Otago Regional Council

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MEMORANDUM

To:	**LWRP Policy Team**
From:	**Science – Groundwater**
Date:	**02/11/2023**
Re:	**Recommended changes to the planning framework for managing groundwater allocation**

Name	Role	Date Completed
Sam Yeo	Author	02/10/2023
Amir Levy	Internal Reviewer	03/10/2023
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1. Purpose

Groundwater is a key resource to many users across Otago. However, over abstraction of groundwater can lead to various issues. These include long term depletion of groundwater levels and aquifer storage, loss of artesian conditions, surface water depletion, and contamination of groundwater (e.g., by inducing saline intrusion). Due to these issues, it is imperative that the allocation of groundwater in Otago follows a scientifically robust approach. This paper summarises the current planning provisions in the Regional Plan: Water for Otago (RPW) for addressing this issue and their limitations. It also investigates methods and approaches used by other regional councils to manage groundwater allocation. Suggestions for improving allocation in the new Land and Water Regional Plan (LWRP) are then provided, although we do recognise that some of the proposed management approaches still need further refining.

2. Context/Setting take limits

2.1 Planning and legislative context

Take limits, or allocation limits as they are more commonly known, have been the primary means of setting sustainable limits to groundwater extraction under the RPW since 20 December 2008 following notification of Plan Change 1C or 18 September 2010 when Plan Change 4A was notified containing further matters relating to groundwater allocation in the region.

The operative RPW, as updated by these plan changes provides a framework for setting tailored maximum allocation limits for identified aquifers in Schedule 4A of the RPW. These tailored limits are generally based on transient modelling to assess the effects of climate variability, a range of rates of groundwater pumping and other groundwater limiting factors such as the freshwater – seawater interface relating to the coastline or critical groundwater levels. Where tailored limits have not be been determined and set in the Plan's Schedule, a default maximum allocation limit based on a percentage of Mean Annual Recharge (MAR), 50% in the RPW, could be used to set a default total annual volumetric groundwater allocation limit within an aquifer.

Clause 3.17(1) of the National Policy Statement for Freshwater Management 2020 (NPS-FM 2020) sets out the requirement for regional councils to:

(a) identify numeric take limits for each FMU; and
(b) include the take limits as rules in its regional plan(s).

Clause 3.17(4) further states that take limits this identified must:

(a) provide for level variability that meets the needs of the relevant water body and connected water bodies, and their associated ecosystems; and
(b) safeguard ecosystem health from the effects of the take limit on the frequency and duration of lowered levels; and
(c) provide for the life cycle needs of aquatic life; and
(d) take into account the environmental outcomes applying to relevant water bodies and any connected water bodies, whether in the same or another region.

These requirements are consistent with the NPSFM's overarching principle of setting of Te Mana O Te Wai which requires that the setting of numeric take limits and other water management measures provides for the maintenance or enhancement of:

1) the health and wellbeing of the water body as a first priority.
2) the health needs of humans (such as drinking water) as secondary priority; and
3) the ability of people and communities to provide for their social, economic, and cultural well-being, as a third priority.

2.2Environmental context

In the groundwater context maintaining the health of a water body in the case of an aquifer, might involve measures to head off seawater intrusion or other loss of aquifer pressures, levels, or interstitial volume. Groundwater take or allocation limits are usually designed to prevent aquifer or groundwater condition crossing a definable threshold beyond which adverse effects start to occur, such as generalised groundwater level decline or outflow exceeding inflow for significant periods.

3. Recommendation

3.1 Suggested changes to the current allocation framework.

Table 1 discusses:

- the effectiveness (limitations) of the approach for managing groundwater in the RPW Policy framework for managing groundwater; and
- outlines any suggested changes to the existing framework.

RPW Provision	Comment	Effectiveness/ Limitations	Proposed change
Policy 6.4.10A2 (a) Define the maximum allocation limit for an aquifer as that specified in Schedule 4A	Schedule 4A currently includes the Cromwell Terrace and North Otago Volcanic Aquifer (NOVA). Take limits for these aquifers have been set based on transient groundwater models.	No issues with the approach of setting tailored take limits, where these are based on transient groundwater models.	No change to current approach to set tailored allocation limits based on transient, scenario-based modelling. Transient modelling has been carried out on the Lower Taieri Aquifers, Hawea Basin & Wānaka Basin-Cardrona Gravels Aquifer (see State of allocation 2023 spreadsheet and Aquifer Boundary refinement log). It is proposed to add these limits into a Schedule of tailored take limits for the above specified aquifers in the new LWRP **Note:** Setting groundwater-take limits based on groundwater modelling is always fraught with limitations and uncertainties but the limits set represent our best scientific understanding at the time. There are a couple of options for management when dealing with uncertainty in setting limits, either; a) set a hard limit that represents our best scientific understanding at the time where takes over the limit are given prohibited activity status or b) set a softer limit where any takes above the limit become "noncomplying".
Policy 6.4.10A2 (b) Define the maximum allocation limit for aquifers not in Schedule 4A (i.e., the default approach for aquifers where a bespoke limit was not set) as 50% of the Mean Annual Recharge (MAR) calculated		The practice of setting default take limits at 50% of MAR is causing ORC to allocate a much higher proportion of MAR than any other council in NZ (KSL, 2020). This questions whether what we are allocating is "sustainable"? If we are to take a conservative approach to aquifer	It is proposed to change the default limit setting by allocating no more than 35% of MAR (instead of the current approach of allocating up to 50%). Until we have further information on aquifers allocated using the default methods, 35% of MAR would be considered more consistent with sustainable management of groundwater resources than 50% MAR.

under Schedule 4D		allocation then 35% would be considered lower risk of exceeding sustainable levels in an aquifer than 50%.	
6.4.1A (b) A groundwater take is allocated as surface water if the take is within 100m of any connected perennial surface water body		The current 100m rule is has been reviewed. *See Groundwater Science's proposal for changes to rules regarding stream depletion*	See Stream Depletion memo
Other	Aquifers that are not managed as surface water (under Policy 6.4.1A) and currently not identified in the RPW and mapped in the RPW maps (C-series maps)	There is no management framework for allocation or limit setting for aquifers not managed as surface water and not included in the C -series aquifers. These aquifers could be in sedimentary units, basement or unspecified/mapped quaternary sediments.	-Recommend including aquifers identified as "Draft" – e.g., Pisa/Luggate/ Queensberry/Glenorchy/Kingston/East and West Cromwell in the new LWRP aquifer maps? -Fractured rock aquifers – refer to "Fractured rock aquifer memo". See "Aquifer boundary refinement log" and "State of Aquifer Allocation as of 2023"

Table 1: summary of current allocation in the RPW

3.2 Justifications

For Schedule 4A aquifers: Tailored, transient groundwater models enable us to calculate recharge from various sources, aquifer properties, and the seasonal variation in water levels and abstraction. This information helps building a transient groundwater model that can then be used to simulate scenarios of groundwater abstraction and their implication, which provides a much more robust basin/aquifer take limits. Transient models are therefore much more robust than the default approach of allocating a portion of Land Surface Recharge (LSR), that does not include other sources of recharge (surface water, range-front recharge, or inter-aquifer exchanges).

For C-series Aquifers: A review (KSL, 2020) has shown that ORC's current default allocation of 50% MAR is the highest of any other council in NZ. It also showed that many councils have carried out bespoke modelling on individual aquifers to determine sustainable allocation. Others have followed guidelines as outlined in the Proposed National Environmental Standard on Ecological Flows and Water Levels (MfE, 2008), with further background provided in Beca Infrastructure (2008) for aquifers that have not had individual, tailored modelling carried out. The maximum limits under the proposed NES are 35% MAR for inland aquifers and 10-15%

MAR for coastal aquifers. Setting 35% MAR default limits in the LWRP would be considered a conservative approach, particularly in aquifers where we have little information and uncertainty of the effects of high allocation (i.e., 50% MAR). The reasoning for allocating lower MAR for coastal aquifers is to mitigate the potential for saline intrusion, which may be difficult to detect and cause irreversible effects on using the groundwater for potable or irrigation needs. In Otago, saline intrusion is identified as a potential issue for the Kakanui estuary (ORC, 2008), South Dunedin and possibly the lower Clutha. Kakanui Estuary is within the Kakanui-Kauru Alluvial Ribbon Aquifer, of which limits are managed by surface water. South Dunedin does not have allocation limits set and has zero water takes. The Lower Clutha area has low water take relative to available volumes and would be considered low risk for saline intrusion – except for large takes close to the coast. Much of the recharge to the aquifer is via the volumetrically large Clutha River branches. Therefore, 35% MAR for the lower Clutha Aquifer would be a suitable allocation regime.

Other coastal areas with mapped aquifers are not expected to be at risk of saline intrusion and therefore 35% MAR would be suitable as an allocation regime rather than the NES 2008 proposed 15% for coastal aquifers.

3.3 Unknowns and Limitations

- One limitation to the methods outlined above (Schedule 4A aquifer) is the need for high input of scientific expertise (internal or external) associated with the bespoke modelling (e.g., data gathering/preparation [both SoE and water metering data, which experience has shown usually has substantial limitations], developing conceptual models, running the actual models, consultation, and defending them in court). In addition to this, the need for high input of resources from Environmental Monitoring, Consents & Compliance staff poses a further limitation. There will also be issues with not having sufficient data for some aquifers. Furthermore, the minimum length of time series data for modelling is at least 5 years, hence, there is a lag time between the installation of monitoring and having sufficiently long datasets that can be used in modelling.
- Workload associated with the determination of recharge and allocation for areas outside the main C-map series aquifers (e.g., fractured rock aquifers) and for surface water connectivity assessments is expected to be high. These proposed changes (e.g applicants calculating the allocation volume per landholding for fractured rock aquifers or stream deletion assessments) are also likely to require higher input and costs from independent consultants hired by applicants wishing to gain a water take consent, while increasing the workload of consents technical reviews (which are likely to get challenged by applicants).
- Confined or semi-confined aquifers are currently assessed using analytical MAR models. These models, which usually only consider rainfall/land surface recharge, are likely to be inadequate for semi-confined/confined aquifer as there will be a substantial time lag between rainfall and recharge, which may overestimate MAR models. These aquifers, such as the Maniototo Tertiary Aquifer, are likely to require transient modelling to set more robust allocation limits. There is only one true confined aquifer in Otago – the Papakaio aquifer, which should be closed for further allocation.
- Overlapping/Tiered aquifers: how to manage?

- Climate change should be addressed under the LWRP. Changes to annual rainfall, snowfall, streamflow, and other recharge sources are projected to alter due to climate change which will affect groundwater resources. A potential approach to deal with this uncertainty is a requirement to periodically assess groundwater recharge and water accounting/availability using a dynamic allocation (i.e., assessing water availability at the start of every year using water levels and allocate it accordingly). Additionally, there may be higher pressure on groundwater resources as surface water flow and snowmelt decrease and some areas experience higher levels of drought or transition to arid climates. Furthermore, the availability and flow seasonality of surface water in some large rivers/lakes such as the Upper Clutha, Hawea, and Lake Dunstan may also change due to changes in snow accumulation and melt. The same can be true for wetter areas, where we may be able to increase allocation amounts. As demand for low carbon energy increases, this may also increase competition for water resources for hydroelectric power generation.

4. References

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