MEMORANDUM

To:	**ORC Policy Team**
From:	**Pete Ravenscroft & Dave Stewart**
Date:	**25 September 2023**
Re:	**Science Approach for Assessing Catchment Allocation**

Name	**Role**	**Date Completed**
Pete Ravenscroft	Author	17th January 2024
Dave Stewart	Reviewer 1	17th January 2024

Purpose

The purpose of this memo is to provide information to inform policy development regarding the management of catchments that are considered to be fully or over-allocated and have not had bespoke flow management reports written for the new Land and Water Regional Plan.

Data and Methods

Friedel *et al* (*2023*) developed a hydrology model that predicts naturalised hydrology and allocation status across selected gauged and ungauged catchments for 31 catchments across the Otago Region. The tributaries of the Clutha and Kawarau Rivers and Lakes Wanaka, Wakatipu and Hawea along with the rivers and streams draining into the Pacific Ocean being defined in detail. All other catchments are not done in such detail. The catchment layer was initially based upon the River Environment Classification (REC) New Zealand layer using rivers of stream order 3 and above for the Otago region. The REC layer resulted in some catchments with stream order less than 3 being included along with significant catchment boundary inaccuracies. The inaccuracies in catchment boundaries using this REC layer resulted in all catchment boundaries being re-drawn as a new layer and the REC boundaries were replaced. The allocation setting component within the model uses Hayes default minimum flow setting and allocation limits for primary allocation. (Table 1):

Table 1. Default minimum flow and primary allocation setting limits (Hayes)

Limit	Surface water body with mean flow ≤ $5m^3/s$	Surface water body with mean flow $>5m^3/s$
Minimum flow	90% of naturalised 7-day MALF (Mean Annual Low Flow)	80% of naturalised 7-day MALF
Primary Allocation rate	20% of naturalised 7day-MALF	30% of naturalised 7day-MALF

The regional model analysis found that 46 of the 317 catchments were over-allocated using this default allocation method. These results were reviewed using a "local knowledge lens" and some catchments were re-assigned to the 'under' or 'over-allocated' groups. This review resulted in 48 catchments being designated as 'over-allocated', leaving 269 'under-allocated' catchments.

Seventeen of the 48 over-allocated' catchments were large, have complicated hydrology or have more than a few consents. A bespoke science report is being produced for the new Land and Water Regional Plan for these catchments.

The remaining 31 smaller catchments with fewer consents to take water were reviewed a second time by science. Two catchments were combined into one at this time because the Basin Burn is a tributary of the Lochar Burn. Science was tasked to apply a "local knowledge lens" to support or otherwise whether the remaining 30 catchments were considered to be 'over-allocated'. Science was also asked to identify options in terms of future management of the water takes within these catchments.

Most of these catchments are small with 7d-MALF $<0.5m^3/s$ in all except the Roaring Meg. In addition, there a relatively low number of water takes operating within each of these catchments.

(Appendix 1).

Each of the 30 catchments had a desk top review undertaken which specifically assessed the following criteria:

- Confirming the number of water takes within the catchment.
- Assessment by two experienced staff who used their local knowledge and expressed their respective views on each of the catchments.
- Assessing the detail of existing water takes; to determine;
  - Whether they took 'run of the river water', rather than stored water
  - Whether they were retakes
  - Whether they were supplementary takes
- Expiry date of each of the consents.
  - Whether the expiry dates were long-term water takes >15yrs or were shorter term consents as result of P.C.7 Plan Change.

- Were there any existing residual flow conditions associated with the individual water take consent.

Additional Catchments Identified

During review of the catchments modelled in the regional model, some catchments were found which should have been included in the modelling but were missed. For example, catchments which had consented water takes but were not defined in the REC layer.

These catchments are:

Shepherds Creek, Short Burn, Catalina Way Creek, Grandview Creek, and Johns Creek

Manual estimation of the mean flow and 7-day MALF data for these catchments was undertaken and an assessment of under or over-allocation according to the default settings in Table 1.

Results

Thirty Modelled Catchments

The regional hydrology model provided estimated 7d-MALF for the 30 identified catchments and from these 7d-MALF figures default allocation limits were calculated using the default settings shown in Table 1.

A number of these 30 catchments have already had several resource consents renewed. During these resource consent processes, assessment of effects is completed, and bespoke hydrology analyses are conducted. A comparison of bespoke hydrology catchment studies against the regional model 7d-MALF output shows there are some noticeable inconsistencies between the two data outputs.

Ten catchments were affected by Plan Change 7 and therefore have short-term consents with expiry dates ranging 2027 – 2029. The rest have varying expiry dates ranging from 2023 through 2052. The longer-term expiry dates tend to reflect the dates when the consents were applied for, early consents tended to receive longer 35-year terms.

Fifteen catchments have water take consents that have residual flow conditions attached to them, however not all the consents within a catchment have residual flow conditions attached to their respective consents.

Five Additional Catchments Identified

Of the five additional catchments identified after modelling, manual estimation showed that only Short Burn and Shepherds Creek were over-allocated. These two catchments and their statistics are included in Appendix One.

Recommendation

The most appropriate way to manage these catchments is via the resource consent process rather than through a minimum flow plan change process. The justification for this is that they are small and the 7d-MALF is $<0.5 m^3/s$ in all but one waterway, which is the Roaring Meg. In addition, there is a relatively low number of water takes operating within each of the catchments.

There is sufficient time before all these consents come up for renewal to allow for bespoke catchment studies similar to the other 17 bespoke catchments already undertaken. These studies need to go beyond hydrology and incorporate other values including ecology.

References

A simple stacked ensemble machine learning model to predict naturalised hydrology and allocation status across gauged catchments and ungauged reaches of Otago, New Zealand. Friedel et. al., 2023.

Appendix 1

Catchment	Rohe	No. surface water takes	**Modelled 7d-MALF**	Default allocation limit	**Consent expiry date**	**Existing residual flow condition**	Panel assessment (over/fully/under)	Comments
Albert Burn	Dunstan	1	176	35	2035	No	Over allocated	
Amisfield Burn	Dunstan	2	165	33	2050	Yes	Over allocated	
Awamoa Creek	North Otago	7	193	39	2029 varies	Yes, with a couple of? consents	Over allocated	
Awamoko Stream	North Otago	2	41	8	2041	Yes	Fully Allocated	
Bannockburn	Dunstan	4	247	49	2029	No	Over allocated	
Bendigo Creek	Dunstan	2	306	61	2035	No	Over allocated	
Benger Burn	Roxburgh	4	91	18	2029	Yes	Over allocated	
Bow Alley Creek	North Otago	1	39	8	2024	No	Over allocated	Taking stored water
Butchers Creek	Roxburgh	2	327	65	2044	Yes	Over allocated	
Camp Creek	Dunstan	2	360	72	2027 & 2028	No	Over allocated	
Chapmans Gully Creek	Roxburgh	0	38	4	no date	One GW take	No surface water takes.	No water takes so cannot be over-allocated. No further work required.
Coal Creek (1)	Roxburgh	2	243	49	2044	Yes	Over allocated	
Coal Creek (2)	Roxburgh	6	285	57	2029		Over allocated	Majority water allocated for frost fighting
Elbow creek	Roxburgh	3	278	55	2028 & 2043	Yes	Over allocated	
Five Mile creek	Dunstan	????	308	62	2044	No	Over allocated	
John Bull Creek	Dunstan	1	230	46	2043	Yes	Fully Allocated	
Lochar Burn	Dunstan	2	146	29	2029	No	Over allocated	Includes Basin Burn

Park Burn	Dunstan	1	407	81	2029	No	Over allocated	
Pipeclay gully Creek	Dunstan	3	19	2	2029	No	Fully allocated	Retake from Carrick w/race?
Poison Creek	Dunstan	1	280	56	2035	Yes	Fully allocated	
Quartz Creek	Dunstan	2	348	70	2036	Yes	Fully Allocated	
Rastus Burn	Dunstan	2	348	70	2031	YES	Fully allocated	One snowmaking one toilets
Roaring Meg	Dunstan	3	1188	238	2052	Yes	Over allocated	Hydro-scheme, non-consumptive. Long reach impacted.
Schoolhouse Creek	Dunstan	1	109	22	2035	Yes	Over allocated	
Scrubby Burn	Dunstan	1	143	29	2035	Yes	Fully Allocated	
Shingle creek	Roxburgh		386	77	2044	Yes	Over allocated	Takes in tributaries of Shingle Ck (Boulder, Chasm)
Tinwald burn	Dunstan	3	277	55	2028	No	Over allocated	
Toms Creek	Dunstan	5	408	82	2029	No	Over allocated	
Waitati River	Dunedin & Coast	3	300	60	2039	Unknown	Fully Allocated	
Water of Leith	Dunedin & Coast	6	326	65	2040	No	Fully Allocated	
Additional Over-allocated Catchments Identified								
Shepherds Creek	Dunstan	9	126	25	2029	No	Over allocated	This 7-dMALFcalculated by Dave Stewart using specific discharge from a neighbouring catchment
Short Burn	Dunstan	2	530	106	2030	No	Over-allocated	