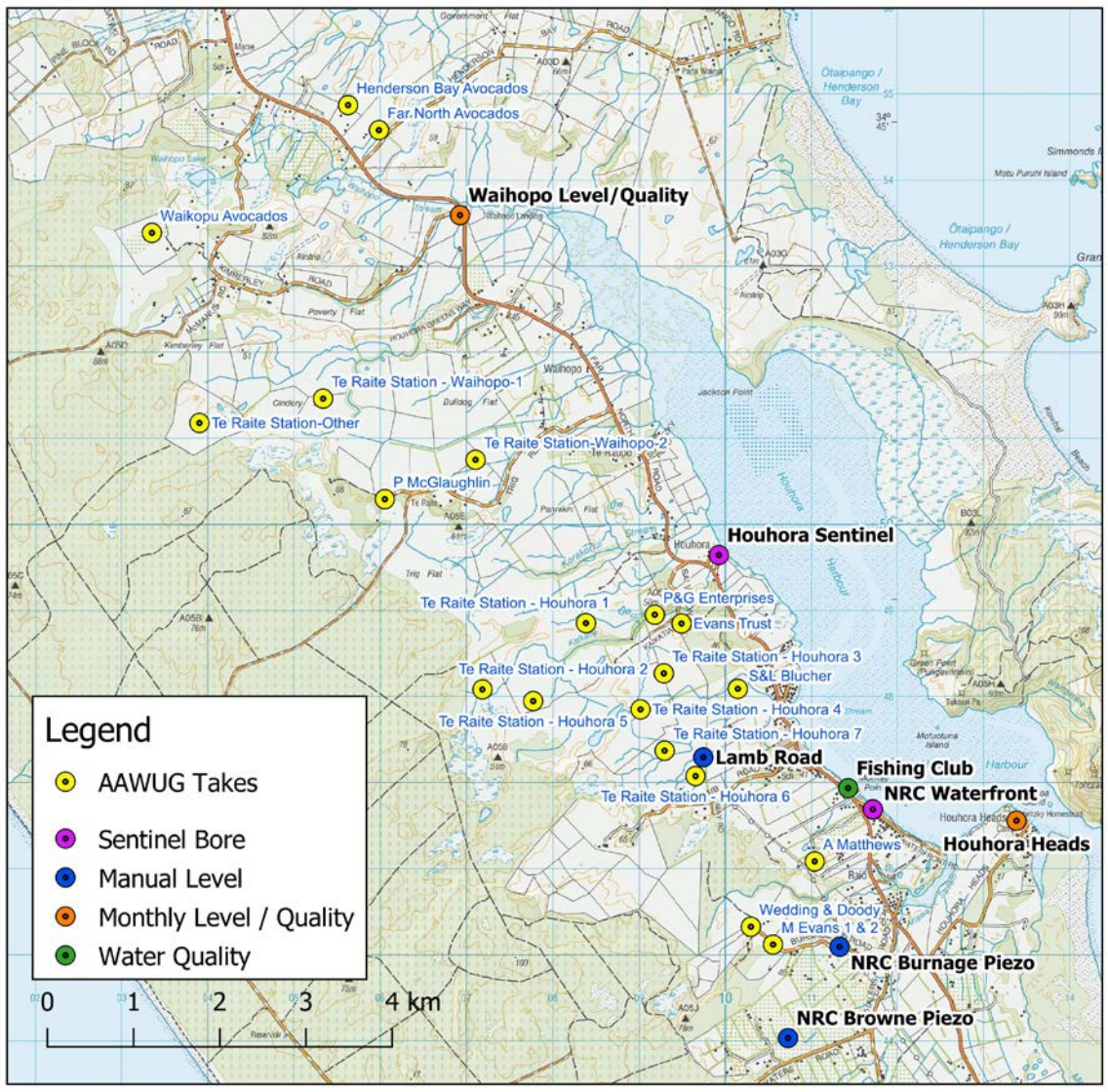

Figure 1. **Monitoring and Production Bore Location Map**

3.2 Groundwater Level Monitoring & Establishment of Trigger Levels

3.2.1 Continuous Groundwater Level Monitoring

Sentinel bores will collect data continuously for water levels and electrical conductivity in individual piezometers and will be utilised as the primary reference sites for regional monitoring of potential effects associated with saline intrusion. Data will be telemetered to the Council.

Groundwater levels will be monitored in the shallow sand and deep shellbed aquifers to quantify the magnitude of drawdown resulting from the proposed abstraction in the deep shellbed and unconfined shallow sand aquifers to ensure it is within the magnitude anticipated in the AEE and meets Objective 1 of this GMCP.

These bores will provide early detection or warning of:

- Groundwater levels around the coastal margin 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; and
- Groundwater levels in the shallow sand aquifer lowering and having a potential adverse effect on surface water bodies, springs, dune lakes or natural wetlands.

Details of the sentinel bores are summarised in **Table 5** below.

All sentinel monitoring bores listed in **Table 5** will be installed prior to the exercise of the consents.

Checking of the sensors required for continuous monitoring will be undertaken on a monthly basis, and any faults will be recorded and remedied immediately. Data will be collected, processed and managed in accordance with the Council's quality standards.

3.2.2 Manual Groundwater Level Monitoring

Groundwater levels will be monitored manually in the shallow sand and deep shellbed aquifers to:

- Quantify the magnitude of drawdown resulting from the proposed abstraction in the deep shellbed and shallow sand aquifers to ensure it is within the magnitude anticipated in the AEE and does not result in adverse effects on surface water environments, existing groundwater users and long-term aquifer storage volumes.
- Ensure coastal groundwater levels are not adversely affected by the proposed abstractions.

Details of the groundwater level monitoring bores are listed in **Table 5** below. The bores include two existing NRC piezometer installations (Burnage Road (LOC.200209) and Browne (LOC.200208)) plus new piezometers to be installed at Lamb Road and Waihopo. An existing private bore at Houhora Heads is also included (subject to access agreement).

No trigger levels will be established for manual groundwater level monitoring sites. The primary value of data collected from manual groundwater level monitoring will be to establish medium to longer-term variations in groundwater levels in response to groundwater abstraction. This information will be utilised to inform the SIMPR (Section **2.1.1**) and the Annual Environmental Monitoring Report (**Section 3.5**).

Table 4: Schedule of Manual Groundwater Monitoring Bores.

Sentinel Bore Name	NRC ID	Depth (m)	Piezo. No.	Target aquifer	Units	Frequency
NRC Burnage Road	LOC.200209	17	-	Unconfined	mAMSL	Monthly
		97	-	Shellbed	mAMSL	Monthly
NRC Browne piezo	LOC.200208	16	-	Unconfined	mAMSL	Monthly
		59	-	Shellbed	mAMSL	Monthly
Lamb Road	TBC	<20	-	Unconfined	mAMSL	Monthly
	TBC	80-100	-	Shellbed	mAMSL	Monthly
Houhora Heads	LOC.200068	21.3	-	Unconfined	mAMSL	Monthly
Waihopo	TBC	TBC	-	Shellbed	mAMSL	Monthly

Notes:

TBC = to be confirmed within 15 months of the date of commencement of these consents.

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

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

3.2.3 Schedule of Groundwater Level Monitoring & Trigger Levels

A two-tier system for trigger level 1 ("TL1") and trigger level 2 ("TL2") for groundwater levels will be set in the bores identified in **Table 5**. Electrical conductivity trigger levels for these bores are contained in **Table 6**.

The Council will set trigger levels for groundwater levels in the shallow sand aquifer in each of the sentinel bores. TL1 and TL2 trigger levels for groundwater level in the NRC Waterfront piezometers are specified in **Table 4** below as sufficient data has been collected from these facilities for this purpose. As a general guide TL2 for the shallow sand aquifer should be no less than 1.0 mAMSL at sentinel monitoring sites (noting that changes in electrical conductivity ("EC") are also a key indicator of saline intrusion and are provided for below in **Section 3.3**). If necessary, water level records for individual sentinel bores will be correlated with existing monitoring sites to provide historical context for estimating the trigger levels.

Groundwater level triggers at the Lamb Road monitoring site will be based on measured static water levels prior to exercise of the water permits listed in Table 1 minus the maximum magnitude of cumulative drawdown calculated to result from the proposed abstraction outlined in the AAGWM Report. As a general guide TL2 for deep shellbed groundwater levels should be no less than 1.5 mAMSL (noting that changes in EC are also a key indicator of saline intrusion).

Table 5: Continuous Monitoring & Trigger Levels – Groundwater Levels.

Sentinel Bore Name	Depth (m)	Piezo. No.	Target aquifer	Units	Frequency	Trigger Levels	
						TL1	TL2
Waterfront (LOC.200210)	1921	4	Unconfined	mAMSL	Continuous	2.30.75	00..65
	7472	1	Shellbed	mAMSL	Continuous	4.42.20	1.82.00
Houhora (TBC)	<10	1	Unconfined	mAMSL µS/cm	Continuous Continuous	TBC TBC	TBC TBC
	80-100 (TBC)	2	Shellbed	mAMSL µS/cm	Continuous Continuous	TBC TBC	TBC TBC
NRC Burnage Road (shallow)	17	-	Unconfined	mAMSL	Monthly	TBC	TBC
NRC Burnage Road (deep)	97	-	Shellbed	mAMSL	Monthly	TBC	TBC
NRC Browne piezo (shallow)	16	-	Unconfined	mAMSL	Monthly	TBC	TBC
NRC Browne piezo (deep)	59	-	Shellbed	mAMSL	Monthly	TBC	TBC
Lamb Road (shallow)	<20	-	Unconfined	mAMSL	Monthly	TBC	TBC
Lamb Road (deep)	80-100	-	Shellbed	mAMSL	Monthly	TBC	TBC
Houhora Heads	21.3	-	Unconfined	mAMSL	Monthly	TBC	TBC
Waihopo	TBC	-	Shellbed	mAMSL	Monthly	TBC	TBC

Notes:

TBC = to be confirmed within 15 months of the date of commencement of these consents.

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

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

Commented [ML12]: Changed to November 2020 trigger level revision version of MWWUG GMCP

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The setting of TL1 and TL2 trigger levels values for remaining piezometers will be undertaken during Stage 1 after 12 months of monitoring data has been collected and within 15 months of the date of commencement of these consents and will replace the interim trigger levels established through the process described at **Section 2.1.2.1** above.

3.3 Saline Intrusion Monitoring & Establishment of Trigger Levels

Sentinel bores will be utilised as the primary reference sites for monitoring of potential effects associated with saline intrusion. These bores will be positioned between existing/proposed abstraction and the coastline to provide early detection or warning of:

- Groundwater levels around the coastal margin 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.

Details of the sentinel bores are summarised in **Table 6** below.

3.3.1 Stage 1 Monitoring

During the initial 12-month monitoring period, sampling for the following salinity indicators in the bores listed in **Table 6~~Table 5~~** below will be undertaken at 6-weekly intervals[3]:

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

3.3.2 Ongoing Monitoring

Ongoing monitoring of groundwater and electrical conductivity levels will be undertaken continuously via individual piezometers in sentinel monitoring bores. Monitoring data will be telemetered to the Council on a twice-daily basis. Sampling at the frequencies specified for the following salinity indicators will take place in the bores listed in **Table 6~~Table 5~~** below:

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

3.3.3 Schedule of Saline Intrusion Monitoring & Trigger Levels

The monitoring and trigger levels as discussed in this section are provided in **Table 6** below. Data will be collected, processed and managed in accordance with the Council's quality standards and *A National Protocol for State of the Environment Groundwater Sampling in New Zealand* (Ministry for the Environment, 2006).

A two-tier trigger level system (TL1 and TL2) for groundwater levels and electrical conductivity will be set in these bores.

As an initial guide, trigger levels for individual determinants will be established as follows:

- **TL1** – Median concentration from the baseline monitoring period +25%.
- **TL2** – Median concentration from the baseline monitoring period + 50%.

The setting of TL1 and TL2 trigger levels for the piezometers listed in **Table 6~~Table 5~~** will be undertaken during the first implementation stage after 12 months of monitoring data has been collected and within 15 months of the date of commencement of these consents and replace the interim trigger levels outlined in **Section 2.1.2.1** above.

All sentinel monitoring bores listed in **Table 5** will be installed prior to the exercise of the consents.

Table 6: Monitoring & Trigger Levels – Saline Intrusion.

[3] This frequency applies to the initial 12-month monitoring period for the establishment of baseline information. The frequencies specified in Table 6 are for ongoing monitoring specifications.

Bore Name	Depth (m)	Piezo. No.	Target aquifer	Parameter*	Units	Frequency	Trigger Levels	
							TL1	TL2
Fishing Club (LOC.200250)	79	1	Shellbed	EC	µS/cm	Quarterly	56	67
				Chloride	mg/L	Quarterly	78	94
				Sodium	mg/L	Quarterly	63	75
				TDS	mg/L	Quarterly	344	413
Waterfront	21	4	Unconfined	EC	µS/cm	Continuous	740	890
(LOC.200210)	72	1	Shellbed	EC	µS/cm	Continuous	560	670
Houhora Sentinel (TBC)~~(Sentinel)~~	<20	1	Unconfined	EC	µS/cm	Continuously	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
	80-100	2	Shellbed	EC	µS/cm	Continuously	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
Waihopo (TBC)	TBC	1	TBC	EC	µm~~µ~~S/~~e~~m	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC
Houhora Heads (LOC.200068)	21.3	1	Unconfined	EC	m~~µ~~S/~~e~~m	Quarterly	TBC	TBC
				Chloride	mg/L	Quarterly	TBC	TBC
				Sodium	mg/L	Quarterly	TBC	TBC
				TDS	mg/L	Quarterly	TBC	TBC

Notes:

* Parameter key: GL = Groundwater Level; EC = Electrical Conductivity; SI = Salinity Indicators; TDS = Total Dissolved Solids.

TBC = to be confirmed within 15 months of the date of commencement of these consents.

Commented [ML13]: MWWUG only has Waterfront with continuous

Commented [ML14]: Assume if it is quarterly then this is the unit used for reporting based on Brydon's email advice 19/05/2021. Otherwise, if continuous is intended then revert back to unamended unit.

3.4 Production Bore Monitoring

3.4.1 Stage 1 Monitoring

During the initial 12-month monitoring period, sampling for salinity indicators in the bores listed in **Table 7** below will be undertaken at 6-weekly intervals[4].

3.4.2 Ongoing monitoring

Monthly water level monitoring will be undertaken in the production bores listed in **Table 6** during the winter months (nominally May to September). This monitoring will provide information to identify any inter-annual variations in aquifer storage which may be anomalous compared to regional trends.

Electrical conductivity ("EC") values will also be measured at monthly intervals from the production bores during the irrigation season to check on any changes in salinity induced by the pumping. Requirements to continue monitoring of groundwater levels and electrical conductivity in individual production bores after Stage 1 will be addressed in the SIMPR (**Section 2.1.1**).

Commented [SK15]: DOC has concerns around a potential lag in realising effects if monitoring data is only collected monthly.
Applicant and NRC note that this is specifically in relation to production bores (and only those <10L/s) which are potentially affected by localised drawdown within the bore attributable to pumping. Sentinel bores will be continuously monitored and information telemetered to NRC.

[4] This frequency applies to the initial 12-month monitoring period for the establishment of baseline information. The frequencies specified in Table 6 are for ongoing monitoring specifications.

3.4.3 *Schedule of Production Bore Monitoring & Trigger Levels*

The schedule of monitoring and trigger levels as discussed in this section are provided in **Table 6** below. Data will be collected, processed and managed in accordance with Council's quality standards and *A National Protocol for State of the Environment Groundwater Sampling in New Zealand* (Ministry for the Environment, 2006).

EC trigger levels will be established in the production bores listed in **Table 6** below.

During the initial 12-month monitoring period EC trigger levels will be no greater than:

- **TL1** – Departure exceeding 25% of the EC value from the initial monitoring round
- **TL2** – Departure exceeding 50% of the EC value from the initial monitoring round

Long-term EC triggers for individual production bores will be established following the initial 12-month monitoring period based on an assessment of spatial and temporal variation in EC observed during the initial period, in a manner consistent with EC trigger levels established in the sentinel monitoring bores.

No trigger levels will be established for groundwater levels in the production bores as water levels in the production bores can be impacted by well efficiency and pumping schedules so are not necessarily representative of groundwater levels in the surrounding aquifer.

Table 7: Monitoring & Trigger Levels - Production Bores.

Bore Name (NRC ID)	Depth (m)	Target aquifer	Parameter*	Units	Frequency	EC Trigger Levels	
						TL1	~~T~~L2
Henderson Bay Avocados	TBC	Shellbed	~~GL,~~ EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Far North Avocados	TBC	Shellbed	~~GL,~~ EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Waikopu Avocados	TBC	Shellbed	~~GL,~~ EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Te Raite Station - Other	TBC	Shellbed	~~GL,~~ SI	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Te Raite Station - Waihopo 1	TBC	Shellbed	~~GL,~~ EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Te Raite Station - Waihopo	TBC	Shellbed	EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
McGlaughlin	TBC	Shellbed	~~GL,~~ EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
P&G Enterprises	TBC	Shellbed	~~GL,~~ EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Te Raite Station - Houhora 1	TBC	Shellbed	~~GL,~~ EC	mS/m~~mAMSL~~	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Te Raite Station - Houhora 2	TBC	Shellbed	GL, EC	mAMSL	Monthly	TBC	TBC
~~Te Raite Station - Houhora 3~~ ~~Te Raite Station - Houhora 4~~				mS/m	Monthly	TBC	TBC
Te Raite Station - Houhora 3	TBC	Shellbed	SI~~GL, EC~~	?~~mAMSL~~	Continuous ~~Continuous~~	TBC~~TBC~~	TBC~~TBC~~
			EC	mS/m	Monthly	TBC	TBC
			GL	mAMSL	Monthly	TBC	TBC
Te Raite Station - Houhora 4	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC

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Bore Name (NRC ID)	Depth (m)	Target aquifer	Parameter*	Units	Frequency	EC Trigger Levels	
						TL1	TL2
			GL	mS/m	Monthly	TBC	TBC
Te Raite Station - Houhora 5	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
Te Raite Station - Houhora 6	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
Te Raite Station - Houhora 7	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
Evans Trust	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
S&L Blucher	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
A. Matthews	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
Wedding & Doody	TBC	Shellbed	~~GL;~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
M Evans 1 ~~& 2~~	TBC	Shellbed	~~GL,~~ EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC
M Evans 2	TBC	Shellbed	EC	mAMSL	Monthly	TBC	TBC
			GL	mS/m	Monthly	TBC	TBC

Notes:
* Purpose key: GL = Groundwater Level; EC = Electrical Conductivity; SI = Salinity Indicators~~.~~
All trigger limit values in this Table to be confirmed by Council.

3.5 Unmapped Natural Wetlands

Natural wetland means a wetland (as defined in the RMA) that is not:

(a) *a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or*

(b) *a geothermal wetland; or*

(c) *any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain derived water pooling.*

Some wetlands in this area have been mapped from prior studies and surveys[5], however, there are sites that may be classified as natural wetland that are currently unmapped.

In cases of uncertainty or dispute about the existence or extent of a natural inland wetland, the National Policy Statement for Freshwater Management 2020 directs that regard must be had to the Wetland Delineation Protocols[6] as a robust method for delineating wetlands based on the United States delineation system. This protocol uses three criteria for identifying and delineating wetlands: vegetation, soils, and hydrology. The vegetation and soils components have been adapted to New Zealand conditions and the hydrological component is currently under development.

[5] Northland Regional Council top wetland study, Protected Natural Areas Programme survey reports.
[6] https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/wetland-delineation-protocols.pdf

Commented [SK17]: DOC maintains that all wetlands should be mapped prior to granting of consents.

3.5.1 Unmapped Wetland Delineation Procedure

The Wetland Delineation Procedure is deemed appropriate for identifying whether three Areas of Interest (AoI) (Appendix A) contain natural inland wetland areas in the ~~Ahipara and Sweetwater~~Waihopo, Other, and (northern) Houhora sub-aquifers. The Wetland Delineation Procedure is therefore replicated in Table 7 below.

Procedures which were completed prior to the commencement of the consent are referenced as having been completed and no further action is required against those particular procedures.

For all other procedures which were not completed prior to commencement of the consents, Table 7 contains the steps that shall be taken to complete that procedure within this adaptive management regime.

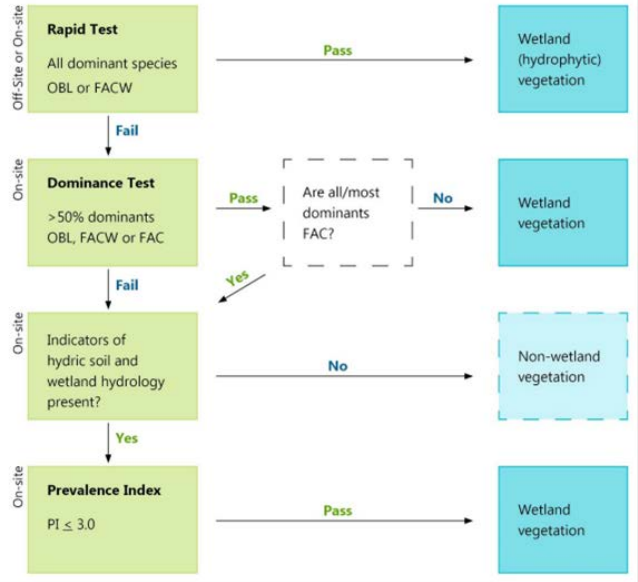
Commented [SK18]: Is there an appendix A?

Table 8: Unmapped wetland delineation procedure.

No.	Delineation Procedure	Completed Prior to Commencement of Consents (Yes/No)	Comment
1.	Determine the project area (the putative wetland).	Yes	See Areas of Interest map attached (Appendix A).
2.	Decide if 'normal circumstances' are present, ie, typical climatic/hydrologic conditions, and no recent disturbances or modifications to the project area. If yes, proceed to step 3. If no, proceed to step 7.	Yes	Area N contains three high-risk sites, as generally shown in the aerial below. Areas (N)2 and 3 have been allocated to the Middle Aupōuri Aquifer Consent Holder group.  Area N1 is on a Recreation Reserve administered by the Far North District Council. Modification occurred between 2007-2009 to clear an area which is now visible as a grassed paddock (see below). Given the time that has elapsed since this last modification, this area is considered to be in 'normal circumstance'.

No.	Delineation Procedure	Completed Prior to Commencement of Consents (Yes/No)	Comment
			
3.	Identify and map the major vegetation types using aerial photographs, maps, contours, inventory reports, other data, and, if necessary, on-site field verification.	No	Within one month of commencement of the consents, the Council, in consultation with the Director-General of Conservation and the Consent Holders, will commission a suitably qualified and experienced ecologist to undertake the desktop and field analysis established under Procedures 4, 5 and 6. A Wetland Delineation Report (WDR) containing details of the assessment approach and outcomes shall be prepared by the same ecologist commissioned to undertake the desktop and field analysis. The WDR shall be circulated to the Consent Holders listed in Table 1 and the Director-General of Conservation a minimum of 40 working days prior to the anticipated commencement of the subsequent irrigation season. The Consent Holders and Director-General of Conservation have 20 working days to provide a response to the Council on the conclusions and recommendations of the WDR. If no response is received from a party within the stated timeframe, then Council will consider that the party has no concerns with the conclusions of the WDR. If any party does not agree with the conclusions and recommendations of the WDR, then a report by a suitably qualified hydrogeologist and/or an ecologist, both
4.	**Off-site methods** to identify wetland presence and sketch approximate boundaries. Wetlands may be confirmed without an on-site inspection depending on: i. the amount and quality of data (vegetation, soils, hydrology, topography) ii. wetland ecological expertise to interpret the data.	No	
5.	**On-site methods** to delineate wetland presence and accurate boundaries: i. for small areas (≤2 ha), establish a representative plot in each major vegetation type and record the plot vegetation in three strata: tree, sapling/shrub, herb ii. for larger areas, establish representative plots along transects (as per Clarkson 2014) and sample the vegetation in three strata: tree, sapling/shrub, herb.	No	

Commented [SK19]: DOC maintains previous comments in relation to SIMPR; potential for review panel

No.	Delineation Procedure	Completed Prior to Commencement of Consents (Yes/No)	Comment
6.	**Hydrophytic vegetation determination**. Based on the data gathered, conduct a hydrophytic vegetation determination using the following flow chart (figure 1). **Figure 1: Flow chart of steps for hydrophytic (wetland) vegetation determination. Wetland indicator status abbreviations: FAC= facultative; FACW = facultative wetland; OBL = obligate wetland.**  Wetland indicator status ratings for species are in Clarkson et al. 2013 and subsequent updates.	No	with experience and knowledge of the locality, detailing the reasons for the disagreement shall be provided to Council within 30 working days from the date that the assessment was sent to the party. Council has the final authority over the delineation of a natural wetland and will provide a report to the Consent Holders and the Director-General of Conservation detailing the reasons for its decision, including the identification and discussion of areas of agreement and disagreement within 5 working days of receipt of the disagreeing parties report.

3.5.2 Repeat Survey

For sites delineated as natural wetland from the procedure set out at **Section 3.5.1**, the Council shall commission, in consultation with the Director-General of Conservation and the Consent Holders, a suitably qualified and experienced ecologist to undertake wetland vegetation survey and subsequent reporting within five (5) years from the original date of survey at around the same time of year as the original delineation survey. The repeat surveys must be designed in a way that enables ecologically meaningful and statistically robust scoring of the wetland condition in order to analyse changes to the wetland's condition resulting from the groundwater abstraction.

This repeat survey must be completed once after the initial delineation Wetland Delineation Procedure (to provide an accurate baseline) but thereafter will only take place every five (5) years where technical assessment carried out according to **Section 2.1.1** confirms that there is an adverse decline in wetland levels resulting from groundwater abstraction.

A decline in wetland water level attributable to groundwater abstraction will be determined from the monitoring and analysis of temporal groundwater level variations in the sentinel bores set out in **Table 4**.

3.6 Environmental Monitoring Report

At the end of each irrigation season, the Council will commission the preparation of an Annual Environmental Monitoring Report (AEMR) by a suitably qualified hydrogeologist with experience and knowledge of the locality. A copy of the AEMR will be provided to the Consent Holders and the Director-General of Conservation by 31 July each year.

The purposes of the AEMR are:

- To provide a summary of the monitoring results for the previous year, including trends, against Objective 1 of the GMCP;
- To assess the monitoring undertaken over the previous year against the standards set out in Objective 1;
- To identify any changes/amendments to monitoring locations/parameters/frequencies that could be incorporated in future SIMPRs;
- To report on any issues apparent with the monitoring; and
- To identify any improvement that could be made with respect to the monitoring.

The AEMR will also contain an evaluation of whether the observed effects of the groundwater takes are consistent with the predictions of environmental response contained in the AAGWM Report.

Commented [SK20]: Technical input necessary for DOC to determine whether additional surveys regardless of effect should be included, eg continue for one additional 5yr cycle.

DOC does not accept shallow groundwater levels as proxy for surface water monitoring.

NRC notes that this approach is consistent with the monitoring of Kaimaumau under MWWUG and as proposed in this GMCP.

An 'adverse decline in wetland levels' would be determined through monitoring of shallow and deep aquifers and technical assessments.

Commented [SK21]: DOC disagrees with assumptions that the aquifer is primarily rainfed and has concerns about this being the 'angle' upon which the reporting is undertaken. Technical input required.

4. CONTINGENCY PLAN

Exercise of the consents is subject to compliance with Objective 1 of this GMCP.

As described in **Section 2**, a trigger level system is used to define environmental criteria that signal changes may be occurring outside of what is normal (TL1) or at a point where remedial action is required to avoid Objective 1 not being met (TL2).

This section details the responses that will be undertaken where trigger levels are exceeded under any of the monitoring suites discussed in **Sections 2.1.2.1, 3.2, 3.3, and 3.4**.

Where a trigger level is exceeded, the Council will commission a Groundwater Trigger Exceedance Report ("GTER"). The objective of the GTER is to establish the cause of a trigger level exceedance and to recommend a programme of action to end the exceedance.

Commented [SK22]: The GTER could be within the scope of the technical review panel suggested by DOC.

A GTER shall include:

- Review of the monitoring results collected and establish why the exceedance has occurred;
- Set out requirements for increased monitoring of the exceedance;
- Set out environmental monitoring to detect effects of the exceedance, such as changes in extent of rivers, natural wetlands, springs or dune lakes;
- Update the report on a regular basis as more data becomes available; and
- Recommend actions to end the trigger level exceedance, which could include:
    - A staged reinstatement of abstraction to pre-exceedance rates and volumes;
    - Reduced levels of abstraction for all or some of the consent holders covered by the GMCP;
    - Suspension of abstraction by all or some of the consent holders covered by the GMCP.

Commented [SK23]: DOC has concerns about the use of a high trust model and would prefer the implementation of expert reviews for these processes.

The GTER needs to include reversibility as key tenet of adaptive management.

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) The Council will notify the Consent Holders within two (2) working days of when the TL1 exceedance became known.

(b) If the exceedance is of a salinity indicator in the bores listed in **Table 5**, then sampling of the monitoring bore(s) in exceedance shall immediately be upgraded to a weekly frequency for four (4) weeks following the first exceedance of the TL1. Weekly monitoring shall continue until sample results are consistently below TL1 values for a period of four (4) weeks or as directed by Council.

(c) If after four (4) 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 Council, then a GTER by a suitably qualified hydrogeologist (and ecologist if the exceedance concerns a surface water body) shall be commissioned by the Council.

(d) The GTER shall assess the significance of the exceedance against the requirements of Objective 1 of the GMCP. The GTER shall assess why trigger levels have been breached, identify the pumping bores in the area(s) of effect and will review all of the available data collected in the affected area(s), in particular the data collected pursuant to this GMCP.

4.2 Exceedance of TL2

In the event of a TL2 exceedance, which represents a significant departure from normal groundwater conditions, with either continuously declining groundwater levels or rising salinity indicators:

(a). The Council will immediately inform the Consent Holders upon a TL2 exceedance becoming known.

(b). Consent Holders must reduce their abstraction to 50% of the current average daily quantity, as calculated using the previous month's water use records required to be kept in accordance with the conditions of its groundwater take consent as directed by Council. If the exceedance occurs within one month of a Consent Holder first taking water for irrigation purposes within an irrigation season, then the average shall be calculated using the water use records for this period only. The Council will advise the Consent Holder in writing of any breach and the required reduction in the daily water take volume.

Given the geographic distribution of water permits included in this GCMP, direction by Council for individual Consent Holders to reduce their abstraction will include consideration of:

- The location, nature and extent of the trigger level exceedance;
- State and trends in the same or related indicator parameters at other monitoring sites listed in **Table 4, Table 5,** and **Table 6**; and
- The location, rate, and volume of abstraction by individual Consent Holders.

(c). A GTER by a suitably qualified hydrogeologist (and ecologist if the exceedance concerns a dune lake or natural wetland) shall be commissioned by Council. The GTER shall assess why the TL2 has been breached, identify the pumping bores in the area of effect, and include a review of all available data collected for the affected area(s), in particular, the data collected under this GMCP.

(d). Once (b) above has been complied with, the Consent Holder may apply to the Council's Compliance Manager for an alternative reduction in its daily water take volume. The Council's approval of an alternative reduction value will only be given if it is satisfied that relevant TL2 values will not be exceeded. The Council will use the GTER to inform its decision on any alternative reduction value for a Consent Holder.

(e). If the TL2 exceedance is in a bore(s) that is/are not continuously monitored, then weekly groundwater level measurements and/or sampling of saline intrusion (depending on which trigger level is breached) in all bores where TL2 trigger levels are breached will commence within one week of the TL2 trigger level exceedance. Monitoring will continue until such time as:

- Three consecutive samples in an individual monitoring bore are below all TL2 thresholds established for that piezometer; or
- As directed by the Council.

(f). If salinity indicators continue to increase or groundwater levels continue to decline after 21 days following the implementation of (b), then the Consent Holder's abstraction must be reduced to 25% of the current average daily quantity, as calculated for (b) above. The Council will advise the Consent Holder in writing of this further reduction and the required reduction in the daily water take volume.

(g). If (f) is implemented, then the Council will commission a review and update of the GTER report by a suitably qualified hydrogeologist with a longer-term programme of recommended responses incorporating observed responses to interim pumping rate reductions. The

Commented [SK24]: DOC is not confident on the basis for this level of reduction and whether it considers the reversibility of effects – technical input required.

updated GTER will include a specific programme (including timeframes) of actions which would achieve compliance with Objective 1 of this GMCP. The 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 that are efficiently utilising the aquifer and are potentially impacted by saline intrusion, and if necessary, the provision of temporary water supplies to any affected parties (excluding any of the Consent Holders) in the event that Chloride concentrations exceed 250 mg/L (being the guideline value for taste prescribed in New Zealand Drinking Water Standards for New Zealand 2005 (Revised 2008)). The GTER will also identify a methodology which the Council will utilise to increase abstraction back to the volumes applicable to the relevant stage of taking (see **Section 2.1**), where this can be done such that Objective 1 of this GMCP will be met. If it is not possible to increase abstraction back to the relevant stage of taking, then the GTER will identify a methodology to increase abstraction to a lesser volume such that Objective 1 of the GMCP will be met.

(h). Actions arising from the GTER shall continue as long as the issue continues.

(i). Implement additional remedial measures as directed by Council, including the suspension of taking.

5. REFERENCES

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