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Takaka Freshwater and Land Advisory Group (November 2016)

Thank you for the opportunity to comment on the proposed management plan.

Having researched the hydrogeology of the Takaka area on and off since the 1970s, I would like to make a few comments on the hydrogeology and its implications for water management and allocation.

Firstly, I would like to compliment your committee in tackling so well the complex task of water resources management in the Takaka valley. As far as I can see, your group has touched all the bases and come up with some well-considered recommendations. I particularly support the ecological approach to sustainable water allocation and the recommendations regarding the management and improvement of stream quality and habitat.

I support the 7 day MALF as a reasonable and practical approach to quantifying sustainable minimum flows. I can appreciate that there will be dispute over whether allocation should be permitted below that level for security of supply. The only justification in my opinion is emergency public health and security. Economic users should plan for occasional low flows and not expect the environment to pay for- and make good- their inadequate management. Te Waikoropupu Springs, in particular, should never be permitted to fall below natural levels (if Te Waikoropupu doesn't justify it, then one must question if there is any other water source in New Zealand that is more deserving of care and respect – tell me where?)

Your committee has a sound scientific appreciation of our current state of understanding of the Arthur Marble aquifer and has received good advice. Nevertheless, we still have much to learn, especially in regard to connections to the sea. Concerning the management of the marble aquifer and other water sources in the valley, however, there are several issues that are worthy of further consideration. I would respectfully point out, also, that in conveying your committee's approach clearly, it is most important to ensure that Figure 1 on page 11 is fully legible. I found it to be over-reduced, especially the legend, with too much information presented in a small space. The critical zone is between Upper Takaka and the sea. Hence I recommend that that section of the diagram be presented separately as another larger scale Figure, where detail can be more easily discerned (otherwise how are readers to decipher it?)

Sustainable management of water resources depends partly on management zones that make hydrological sense, e.g. recharge zone, confined aquifer zone,

discharge zone. Management objectives, no matter how laudable, will be undermined if the zones are inappropriate or inaccurately demarcated. This leads me to make several points:

1. Although this may be a consequence of the small scale of Figure 1, it appears to me that the eastern boundary watershed of the Takaka River catchment is incorrectly drawn on Takaka Hill. As I read the map, it includes an upstream section of the Holyoake Stream basin, which does not flow to the Takaka River, but drains towards Marahau and Tasman Bay. The Takaka watershed in that vicinity passes from Pikikiruna summit to Mt Evans as shown on the attached map (see my attachment 1, where I have mapped the watershed, and attachment 2 that shows water tracing results and other hydrogeological detail. The key for attachment 2 is provided in attachment 3).

2. I consider that the management zones shown on Figure 1 should be simplified. So far as the conservation of Te Waikoropupu Springs is concerned, the main issue is the protection of recharge quality and quantity. Consequently,

firstly, areas with direct recharge into marble uplands (both east and west of the Takaka River) should be designated as parts of one unconfined marble recharge zone; and

secondly, areas where there is indirect recharge into marble through river gravels in the upper Takaka valley should be identified as another zone.

These are the two most critical management units in the valley, because the quality of their management will determine future water quality in the marble aquifer.

The first zone includes marble parts of catchments on uplands to the east from Kitty Ck to Dry River, Rameka Ck, Gorge Ck, Ironstone Ck almost to the Waitui confluence in the south. While, on the western side, the marble outcrops around Sam and Cotton Creeks should also be included, plus other smaller marble outcrops (see attachment 1 for named creeks and attachment 2 for the mapped marble outcrops).

The second zone includes gravelly floodplain and terrace flats upstream of the unconfined/confined marble boundary. Upstream of (south of) the boundary is a zone where influent flow from the Takaka River and local valley rainfall recharges the marble aquifer, having first percolated through valley floor alluvial and terrace gravels. This is a critical management zone for water quality, because of runoff from relatively intensive land use, and in fact involves the entire upper Takaka catchment, even though the valley flats present most of the management issues. There are many collapse sinks (some with ponds) in alluvial sands and gravels beside highway 60 in this zone (p. 34 suggests as many as 200), clearly indicating relatively direct hydrological communication to the underlying marble and its aquifer. However, marble does not underlie the entire valley floor.

3. The exact position of the confined/unconfined (artesian) boundary is difficult to pin down, and I suspect that it is irregular (and may have been breached in part during glacial low sea-level incision), but it is an important natural

hydrogeological boundary with major implications for water management. Your document does not appear to take it explicitly into account. My estimate of its approximate position is shown on attachments 1 and 2, lying between Gorge Ck confluence and East Takaka and across the valley towards Hamama. See my attachment 4 for schematic relationships.

4. Downstream of the confined/unconfined boundary, water allocation and management practices are unlikely to have a material effect on the quality and quantity of Te Waikoropupu Springs. This is because there is no significant direct recharge or groundwater communication between the lower valley and the springs [possible localised exceptions may be via a few collapse sinkholes that have breached the caprock].

5. When the marble aquifer is full, it overflows. This water, together with inflow from the Waingaro and Anatoki Rivers and local rainfall, permits recharge of the the floodplain and terrace gravels of the lower Takaka valley. The unconfined gravel aquifer in the lower valley requires management in its own right, so it would be justified to include all the gravel valley floor downstream of the confined/unconfined (artesian) boundary as one management unit (with internal subdivisions where more intensive management is required).

6. The Takaka Limestone aquifer has its own recharge and storage characteristics and so requires designation as a separate management unit. Its outcrop is shown on attachment 2 but, as your committee will know, the limestone also extends as sub-crop beneath part of the valley.

7. Given the above points, I do not see the hydrological logic of the proposed Middle Takaka management unit, especially because the confined/unconfined aquifer boundary passes more-or-less E-W across it.

8. Sometimes the proposed management units appear to have more to do with administration than with natural hydrogeological considerations. Thus the Takaka Township Zone and quite a lot of the Motupipi Zone are just parts of the wider lower valley unconfined alluvial aquifer, a mix of floodplain, low terraces and groundwater fed outflow streams. Water does not respect administrative boundaries, so I suggest that water quality and quantity in the lower valley should managed as part of a large natural unit, but with problem areas (e.g. around Takaka township) identified and managed more intensively.

My final remarks concern proposals for managing consumptive water take from the Confined AMA Zone. In your document, these are discussed in section 8.7.2 from page 49. I was particularly pleased to read that a Water Conservation Order (WCO) proposal has been made as an approach for managing the Arthur Marble Aquifer and the Te Waikoropupu Springs. However, I was concerned to read on p. 50 that "Consumptive water takes from the **Confined AMA Zone** have not been included in the AMA Recharge zone accounting." I do not understand the logic for this. The difficulty of evaluating the outflow to the sea, and thus being unable to neatly close the water balance accounting, does not in my opinion provide justification to duck the problem of managing and measuring water takes from the confined aquifer (unless I have misunderstood the reason or what is intended).

The Takaka valley groundwater system is an overflow-underflow system (see attachment 4). Your FLAG document clearly explains the various recharge sources that contribute to the water in the marble aquifer. So one can quantify the recharge input reasonably well. Thus it is well understood that the Takaka valley has a recharge zone upstream of and around the artesian boundary. The caprock over the confined aquifer acts as a lid that is overtopped when recharge from upstream is particularly high and the aquifer is full. This overflow sustains the middle reaches of the Takaka River (site 3 on attachment 4). The confined part of the marble aquifer transmits water that is discharged by underflow to Golden Bay. The groundwater flow is driven by high hydraulic head inland, so it diminishes when the inland water table is low. Part of the confined groundwater escapes through a breach in the caprock, that sustains an overflow spring, namely Te Waikoropupu Springs (site 2 on attachment 4). And the remaining groundwater flow discharges to submarine springs (site 1 on attachment 4), but –in theory- only when the hydraulic head inland is sufficient to overcome the damming effect of the marine hydrostatic head.

Where this is leading me is to make the point that any water take in the recharge zone (whether from surface rivers or groundwaters), and any water take from the confined transmission zone downstream of the artesian boundary, will reduce the volume of water that is discharged in springs (Te Waikoropupu Springs plus submarine springs). Further, and more critically, such takes during drought will mainly impact on the outflow of Te Waikoropupu Springs, because under such conditions the inland hydraulic head is so low that the marine springs may cease to operate (because the hydrostatic head of the sea can barely be overcome).

Thus in my opinion consumptive water takes from the Confined AMA Zone **must be** included in the AMA water balance accounting, even though until we a have a much better understanding of the groundwater system there will clearly be uncertainties as to what is actually going on underground. Water takes from the confined AMA will have negligible effect on the springs when the aquifer is full to overflowing, but are likely to have increasingly noticeable effects as drought conditions tighten. Water takes from the upper Takaka River will similarly have no effect on the springs when the aquifer is full, but during drought every litre taken from the river will cumulatively impact on the springs, becoming more noticeable as drought deepens.

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