Groundwater and Landuse Intensification in the Waiau Catchment

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Key points – Groundwater

- Surface water allocation Status = existing consents
- Groundwater allocation Status - low level of uptake
- Proposed groundwater allocation has increased by 141%
- Te Anau groundwater allocation sufficient for 39,400 ha
- Need surface water allocation to access groundwater
- Plan not clear this is the outcome, which may mislead future applicants

Key points – Landuse Intensification

- The three aquifers in the Te Anau basin have high to very high sensitivity to nitrate accumulation
- Potential for a doubling or trebling of the nitrogen loss from land area with irrigation
- Extra nitrogen into the Waiau catchment is likely to significantly increase the presence of nuisance periphyton.

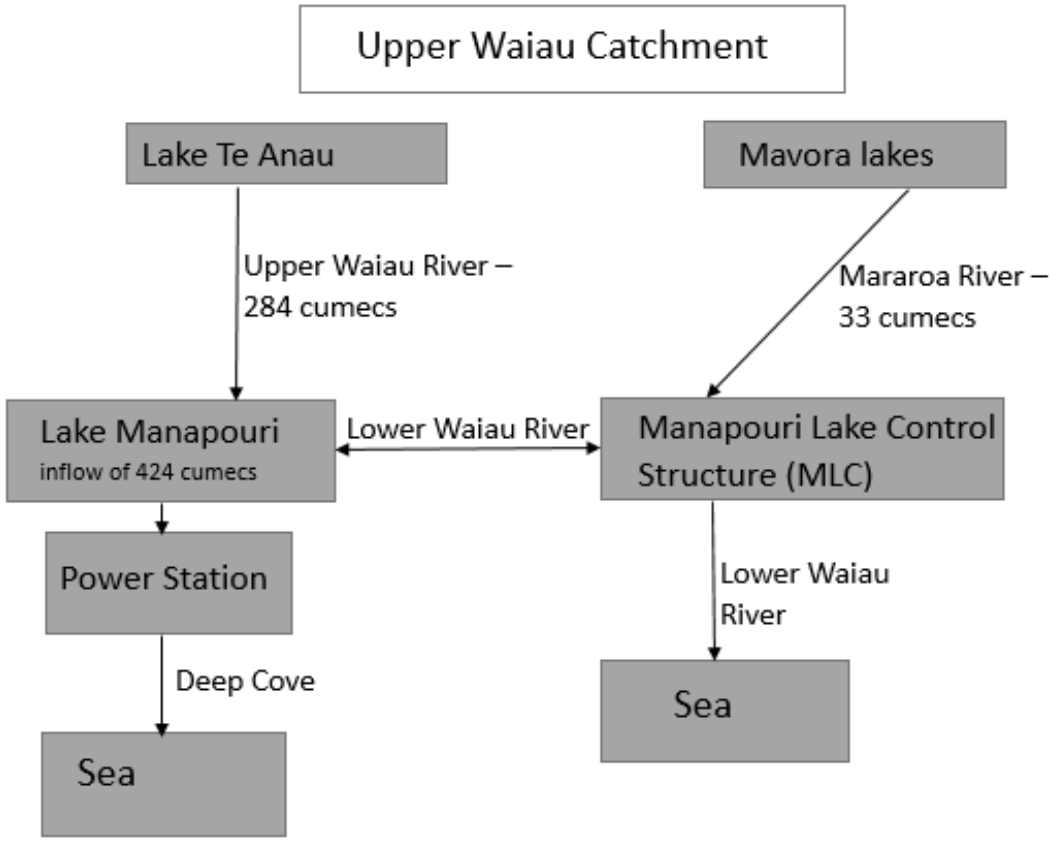
Reference slides

Catchment Hydrology

Two Distinct Areas: Te Anau and Waiau River Basin

1. Remnant glacial outwash fan east of the Te Anau and Manapouri townships dissected and deeply incised by a number of streams. This terrain area contributes the majority of the water to the Te Anau Groundwater zones.

2. Lower Waiau River and associated terraces and river outwash flat, which basically represents a narrow river basin



Catchment Hydrology

- Surface water is fully allocated
- Groundwater has a low level of allocation

Two groundwater allocation zones:

- **Te Anau Groundwater Zone**
- **Lower Waiau Groundwater Zone**

- The existing groundwater zones differ to the three identified in the Plan for which allocation has been increased by **141%**

Allocation Zone	Allocation status
Waiau Catchment	Fully allocated
Surface Water – Primary allocation regime	The primary allocation is that authorised through resource consents in force and operative with their terms
Surface Water – Secondary allocation regime	Fully allocated The primary allocation encompasses any supplementary allocation
Te Anau Groundwater Zone	Low
Lower Waiau Groundwater Zone	Low

Catchment Hydrology

- Limited data and information known about Te Anau basin hydrogeology

What is known - surface geology mapping and limited aquifer testing

1. The terrain, being glacial deposited sediments, is likely to have low permeability in places and is likely to impede groundwater flow.
2. Seepage on terrace faces and spring discharge are a common feature at the base of the large moraine and alluvial terraces.
3. Spring low flow discharge rates quite high (~300 L/s) from Kepler Swamp into Home Creek and Kakapo Swamp into the Whitestone River.
4. The 3 bores that have been assessed for aquifer characteristics reside in riparian margins and subsequently display aquifer parameters that are commensurate with a degree of groundwater/surface water connection.

Flows measured at MLC

• Meridian maintains the flow in the Lower Waiau River by regulating catchment inflows and stored water from Lake Manapouri when catchment inflows are low.

Minimum flows over the Manapouri Lake Control Structure (MLC) structure into the Lower Waiau River:

1. 16 cumecs minimum over the summer period;
2. 12 cumecs minimum over the winter period; and
3. 14 cumecs in the months of October and April.

In addition to minimum flows, the following are also released:

• Flushing flows;
• Recreational release flows; and
• Water from the Mararoa River when turbidity levels are above consented levels

• The mean annual flow at the MLC is 68 cumecs

Figure 1: Waiau River Flows 05/15 to 04/17

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- Figure 1 to Figure 3 provide an illustration of how flows vary with time at the MLC.

- The Waiau River flow at the MLC is periodically well above the minimum flows of 12 to 16 cumec due to changes in catchment inflows and MPS operation.

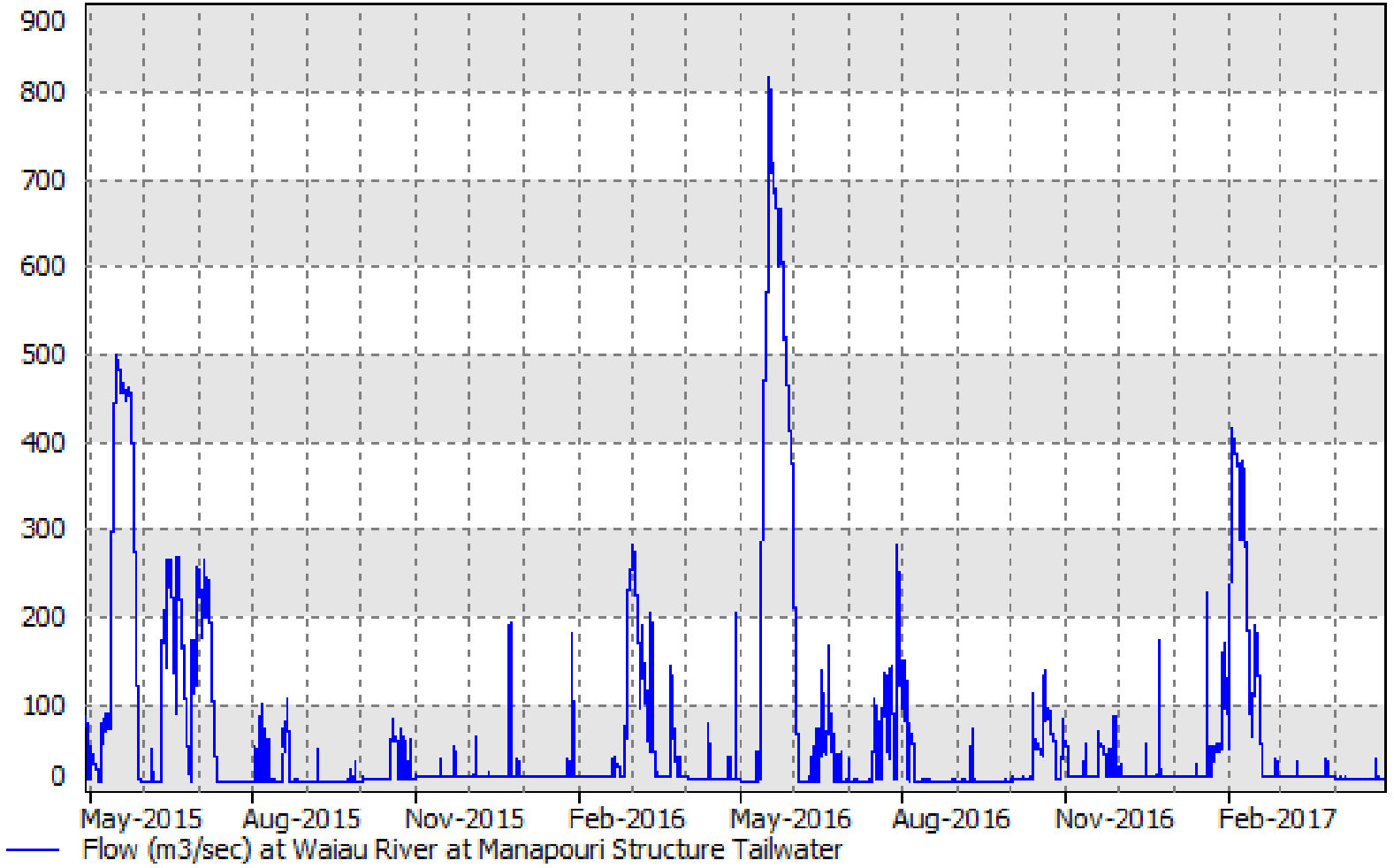


Figure 2: Waiau River Flows 01/17 to 04/17

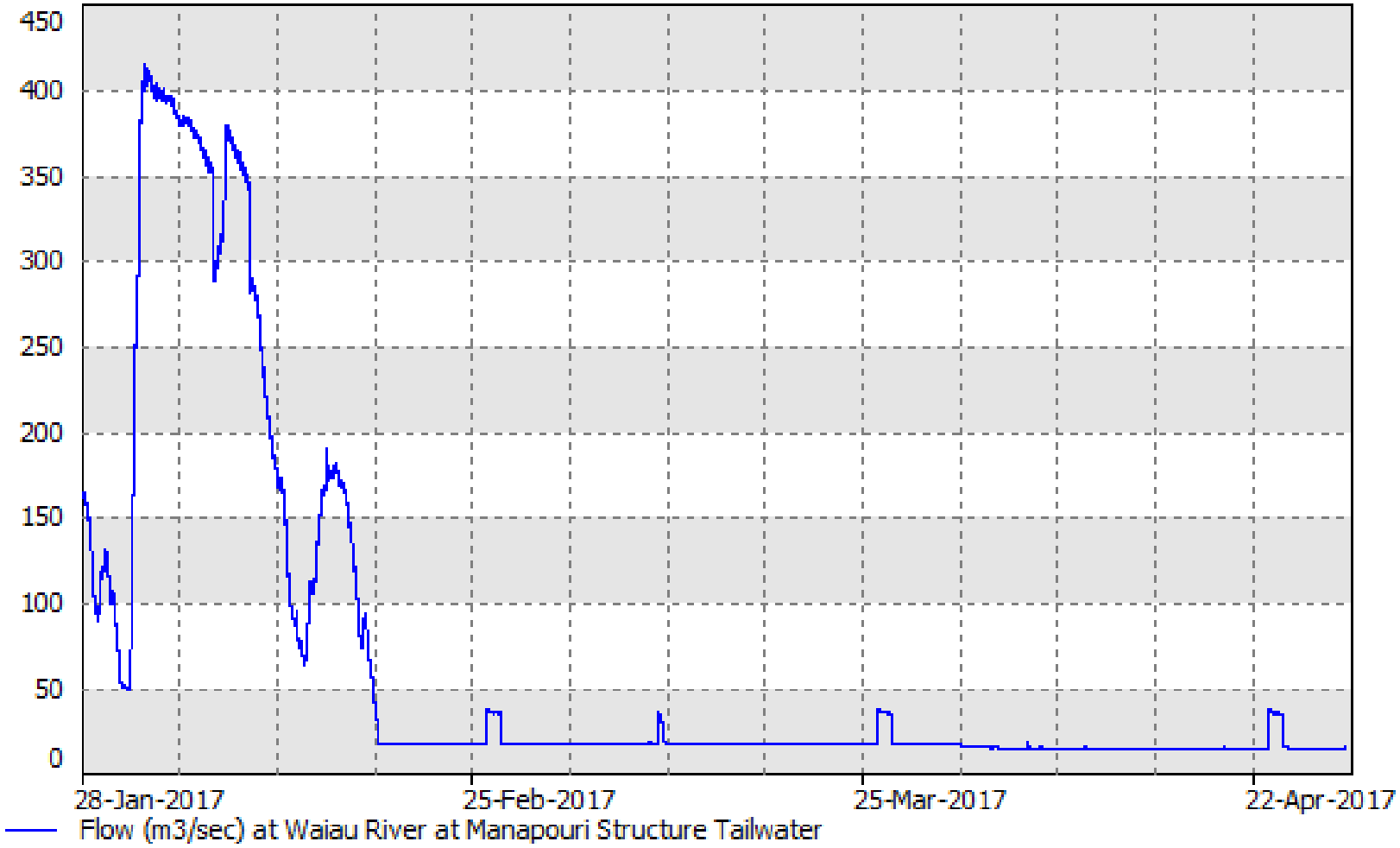
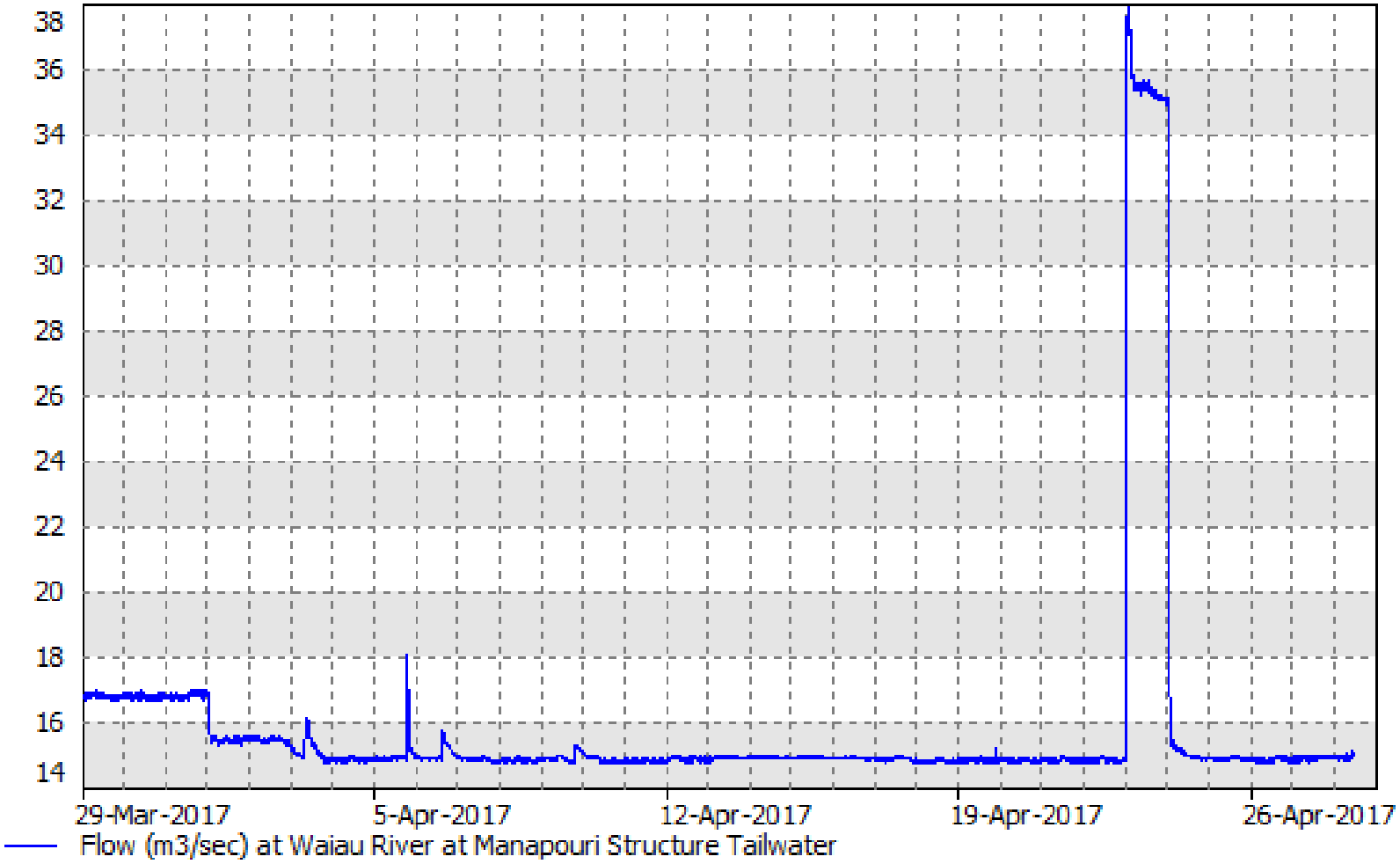


Figure 3: Waiau River Flows 03/17 to 04/17



Rule 54(d) and Appendix L.5

- In the total Waiau Catchment, Rule 54(d) via appendix L5 provides the allocation

Catchment	Groundwater allocation Volumes (M m3/yr)		
	Operative plan	Notified plan	S42a
Total catchment	112	118	158
Te Anau/Whitestone	66.6	89	118

- Meridian has estimated the lost renewable energy generation of 21 GWH from the Notified Plan allocation which has a value of $1 million to $1.7 million per year.

Groundwater Application Rules

Riparian and Direct – managed as surface water take;
High – stream deletion volume included in surface water allocation and surface water minimum flows apply;
Moderate - stream deletion volume included in surface water allocation remainder in Groundwater zone;
Low – entire volume included in groundwater zone;

Hydraulic connection	Consent status (new activity)
Riparian and Direct	Non complying - does not comply with Rule 52 (a)
High	Non complying - does not comply with Rule 52 (a)
Moderate	Non complying - does not comply with Rule 52 (a)
Low	Discretionary

Rule 54(d) and Appendix L.5

- Rule 54(d) Other than that provided for by Rule 54(a), 54(b) and 54(c), the take and use of groundwater takes from groundwater management zones listed in Appendix L.5 is a **discretionary activity** provided the following conditions are met:
    - the total groundwater allocation is within the primary or secondary allocation limits established in Appendix L.5; and
    - if the degree of hydraulic connection, calculated in accordance with Appendix L.2 is ~~**not**~~ Riparian, Direct or High, the relevant surface water minimum flows and allocation limits are met;
    - any interference effects are 'acceptable' in accordance with Appendix L.3;
    - if the total groundwater allocation is within the secondary allocation limit, then minimum groundwater level cut-offs and seasonal recovery triggers are established in accordance with criteria outlined in Appendix L.6.

Groundwater Rule - Confusion

Resulting consent activity status under Officer's amended version (word "not" **removed**)

Hydraulic connection	Consent activity status (new activity)
Riparian, Direct and High	Discretionary if complying with surface water allocation and minimum flows **Non complying** – As no surface water allocation
Moderate and Low	Non complying, as not included in listed hydraulic connection states

Resulting consent activity status under notified version (word "not" **remains**)

Hydraulic connection	Consent status (new activity)
Riparian, Direct and High	Non complying, as not included in listed hydraulic connection states
Moderate and Low	Discretionary if minimum flows are applied and surface water allocation exits

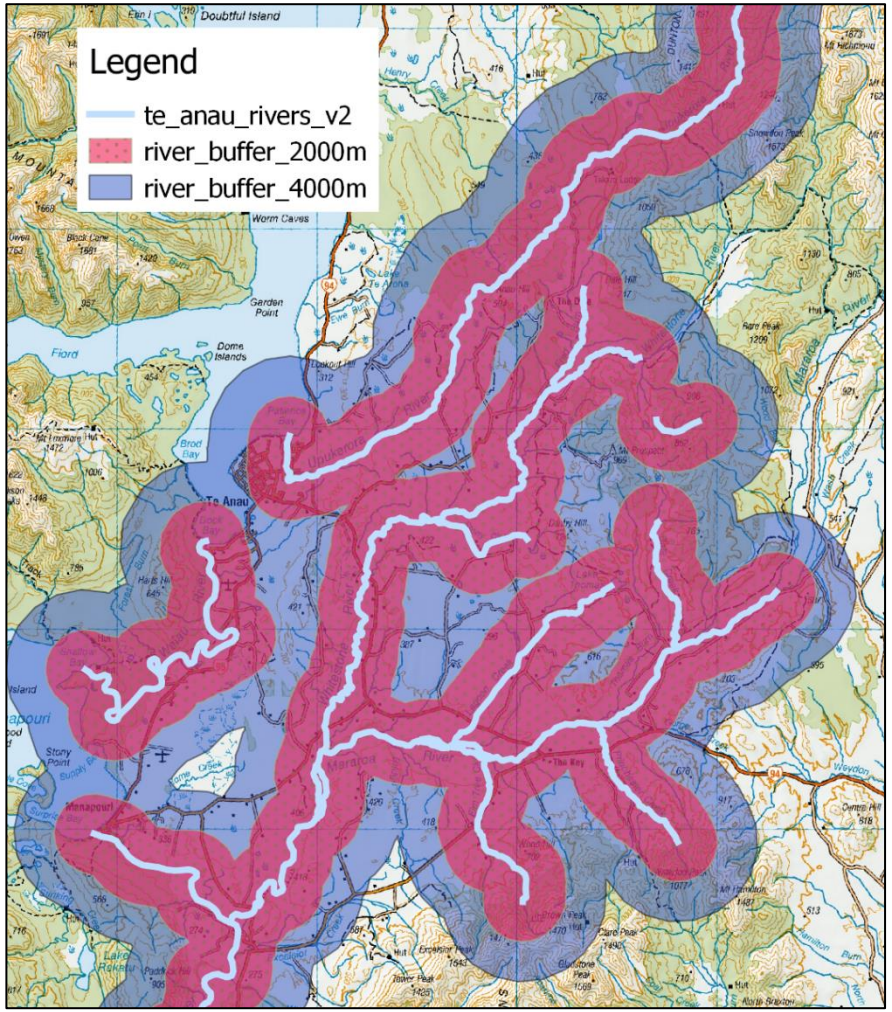
A restrictive consenting status classifying the groundwater resource abstractions with more than a low surface water connection status is an appropriate stance to protect surface water users and puts the onus on groundwater applicants to prove a lack of connection.

Groundwater Abstraction -

- The groundwater allocation of 118 Mm^3/yr in the Te Anau Groundwater zone is a significant volume of water. sufficient for 39,400 ha at 300 mm/ha/yr.

- Unlikely allocation for irrigation use would be able to be developed due to the stream depletion effect restrictions and the need for an associated surface water allocation.

- In accordance with Appendix L5 Table Y2, a stream depleting groundwater abstraction greater than 2 L/s needs an allocation from the **fully allocated** Waiau River surface water allocation.



Groundwater Application Rules Analysis

Analysis is supported by the 42A Officer's report, which in Appendix C4 discusses the management approach to moderately connected groundwater by Policy 23 and Rule 54:

"The proposed approach to managing groundwater takes with a Moderate hydraulic connection is to include the calculated stream depletion effect resulting from such takes within the allocation volume for the relevant surface waterbody. This means groundwater takes with a Moderate hydraulic connection ***can only be granted where surface water allocation is available*** *from the relevant surface waterway***."**

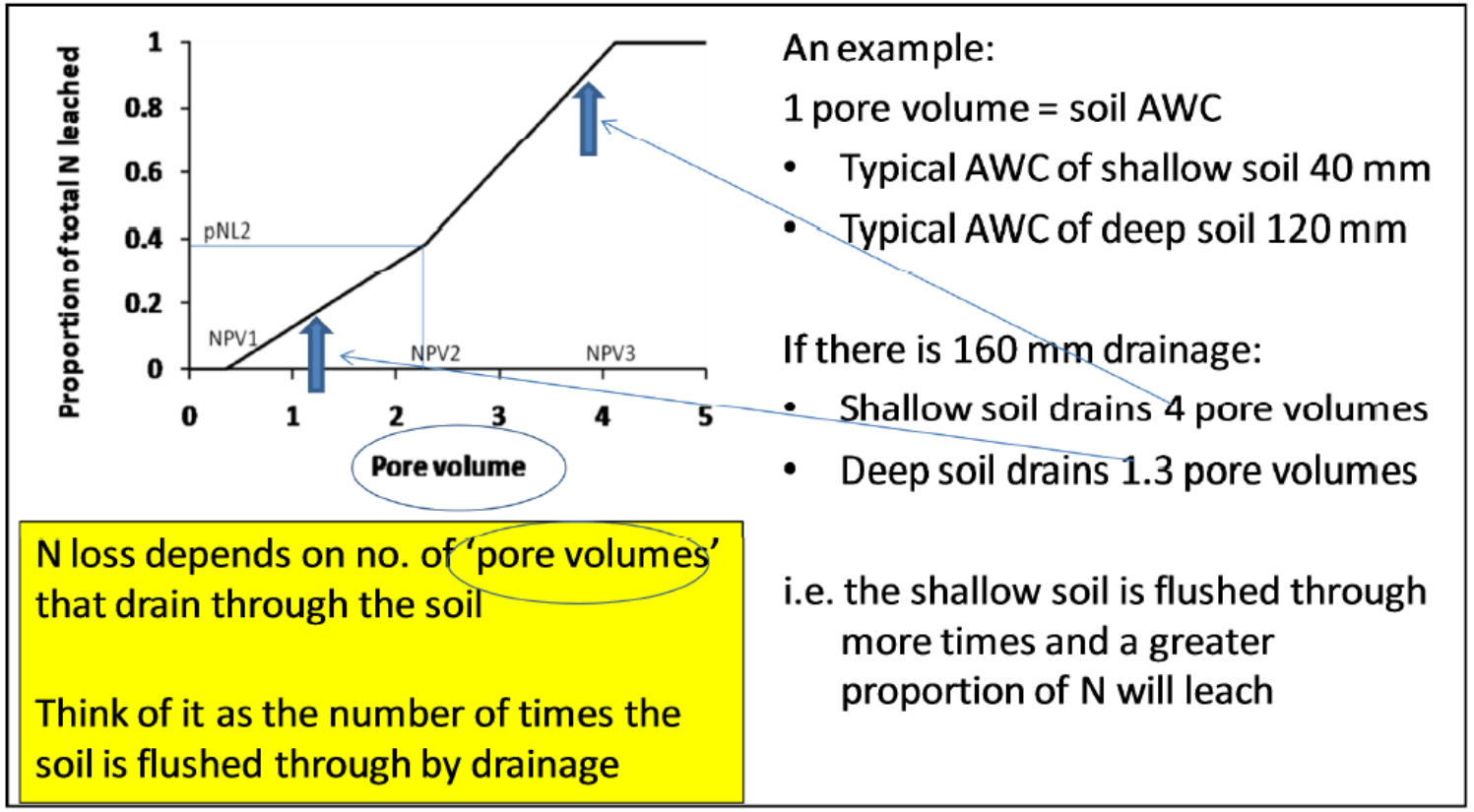
Given there is **no surface water allocation available** in the whole Waiau catchment the implications are that Riparian, Direct, High and Moderately connected groundwater takes are not anticipated to gain consent.

In the context of the Waiau catchment I support that position. It is important that the Plan is clear for the Waiau River Catchment this is the outcome.

Land use intensification

- In OVERSEER®, nitrogen leaching below the root zone to water is directly related to the number of times the soil pore volume drains

- Even with very efficient irrigation, The addition of irrigation water to soil increases the drainage volume from that soil due to the unpredictable nature of rainfall.



Land use intensification effects

- The three aquifers in the Te Anau basin have high to very high sensitivity to nitrate accumulation
- Irrigation increases drainage lost below root zone and with land intensification will increased nitrate loss to groundwater via leaching
- OVERSEER®, nitrogen leaching below the root zone to water is directly related to the number of times the soil pore volume drains
- The addition of irrigation water to soil increases the drainage volume from that soil due to the unpredictable nature of rainfall.

Overseer - very efficient irrigation

- 600 cow dairy farm (wintered on)
- OVERSEER® applied 125 mm over the four months.
- N loss would be greater at 300mm/yr irrigation

Soil type	Profile available water (mm)	Annual drainage (mm)	Irrigation applied (mm)	Nitrogen loss (Kg N/ha/yr)	Increase in N loss (%)	Increase in drainage (%)
Tuatapere Silty Loam	81	508		49		
Tuatapere Silty Loam Irrigated	81	604	125	54	10%	16%
Monowai Silty Loam	63	547		86		
Monowai Silty Loam Irrigated	63	606	110	89	3%	10%

Nitrogen loss under different land uses

- Ledgard G (2013) presented the nitrogen loss for different landuse types
- N loss significantly increased if the farm system intensified or the irrigation depth applied was 300 mm/yr.
- Doubling or trebling of the nitrogen loss from land area
- The impact of extra nitrogen into the Waiau catchment from the irrigation development of 52,770 ha is likely to significantly increase the presence of nuisance periphyton.

Land Use	Loss (Kg/ha/yr)	Range (Kg/ha/yr)
Dairy Platform	30	22-49
Wintering Support (all animals)	55	39-114
Sheep/Beef/Deer Pasture intensive	12	8-23
Sheep/Beef/Deer Pasture (Extensive)	6	4-8
Forestry	2	0.5-5
Crop Arable	45	12-45

LOWE Environmental Impact

Advice AEE Agricultural Analysis Application Approachable Assessments Assimilation Assistance **Biosolids** Capability Client Communications Communities Compliance Compost **Consents** Consultation Contamination Coordinate Council Cultural Current Data Degradation **Design** Detention Developments **Discharges** Documentation Drafting E. coli Ecosystems Effects Engagement Environment Equipment Evidence Excellence Experienced Expert Facilitating Farming Feasibility Fieldwork First-flush Fit-for-purpose Flooding Fun Geology Graphs Greywater Groundwater Guidelines Handbag Hazardous Hydraulics Innovation Interpretation Investigation **Irrigation** Land Landfills Landscape Land-treatment Leaching Lodge **Management** Metals Microbiology **Modelling** Monitoring NES **Nitrogen** **Nutrients** Onsite Optimisation Organics Overseer Papers Pathogens Phosphorus Plain-english **Plans** Preparation Presentations Project Quality Relevant Remediation Reports Research Review **Sampling** Scientific Septage Sludge **Soil** Solutions Spreadsheets Standpipes Stormwater Strategy Support Surface Water Sustainability Systems Team Testing Timely **Treatment** Validation **Wastewater** Water Water-balance Waterways