STYGOFAUNA

Ministerial Briefing for Tony Burke

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Groundwater Dependent Ecosystems of the Maules Creek Alluvial Aquifer. Ref No.: 2011/01583

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Title Photo:

Stygofauna being sampled from a bore in Maules Ck, Alluvial Aquifer.
http://www.aabio.com.au/tag/peter-serov/

Introduction

The Maules Creek Community Council Inc has nominated in 2011 the Ecological Community known as *Groundwater Dependent Ecosystems of the Maules Creek Alluvial Aquifer* for consideration by the Threatened Species Scientific Committee (the committee). The committee chose not to list the ecological community in 2012 due to a shortage of information about the community. (See Appendix 1)

This ruling however, does not diminish either the significant environmental/conservation value or ecosystem function values of this aquifer on a local, regional or national level. This small ecologically isolated aquifer provides habitat for a groundwater biodiversity hotspot in a region that is already impacted by clearing, over extraction, river regulation, and is at risk of complete alteration and loss due to potential of excessive drawdown of the aquifer and surface water/ groundwater contamination. It represents the only major water supply for the riverine, terrestrial and subterranean groundwater ecosystems and contains a unique community that consists of highly endemic species, the most North West range limits of highly specialized genera and families of aquatic/subterranean invertebrates and threatened terrestrial ecological community. The aquifer also supports the most comprehensive range of Groundwater dependent ecosystem types within the Namoi Region.

1. What are Groundwater Dependent Ecosystems?

Groundwater Dependent Ecosystems are those ecosystems that have "*their species composition and natural ecological processes wholly or partially determined by groundwater".* WMA (2000) amendment (Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources, 2008, Order Schedule 1, Dictionary, Department of Water and Energy 2008), The GDE Atlas 2012, Risk Assessment Guidelines for Groundwater Dependent Ecosystems 2012.

The Maules Creek Aquifer is one of the only alluvial aquifers that have been thus far surveyed, to support a complete range of GDE types excluding only karst and marine estuarine ecosystems. It is the only aquifer west of Tamworth in the Namoi River Valley to support perennial pools and the associated surface water ecosystem, a shallow, sand/cobble river bed with a deep Hyporheic zone which is directly connected to the alluvial aquifer. Groundwater fauna have been collected at less than 10cm depth in the river bed.

These GDE types include;

i. **Subsurface Ecosystems – Underground Ecosystems**
   - Subsurface Phreatic Aquifer Ecosystems. (Stygofauna - an assemblage of subterranean aquatic invertebrates);
   - Baseflow Stream (Hyporheic or subsurface riverine water ecosystems);

ii. **Surface Ecosystems – Above ground ecosystems**
   - Groundwater Dependent Wetlands such as springs;
   - Baseflow (Groundwater fed) surface water Streams such perennial stream sections and permanent pool ecosystems);

- Phreatophytes - Groundwater Dependent Terrestrial (vegetation) Ecosystems.

2. What are Stygofauna?

Stygofauna is a broad term that encompasses a diverse, highly endemic, morphologically specialized assemblage of subterranean aquatic invertebrates. This groundwater ecosystem type has been used extensively in Western Australia for over a decade to regulate and monitor the impact of mining and developments, due to the ecological features it possesses. These unique features include:

- *A high proportion of either phylogenetic or distributional relicts as well as short range endemic species.*

-*They are extremely sensitive to the environmental characteristics of the water they inhabit and, thus, potentially are useful indicators of groundwater health.*

- *Some are rare or unique.*

- *The ecosystems surviving in aquifers, caves and springs are amongst the oldest surviving on earth.*

- *They have water quality benefits, biodiversity value and add to the ecological diversity in a region.*

The Maules Creek stygofauna community has one of the highest subterranean biodiversity thus far encountered in NSW and a number of unique species and groups that have only been found sporadically across eastern Australia. Some of the fauna that highlight the significance of this community include the extreme NW range of crustaceans including Syncarida, Amphipoda, 3 species (at least) and two families of aquatic, blind water beetles, Oligochaetes (aquatic worms).

Below are a series of species types that have been collected from the Maules Creek Alluvium.

Photo 1. Synarida, Psammaspididae, *Psammaspides* n. sp. (©P.Serov 2011)

Photo 2. Amphipoda, Neoniphargidae n. sp. (©P.Serov 2011)

Photo 3. Isopoda, Janiridae, *Heterias* n. sp. (©P.Serov 2011)

3. What do Stygofauna do for water quality?

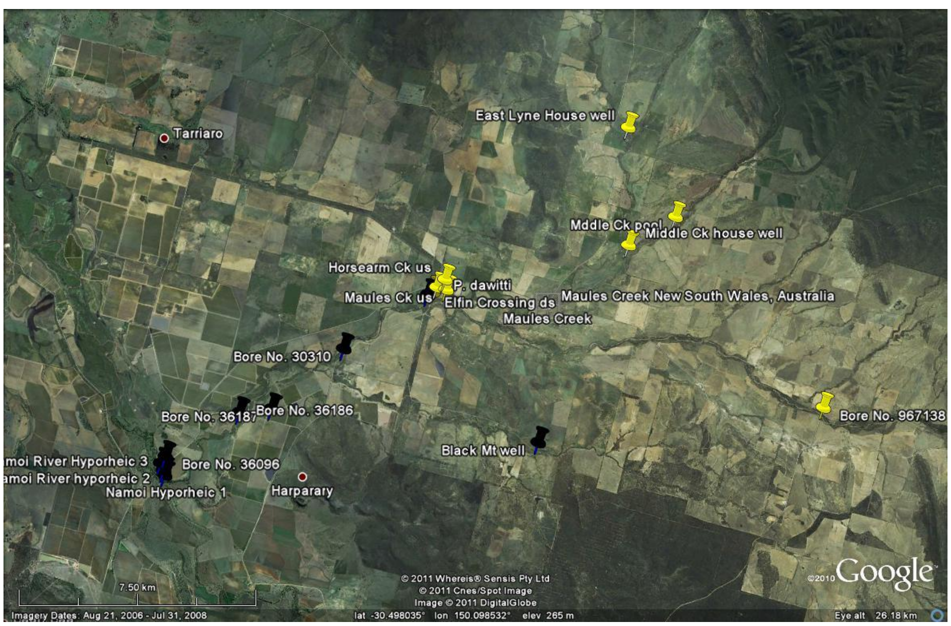
Humphries (2006) reports that “groundwater fauna contribute substantially to the biodiversity of Australia. In addition**, they may be functionally important in aquifers and, especially, in hyporheic zones**, that zone of interaction between river water and the groundwater present in the banks and beds of rivers (Boulton 2000; Hancock 2002)”. The significance of the groundwater/surface water interconnectivity was presented at the Australia Society of Limnology at the 2009 Annual Conference.

Furthermore, Stygofauna can be used as biological tracers of groundwater discharges and recharge and this has major implications for the management of both surface ecosystems and groundwater ecosystems.

4. Where are Stygofauna found at Maules Creek?

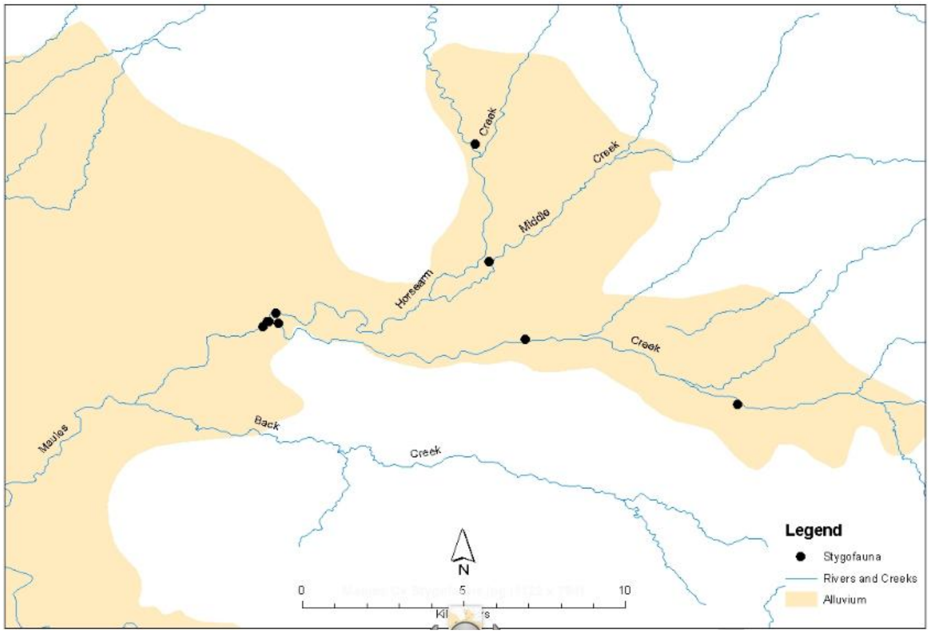
Stygofauna surveys within and around the Maules Creek Catchment (also known as Zone 11 in the Namoi Catchment Water Sharing Plan) as well as the Namoi River from Tamworth to the west of Wee Waa, have identified that the Maules Creek alluvial aquifer contains an isolated, diverse and highly endemic stygofauna community.

This site map taken from the original nomination shows where stygofauna have been located in the area. Yellow pins are positive stygofauna sites and black pins are negative - no stygofauna.



(©P.Serov 2011)

The successful sampling locations are located on the below map of the Maules Creek Alluvial Aquifer.



(©P.Serov 2012)

It is clear from this map the isolated nature of this community. Although a similar fauna is known from the Cockburn River and the upper Peel River east of Tamworth, the communities contain different species assemblages and no overlapping species. Therefore the communities are completely separate.

5. Threats to Stygofauna

"Groundwater fauna, especially stygofauna are extremely sensitive to the environmental characteristics of the water they inhabit and thus potentially are useful indicators of groundwater health (Tomlinson & Boulton, 2008, Serov *et al*, 2009)." These environmental characteristics include;

i. Water Chemistry Balance

These invertebrate communities are adapted (e.g. no eyes or skin pigment) entirely to these very specialised environments such as that within the alluvial aquifer. They are highly susceptible to changes in water chemistry. (Serov P, 2011)

ii. Water Table Levels

Drawdowns of groundwater in excess of 1 meter threaten the viability of Stygofauna due to sensitivity to dissolved oxygen levels (Serov P 2011). As the aquifer also supports perennial pools and a highly connected Hyporheic community as well as terrestrial vegetation communities that are entirely dependent on the natural range of water level fluctuations. All estimated water level drawdown will have a detrimental impoact on these communities. Scenario 2 of the Namoi Water Study (drawdown map shown below) and the latest mine groundwater study from the Tarrawonga mine (Merrick & Alkhatib 2012) confirms that the drawdown will be in excess of 1 meter and will average 5 meters in the area. This is well below the stream, pools and Hyporheic level, which would therefore indicate and automatic loss of these communities.

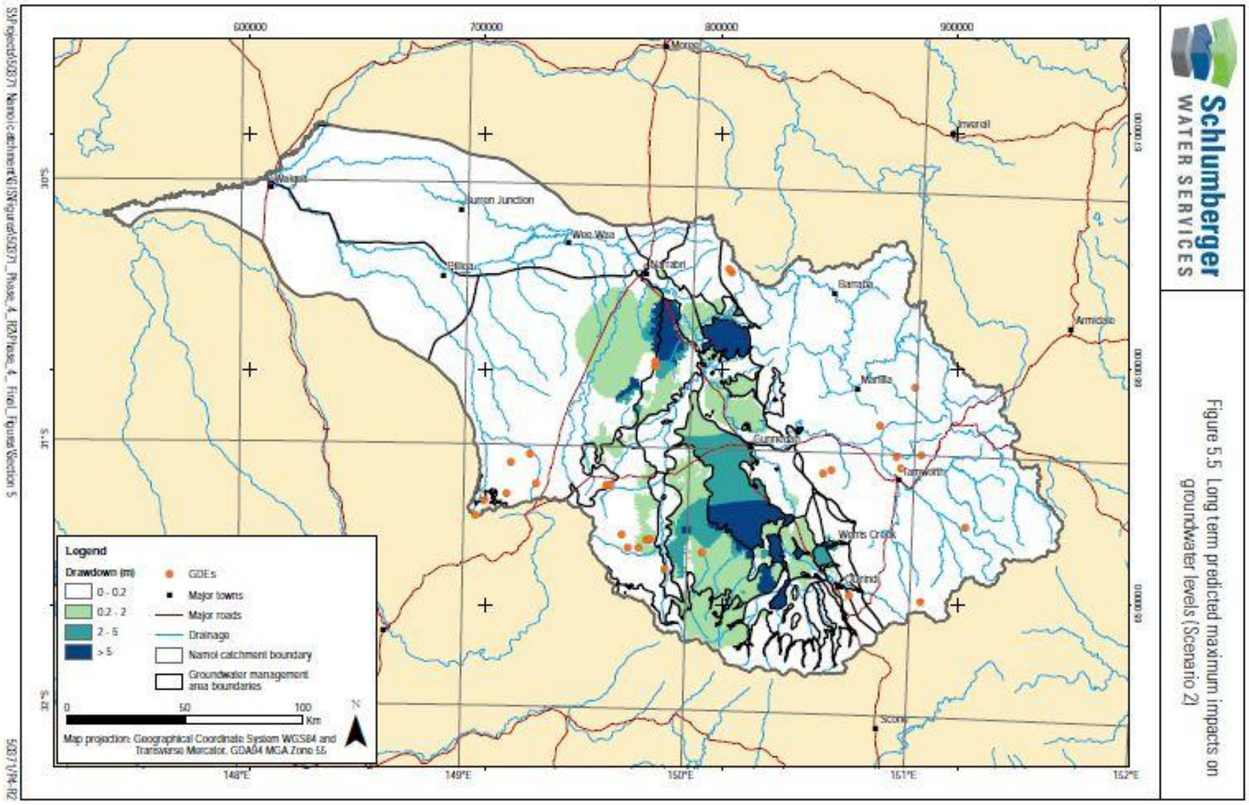


Figure 5.5 Long term predicted maximum impacts on groundwater levels (Scenario 2)

iii. Insufficient State Legislative Protection

Although the NSW government has a GDE Policy and a process for delineating and ranking High Priority GDE's they have not and will not appropriately considered subterranean ecosystems and stygofauna and do not have a current system for public listing of any GDEs for high ecological value listing of GDE's even though an assessment process has recently been completed, endorsed and published by the National Water Commission. This assessment process includes a background brief and methodology for assigning ecological value and current and potential risk from development all GDEs, including stygofauna See Serov 2012 at http://www.water.nsw.gov.au/Water-management/Water-availability/Risk-assessment/Groundwater-dependent-ecosystems/Risk-assessment-guidelines-for-groundwater-dependent-ecosystems). It is imperative that an open and transparent process be urgently developed to allow the general public to add highly sensitive and ecologically valuable groundwater ecosystems to the high priority listing and that protection measures are increased to cover more than simply water levels. A holistic landscape approach is needed to protect the complete range of Groundwater dependent Ecosystems. This is currently lacking.

6. Conclusion

It is the view of the MCCC that the GDE of the Maules Creek Alluvial Aquifer are under imminent threat as there are;

1. A fine balance between existing groundwater extraction and recharge
2. Approvals of massive new coal mines and coal mine expansions in the area that are yet to commence groundwater extraction.
3. Modeled cumulative impacts in the shallow alluvial aquifer of a 5m drawdown adjacent to Maules Creek and 1m drawdown further up the valley due to that mining
4. Existing and new coal and CSG exploration leases that overlay the entire alluvial aquifer
5. Further identification of potential coal mines in the Maules Creek Alluvial Aquifer contained in the Strategic Regional Land Use Policy (SRLUP) and the Namoi Catchment Water Study.
6. Insufficient quantity and quality of the underlying science in relation to the planning conditions imposed by the Planning NSW regarding GDE of the Maules Creek alluvial Aquifer. For example, ***GDE's were not mentioned at all in the Maules Creek Coal PAC Report. (PAC 2012)***

These facts confirm that there is an imminent threat to the GDE of the Maules Creek Alluvial Aquifer.

7. Recommendations

1. Emergency consideration of the listing due to immediate threats from open-cut coal mining
2. Special consideration and application of the precautionary principle given that the listing has been held back to date only by lack of knowledge
3. That the IESC is required to fully and thoroughly assess the impacts of proposed mines on the endemic Stygofauna of Maules Ck.

8. References

Humphreys W 2006, 'Groundwater fauna' paper prepared for the 2006 Australian State of the Environment Committee, Department of the Environment and Heritage, Canberra, <http://www.environment.gov.au/soe/2006/publications/emerging/fauna/index.html>

Merrick N, Alkhatib M, A *Hydrological Assessment in support of the Tarrawonga Coal Project*, Jan 2012

Namoi Catchment Water Study Final Report, Schlumberger Water Services, July 2012

Serov, P. Paper 1 in preparation. *A Revision of the Family Psammaspididae with the Description of New Species.*

Serov, P. Paper 2 in preparation. *Raptornungidae, a New Family of Predatory Subterranean Anaspidacea (Syncarida, Crustacea) from North East, New South Wales, Australia*.

Serov et al, 2012. Risk Assessement Guidelines For Groundwater Dependent Ecosystems. National Water Commission.

See also Original 2011 Nomination for listing of the Ecological Community.