Comments on Draft Mataranka Water Allocation Plan 2024 – 2034

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To Whom It May Concern,

Thank you for the opportunity to provide feedback on the draft Mataranka Water Allocation Plan 2024-2034. I am a retired hydrogeologist having had a 37-year career crossing a range of natural sciences. I have a doctorate in integrated water management, a masters in hydrogeology and an honours degree in geology.

I have read the four associated draft documents made available at https://haveyoursay.nt.gov.au/water-management.

Please find my comments below.

Summary

It is difficult to fathom a Plan that encourages extraction beyond replenishment from the very start, for an aquifer that is inherently complex and difficult to understand, where recharge is far from guaranteed, and for a connected system linked to such critically important ecological and cultural assets.

The community and ecosystems of Mataranka deserve better than this Plan.

A complex groundwater system where uncertainties are high

The Cambrian Limestone Aquifer (CLA) has been described as "*complex, karstic in nature and includes variably hydraulically connected sequences*" [1] . Karstic carbonates like the CLA are inherently complex as groundwater can flow within them in three different ways (1) slowly through the sediment matrix itself (2) variably through faults and fractures and (3) rapidly through features formed by dissolving of the carbonate (conduits such as caves, cavities, sinkholes etc) – refer Figure A, below. This complexity is reflected in the range of groundwater discharge features for the CLA – from diffuse seepage in river channels and wetlands, to differences in the origin of groundwater from discrete springs [2].

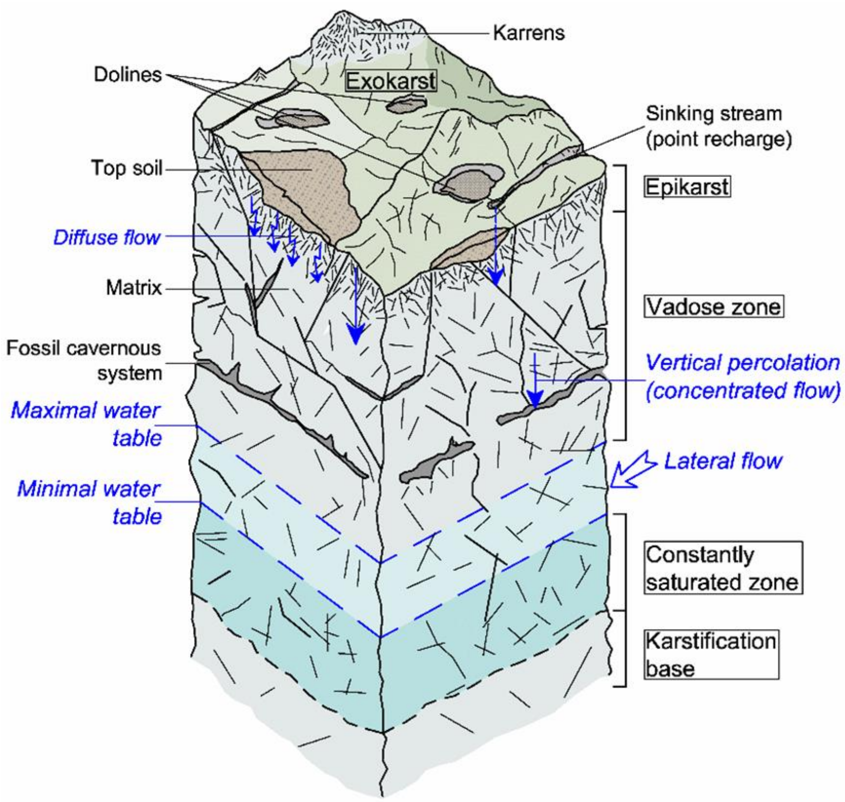

Figure A. Elements of a typical unconfined karst aquifer [3]

Groundwater flow models such as the one used for the Plan (the Daly Roper DR2 model) have great difficulty in incorporating fracture and conduit flow. This limitation is acknowledged in the model report [4], stating that "*the model is not designed to examine localised (<10-20 km) flow paths*". Considering the dimensions of the Plan management zones are in the order of 40-80 km [2], this limitation becomes significant. It is likely that the groundwater system will respond quicker and somewhat differently than what the DR2 model predicts. There will be surprises in how the groundwater system will respond to pumping.

The message is that karstic carbonate groundwater systems like the CLA are notoriously difficult to characterise, predict and manage.

An increasing lack of transparency

There is a worrying trend of important information and data being omitted from Plan documentation. A comparison with the recently released Georgina Wiso Plan shows that an increasing lack of transparency is manifest in different ways:

1. The absence of estimates of critical water budget components. The glaring example is that there is no quantification of all current and likely future water uses in this Plan.
2. Absence of any available monitoring data on the plots presented of model output. At least for the Georgina Wiso Plan, the available groundwater level monitoring data was plotted with the modelled groundwater levels. This has not been done for this Plan. The classic example is the so-called demonstration of how reliably the DR2 model can predict end of dry season flows [2], when the relevant plot (Figure 18) does not even have the available river flow monitoring plotted to allow this comparison.

3. Limited information about how key Plan parameters have been derived. This is case for the river flow thresholds [2] (Page 16, Figure 10), used to define seemingly arbitrary climate conditions (dry, average, wet). These climate conditions do not match up with what was defined by the rainfall analysis (Table 1) e.g. the period 2012-2024 is classified as dry in Table 1 but wet in Figure 10.
4. There are statements where no supporting evidence is provided. In the Background Report [2], these are statements like:
   - "*the DR2 (model) provides the most conservative estimate of recharge*" (Page 22). At least in the Georgina Wiso Plan there was a summary table of the various recharge estimates to help make this decision.
   - "*stygofauna … are highly unlikely to be impacted by the levels of extraction proposed*" (Page 47), stated without any justification.

Compared to previous Plans, there has been an alarming decline in transparency with the release of the draft Mataranka Plan.

Questionable interpretations

It is disturbing that there are conclusions made that are either not justified by, or are counter to, the data presented. This is particularly the case for the Background Report [2], with statements like:

- "*rainfall records demonstrate an overall trend of gradually increasing rainfall*" (Page 11). This is based on some simplistic and statistically invalid linear data trends (Figures 3-5). The subsequent trend analysis using cumulative residual errors (Figure 6, Table 1) clearly demonstrates that rainfall is not gradually increasing between 1900 and 2022.
- "*long term flow records illustrate an overarching trend of increasing end of dry season flow*" (Page 15). This is an oversimplification, as there has been a declining trend in minimum annual flows over the past 10-20 years (Figures 8 and 9). Any insinuation that dry season flows will continue to increase in the future is not valid.
- "*licensed extraction commenced in 2013, it has had no significant impact on end of dry season flows"* (Page 16). Yet, the consistent decline in minimum annual flows since 2013 evident in Figure 10 is not referred to or explained.
- "*storage change across the plan area is increasing annually for the modelled time period*" (Page 31). This view of a steady groundwater storage increase is not supported by the plots of modelled groundwater levels. For North and South Mataranka, the bulk of the storage increase occurred in the early 1970s and then late 1990s (Figures 15-16). These coincide with the transition to wetter decadal periods of modelled recharge (Figure 12). Groundwater storage was broadly steady or decreasing in the intervening years, including the past two decades (Figures 15-16). This is clearly counter to the statement in the Overview (Page 9) that "*groundwater levels have continued to increase despite extraction occurring (from around the early 2000's onwards)"*. For Larrimah, rather than a gradual rise year in year out, modelled groundwater levels show rapid step-ups relating to infrequent anomalously wet years.

The most questionable messaging is the downplaying of the groundwater connectivity between the Larrimah zone and the South Mataranka zone, justifying the former to be managed differently. This is reinforced by statements that there is a "*very low water table gradient which implies low groundwater velocities*" and that "*the time taken for groundwater to travel from the plan boundary with the Georgina Basin to the discharge zone at the Roper River is estimated to be in the order of tens of thousands of years*" (Page 29). This may well be the case under "natural" conditions. However, what is not discussed is the potential for any groundwater extraction in the Larrimah zone exceeding recharge to significantly lower groundwater levels, change flow directions and increase velocities. This includes the possibility of capturing a component of the northerly groundwater flow into and within South Mataranka.

There are numerous statements made in the Plan documentation that are not supported by the data provided. In fact, there are examples where the data is counter to the conclusions made.

An optimistic view of the water budget

Recharge is a critical planning parameter as it defines the capacity for groundwater replenishment. The Background report [2] states that the most conservative estimate of recharge was used, as provided by the DR2 model (Page 22). This is not the case, as the DR2 model can be applied in more conservative (and appropriate) ways.

Recharge in the Plan area is driven by the relatively wet decadal-scale periods of the climate record, in particular extreme rainfall events. These wetter decades are apparent in the modelled recharge for the North and South Mataranka zones (Figure 12). The influence of extreme events is most apparent in the Larrimah zone, where the vast majority of recharge is in just 5 of the 52 years modelled (Figure 13).

For the Plan, the DR2 model was based on the period 1970-2022, deriving an overall average annual recharge of 308 GL/yr. The DR2 model update report [4] used a longer model period (1900-2019) resulting in an average annual recharge of 211.3 GL/yr, about a third less. The Plan Background report [2] concluded that climate variability has the greatest impact on groundwater storage and flows in the Roper River (Page 47). It would then make sense to use the longest possible climate record to best capture this variability, i.e 1900 onwards.

This becomes an imperative for the Larrimah zone considering the episodic nature of recharge. Figure B below plots recharge from previous departmental modelling for the Larrimah zone [5]. It shows the five key recharge events from 1970 onwards, as used in the Plan, but it also shows that there were none of these scale events in the 70 years previously. This figure starkly presents the bias in the 1970-2022 model period used for the Plan. This derived an annual average recharge for the Larrimah zone of 17 GL/yr, compared to 8 GL/yr using the longer record. This figure also highlights the peril of using the annual average as the key metric - in comparison, the median annual recharge for 1900-2019 is just 0.03 GL/yr.

Climate variability, including the historic record of extended dry periods with the absence of extreme rainfall events that dominate the recharge budget, warrants a conservative approach to estimating recharge. In contrast, the use of the DR2 model with a relatively wet climate period generates optimistic recharge estimates for the Plan.

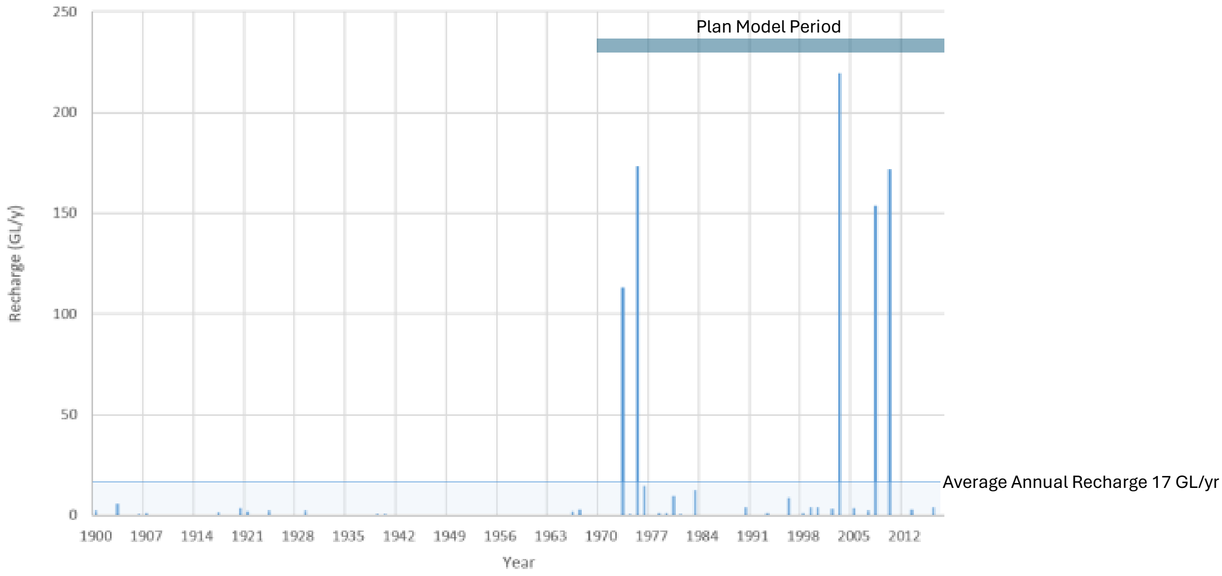

Figure B. Modelled recharge for the Larrimah Zone [5].

A failure in meeting environmental groundwater needs

The Background report [2] acknowledges that the high ecological values of Mataranka depend on permanent or seasonal groundwater - the nationally significant Mataranka Thermal Pools, the richness and uniqueness of the aquatic species, the riparian forests of cabbage palm and melaleuca. The report also summarised recent work on eco-hydrological relationships including:

- Cabbage palms require permanent groundwater access and measures to maintain shallow watertables and to avoid prolonged dry conditions.
- Freshwater sawfish are threatened by low river levels causing barriers to migration paths, with minimum annual baseflows influencing sawfish recruitment outcomes.
- Barramundi recruitment outcomes are also influenced by seasonal and prolonged low flows.
- The gulf snapping turtle is threatened by reduced groundwater discharge to the river, as well as increased nitrate levels in groundwater due to agricultural development.

The underlying theme of these relationships is that the focus of attention should be the prolonged dry periods, rather than the average or wet. These relationships are not directly incorporated in the assessment of potential impacts of groundwater extraction [2], using multiple model scenarios (Table 8). The metrics used are not adequate to the task (Table 9):

- Metric 1 – Average reduction of end of dry season flows at Elsey Homestead. Using an average across the 50 water years is meaningless as it captures both wet and dry decades. A better way is the range of baseflow metrics available to understand the magnitude and duration of critically low flows. This should be based on an understanding of low-flow thresholds for key aquatic species.
- Metric 3 - Bitter Springs average annual reduction in groundwater elevations. You would think that flow would be a better metric for a spring? Again, using an average does not look at the critical dry periods which drive impacts on key aquatic species.

- Metric 4 – Difference in groundwater level between 1970 and 2020 at nodes (relating to throughflow from Larrimah zone to South Mataranka zone). Comparing groundwater levels at the start and end of a 50-year model period says little about groundwater responses and impacts in between. Note that the reduction in groundwater levels under the Plan scenario (SC4) is significant when compared to the existing entitlements scenario (SC1) (Table 9). At Node 3, the modelled rise is 2.2m with Plan extraction, rather than a 6.0 m rise with current entitlements, a 3.8m reduction. This is important as it shows that the influence of proposed groundwater extraction in the Larrimah zone is predicted to reach and go into the South Mataranka zone. Comparing the magnitude of the reduction (3.8 m) at the zone boundary with the existing watertable gradient of ~10m across the Larrimah zone (Schedule O), shows just how significant this level difference is. It highlights the risk of Larrimah pumping capturing a component of the northerly groundwater flow into and within South Mataranka, and ultimately to the Roper River.
- Metric 5 – Modelled change in groundwater storage in Larrimah zone. Using groundwater storage as a management metric is inappropriate, unconventional, and not useful for protecting key environmental assets. The underlying message is that unsustainable dewatering of the aquifer is the anticipated outcome of the Plan.

The Plan metrics are useless as they do not characterise the key potential ecological impacts, both in time (no focus on critical dry periods) nor in space (no geographical context with key ecosystems). This is frustrating as the DR2 model can be used to deliver far more sophisticated impact assessments. Any learnings about eco-hydrological relationships are not specifically incorporated into the Plan, replaced by a simplistic categorisation of climate conditions.

An expansionist Plan with great risks

Considering the uncertainties surrounding the understanding of karstic carbonate aquifers like the CLA, the climate and recharge variability and the connectivity of the groundwater system to key ecological assets, one would assume that a conservative approach to groundwater planning would be taken. Unfortunately, the opposite is the case.

For the two Mataranka zones, there should have been extensive assessment of the impacts of extraction since 2013, to review assigned sustainable yields. This is in the context that more than half of the licence allocations remain unused (Figure 21). It is going to much more difficult to rescope the Plan when groundwater use reaches the diversion limits defined by sustainable yield.

There is no evidence presented for the conclusion in the Background report [2] that "*Groundwater levels have continued to increase despite extraction occurring (from around the early 2000's onwards) confirming that..water extraction has had a negligible impact on groundwater levels or on dry season flows to the Roper River*". There is no mention that minimum annual flows have actually decreased since 2013 (Figures 8 & 9).

For the Larrimah zone, the sustainable yield (35.238 GL/yr) is over twice the average annual recharge rate defined by the Plan (17 GL/yr). Remember that this is based on modelling using a relatively wet climate period (1970-2020). The sustainable yield is over 4 times the modelled average recharge when the recharge estimates for the 70 years prior to 1970 are also incorporated [5]. Its potentially worse than this. The Plan assumes that the relatively wet climate conditions will continue, including a similar recurrence of the episodic extreme recharge events. Over the 10-year Plan period, everything is based on the Larrimah zone aquifer being replenished by 170 GL. There are decades in the 1970-2020 model period when recharge was nothing like this. This doesn't even consider that we have a historical context (1900-1970) where no significant recharge event occurred for 70 years (Figure B). Recent work in the Daly catchment using tree-ring data concluded that the relatively wet conditions over the last 40 years is unprecedented in the last ~600 years [6]. The authors warned about setting water allocations based on such an assessment period of unprecedented high aquifer and river levels – this being the case for this Plan. Effectively, the starting point for planning is active dewatering of the aquifer. The question is not whether groundwater levels will decline, but rather by how much.

The concern that drawdown of watertable levels in the Larrimah zone could propagate across zone boundaries and have broader negative impacts has not been identified or addressed in the Plan. However, these concerns are justified, considering more recent application of the DR2 flow model [7] [8]. Figure C below, presents the modelled lowering of the CLA watertable over the next 50 years under two scenarios (1) Scenario A - current licenced groundwater entitlements and (2) Scenario B35 - an additional 35 GL/yr extracted as 5 GL/yr at seven hypothetical development sites, including within the Larrimah zone [7]. The key point from these drawdown maps is that the impact of groundwater development at Larrimah is regional in extent. Drawdown from pumping at Larrimah does extend northwards across the South Mataranka zone towards the Roper River, over more than 100 km, highlighting connectivity and potential consequences. This widespread propagation of watertable decline was attributed to the low storage properties of the CLA [7].

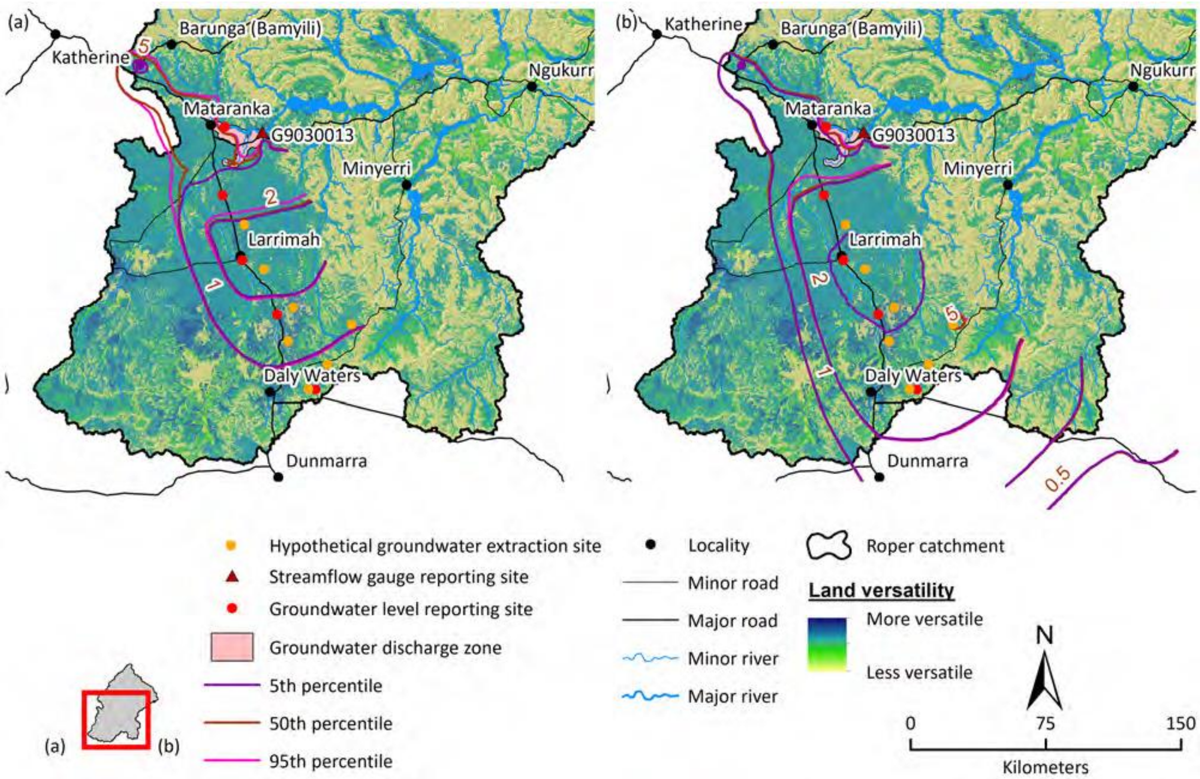

Figure C. Modelled drawdown in groundwater level in the Cambrian Limestone Aquifer (CLA) under (a) Scenario A current licensed entitlements and (b) Scenario B35 at ~2070 [7]

The following statement in the Background report [2] aptly summarises the incongruence between this Plan and the intent of the National Water Initiative – "*The Larrimah zone behaves like, and is characterised as, an Arid zone system where recharge to water resources is episodic and aquifers must be relied upon to sustain life*". This is backed up by perplexing statements like "*Relying on available stored water is a more cautious approach than relying on recharge, as it protects against uncertainties associated with climate variability*." This is code for the Larrimah zone being arbitrarily labelled "Arid Zone", somehow giving legitimacy for aquifer dewatering with scant regard for the consequences. The warped logic is that as the aquifer is not being regularly replenished in the Larrimah zone, permission is granted to actively mine the groundwater. Unfortunately, this logic has already been implemented for many critical aquifers across the world [9] [10] and we now see the consequences - the groundwater resource is disappearing, and with it the capacity to buffer against droughts and climate change, any opportunities for future economic and community development, as well as the viability of any cultural or ecosystem dependencies.

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30th May 2024

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