Moolarben Coal Expansion

On the 6 April 2018 the NSW EPA requested assistance from OEH SD with a strategy for discharges into the Goulburn River catchment, considering proposed modifications to the Ulan and Moolarben Coal Mines. On the 10 April 2018 the NSW EPA, OEH SD and DPE met with Moolarben Coal representatives to discuss issues raised in relation to the Moolarben Coal Expansion. On 28/05/2018 the NSW EPA wrote to OEH SD requesting a review of the Response to Submissions (RTS) for the Moolarben Coal expansion (Moolarben Coal 2018). The current report has been written to address the EPA's request to review the RTS for the Moolarben Coal expansion.

Summary

The major issues associated with the MCO expansion can be summarised as:

1. The salt load to be discharged to the Upper Goulburn River
2. The proposed flows to the Upper Goulburn River and lack of appropriate monitoring of flows in the area.
3. The quality (including ionic composition) of the proposed discharge waters
4. The lack of an adequate cumulative impact assessment for the Moolarben Coal expansion, especially given Ulan Colliery already discharges substantial amounts of saline water to the Upper Goulburn River.

Based on a review of the RTS (Moolarben Coal 2018) and associated documents it is concluded that:

- The combined salt loads from both the UMCL and MCL discharges could potentially end up being approximately 35 times background salt loads for the Upper Goulburn River. There is a clear need to better address the amount of salt being discharged (or proposed to be discharged) to the Upper Goulburn River. There is little consideration in the EA or RTS of the cumulative impact assessment for the total salt load from both mines (Moolarben and Ulan) – or its potential downstream effects.

- Monitoring of current flows[1] in the Upper Goulburn River appears to be exceedingly poor.

- The RTS largely ignores the cumulative effects of MCO discharges on top of those of UCML (and other mines in the broader area). The cumulative impacts of both MCO and UCML discharges could be severe, given their location high in the headwaters of the Goulburn River. There appears to be no appropriate monitoring of flows in the Upper Goulburn River to rigorously assess any flow-related impacts.

- It is noted that there has been limited if any sediment sampling of the area to understand whether historical discharges have contaminated sediments in this area or what the proposed discharge might add to sediment contamination in this regard.

[1] There appears to be no appropriate daily monitoring of flows in the Goulburn River in the area where MCO seeks to discharge.

- The ANZECC Guidelines should be used consistently when developing local water quality criteria and proposing trigger levels/discharge limits[2]. A more appropriate local water quality guideline value for Manganese (based on the data presented) would be 0.39 mg/L.

- The statement that "*mine affected water stored in mine storages (for measured analytes) currently has a similar ionic make-up to surface water in the Goulburn River*" is incorrect.

- Based on data for this area and elevated ionic constituents in dams and other mine water releases, it can NOT be expected that *water discharged by MCO would have a similar ionic make-up to current water flows in the Goulburn River*

- Further research into the effects of differing ionic composition in this area is clearly required. It is recommended that ecotoxicity testing is undertaken on discharge waters to ascertain whether they are or are not toxic to aquatic life, prior to any disposal into surface waters.

- If the mine expansion is approved, it is recommended that a condition of consent specifies that the discharge is not to be toxic to aquatic biota.

- An appropriately sized water treatment plant is required to address the salinity issues associated with the proposed, large volume, saline discharge to the Upper Goulburn River catchment.

Adequacy of response to issues raised by EPA/OEH on the Moolarben Coal expansion

The RTS is not considered to have appropriately addressed many of the very serious issues raised in relation to the Moolarben Coal Expansion by Government Agencies and the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mines Development (IESC).

The IESC (2017) stated that:

> *The proponent needs to assess the potential impacts of up to 20 ML/day sustained discharge on the Goulburn River (including the diversion channel), addressing:*
> *a. the identification of the in-stream macrophytes in the diversion channel;*
>
> *b. risks to the persistence and health of macrophyte beds, including their capacity to survive sustained higher flows;*
>
> *c. potential consequences of sediment mobilisation should macrophyte cover be reduced;*
>
> *d. the metal and other contaminant content of sediment within the channel and potential bio-concentration of metals and other contaminants in the macrophytes;*
>
> *e. the capacity of the macrophyte beds to reduce turbidity of mine water discharge;*
>
> *f. the potential geomorphological impacts (to sediment composition and depth) of up to 50 ML/day of cumulative mine discharge (from both Moolarben and Ulan mines) to the Goulburn River downstream of the diversion channel;*

[2] Especially for EC, pH and other variables found at elevated levels in the discharge.

g. potential ecological effects of a reduction in low flows, changes to flow variability and geomorphology in the Goulburn River (as discussed in paragraph 5); and

h. avoidance and mitigation measures for potential hydrological, water quality and ecological impacts.

Very few of these issues have actually been mentioned or assessed in the RTS. As a result, significant issues remain, especially with the proposed discharge, its level of treatment and its potential environmental and social effects on the Upper Goulburn River. These significant issues can be summarised as:

1. The salt load to be discharged to the Upper Goulburn River
2. The proposed flows to the Upper Goulburn River and lack of appropriate monitoring of flows in the area
3. The quality (including ionic composition) of the proposed discharge waters
4. The lack of an adequate cumulative impact assessment for the Moolarben Coal expansion, especially given Ulan Colliery already discharges substantial amounts of saline water to the Upper Goulburn River

These issues are discussed further below.

The Salt Loads to be Discharged to the Upper Goulburn River

The increasing salinisation of Australia's freshwater streams and rivers is of significant concern. Scientific experts in this area (e.g. Cañedo-Argüelles et al 2016) have also recently argued that salinity standards for specific ions and ion mixtures, not just for total salinity, should also be developed and legally enforced to protect freshwater life and ecosystem services.

There are a variety of potential sources of salinity in the Hunter River catchment[3] including rainfall, atmospheric deposition, run-off and infiltration, weathering of geological strata, groundwater and a range of anthropogenic sources including the Hunter River Salinity Trading Scheme (HSTS; see EPA 2013). The Goulburn River sub-catchment can contribute relatively high salinity water to the Hunter River, but it is not currently captured by the Scheme upstream of Kerrabee. Due primarily to its location with the upper reaches of the Goulburn River Catchment, UCML were not afforded the regulatory provisions detailed within the Hunter River Salinity Trading Scheme for the management of saline water generated through its industrial processes (UMCL 2006). The same situation applies to Moolarben Coal. Having large volume discharges located high in the catchments of rivers will always be problematic due to low flows and the lack of dilution that can practically be achieved for such discharges. Alternative management action needs to take place if the salt levels/loads from such discharges are not to have adverse impacts on the receiving environment and downstream users.

As identified above, UCML and Moolarben Coal have not been afforded the regulatory provisions detailed within the Hunter River Salinity Trading Scheme for the management of saline water. Salt loads from these discharges are nevertheless important given the relatively low flows in the Upper Goulburn River catchment and because the discharges can potentially cause elevated salinity levels leading to adverse social and environmental outcomes. The recent reporting of extensive salt deposits on the banks of the Goulburn River (see Figure 1) is potentially one expression of this problem.

[3] Which includes the Goulburn River.

A major focus of the monitoring and reporting associated with mining discharges in the Upper Goulburn River involves electrical conductivity, which is related to the amount of salt and minerals in the water. The salt amount in water is known as TDS, or total dissolved solids. This is measured in parts per million, ppm, which can also be converted to mg/L. Electrical conductivity can be converted to TDS to provide an estimate of salt load (in kg/day or tonnes/annum) using established conversion factors[4]. The conversion factor will depend on the types of minerals and salts dissolved in the water and the conversion factor can be found in published tables. Salt load estimates for UCML operations were calculated and provided to the EPA in earlier advice (OEH 2017).

Figure 1. Salt encrustations on the banks of the Goulburn River at Gleniston. Source: J Imrie email 13 September 2017

Currently there is no discharge from the Moolarben Coal mine, so no salt is currently being released from the mine via a discharge (even though MCO have an EPL that would allow them to do so). Approximate salt load estimates based on proposed flows and EC levels in the Moolarben Coal EA and RTS suggest that:

[4] For example: http://onlinecalc.sdsu.edu/onlinesalinity.php. It is noted that this calculation leads to lower estimates of TDS than using other methods based on conversion factors (such as 0.67*EC). Further consideration of the method for calculating TDS from EC is needed, including consideration of the use of daily flow and conductivity data to calculate annual salt loads.

- At 20ML/day and EC900 the discharge would add ~4400 tonnes of salt per annum to the Upper Goulburn River.
- At 10ML/day and EC900 the discharge would add ~2200 tonnes of salt per annum to the Upper Goulburn River.
- At 20ML/day and EC700 the discharge would add ~3400 tonnes of salt per annum to the Upper Goulburn River.
- At 10ML/day and EC700 the discharge would add ~1700 tonnes of salt per annum to the Upper Goulburn River.
- At EC600 and 20ML/day the discharge would deliver ~3000 tonnes of salt per annum to the Upper Goulburn River.
- These salt loads would be additional to the salt load UCML currently discharges (~3600 tonnes per annum for 2016; OEH 2017).

Based on historic data for the area (DLWC water quality and flow data for Station 210046), 'background' salt inputs in the absence of mine discharges would appear to be approximately 230 tonnes per annum.

The combined loads from both the UMCL and MCL discharges could potentially end up being approximately 35 times background loads for the Upper Goulburn River. There is a clear need to better address the amount of salt being discharged (or proposed to be discharged) to the Upper Goulburn River. There is little consideration in the EA or RTS of the cumulative impact assessment for the total salt load from both mines (Moolarben and Ulan) – or its potential downstream effects.

The Proposed Discharge Volumes (Flows) to the Upper Goulburn River

Monitoring of current flows in the Upper Goulburn River is exceedingly poor.

Establishing what are 'natural' flows in the Upper Goulburn River catchment is difficult given the major changes that have occurred within the catchment including: land clearing, the construction of open cut pits; underground mine workings; the establishment of Moolarben Dam; and the diversion of the Goulburn River adjacent to UCML workings. An earlier Water Resources Commission gauging station (Stn210046) was previously located on the Goulburn River at Ulan. Data from this station is available from the Pinneena Surface Water Data Archive (NSW Office of Water 2009) for the period[5] 10/3/1956 to 31/8/1982.

UCML's 2005 Annual Report identified that a Goulburn River gauging station (SW02) downstream of the mine was commissioned in May 2005. In November 2005 construction commenced on a second river gauging station upstream of the mine in the village of Ulan (UCML 2005). The upstream gauging station (SW01) was commissioned in June 2006 (UCML 2006). The upstream station is located near the school at Ulan township and the downstream station is located under the bridge over the Goulburn River on Ulan Road. The earlier Water Resources Commission gauge (Stn210046) appears to be downstream of Moolarben Dam, but upstream of the new UCML upstream gauge (SW01).

Median flow for the Water Resources Gauge (210046) over the period 10/3/1956 to 31/8/1982 was 2.225 ML/day (see the flow exceedance curve below; Figure 2). The significant reduction in recent

[5] The majority of these data post-dates the construction of Moolarben Dam. Advisian (2017) stated: *The Moolarben Creek Dam is located on Moolarben Creek, approximately 1.5 km upstream of the confluence with Sportsmans Hollow Creek. It was constructed between 1955 and 1957 to supply cooling water for the Ulan Power Station (Tickle, 2005).*

upstream flows at SW01 is quite noticeable (Median flow for SW01=0 ML/day for the period post November 2008). In fact, no flows were recorded at SW01 since the beginning of 2011 (see UCML AEMR's for 2011, 2012, 2013, 2014, 2015) and flow at SW01 was no longer reported in the 2016 UCML AEMR, despite the obvious rainfall related responses at SW01 in 2009 and 2010 (Figure 2). Either the gauge is non-functional or no water is currently being released/flowing from upstream. An explanation of these recent flow results for SW01[6] is required to understand the context for MCO discharges into the Upper Goulburn River.

Whilst no data for SW01 has been reported in recent times, flow records for SW02 and discharge data for LDP6 and LDP19 have been reported (UCML AEMR's for 2008-2016). An analysis of these Flow data indicates:

- LDP19 discharges initially commenced in March 2011, with a significant increase in flows in 2015. Median flows towards the end of 2016 were ~17ML/day[7].
- The median of the combined flows from UCML LDP6 and LDP19 are currently about 24 ML/day (over 10 times the median flow recorded at Stn210046 for the period 10/3/1956 to 31/8/1982; OEH 2017)[8].
- Throughout much of 2014-2016 the flows recorded at the downstream gauging station SW02 were largely sourced from Ulan LDP discharges[9] (note overlap of black and blue lines in Fig 3 below).

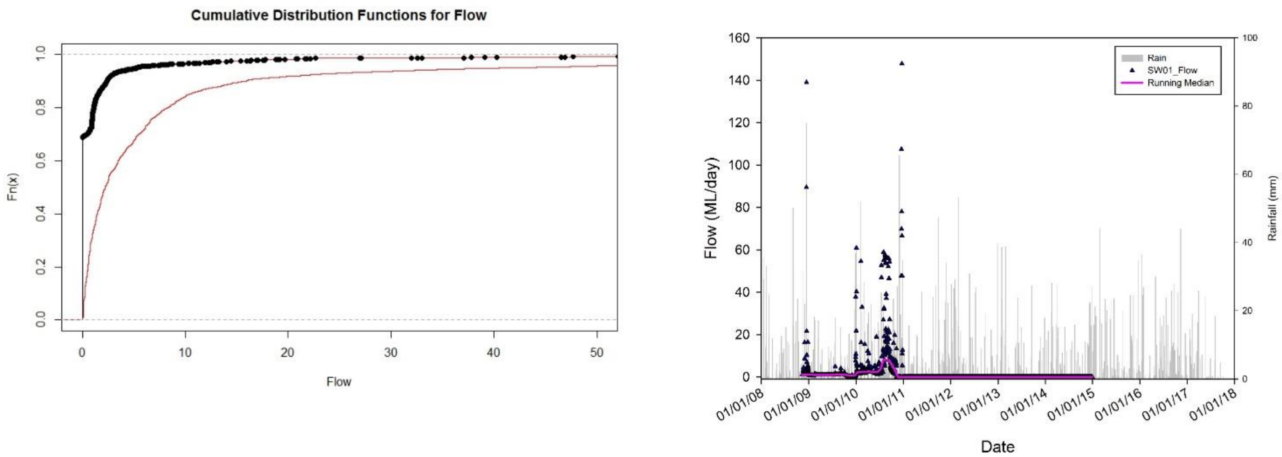


Figure 2. Flow exceedance curves for Stn210046 (red line; 10/3/1956 to 31/8/82) and SW01 (black line; post November 2008) left; and time series plot of SW02 flows right. Source: Pinneena Database (210046) and UCML AEMR 2008-2016.

---

[6] This issue and recent data on flows for this area were not reported in the MCO EA or RTS. Without such important quantitative information, it is unclear how MCO can reach a reliable conclusion of 'negligible' or 'no significant' impact of their discharge proposals. The magnitude of the proposed discharge (20ML/day) clearly suggests a non-negligible hydrological impact in this area.

[7] Although maximum flows have been ~20 ML/day – see OEH 2017.

[8] This appears to have reduced due to the current rainfall deficit and the Upper Goulburn River was recently reported as being dry (i.e. having no flow).

[9] Reinforcing the potential for negligible flow releases from Moolarben Dam. It should be noted that UCML AEMRs reported flows of 0 ML/day at SW01 for most of this period.

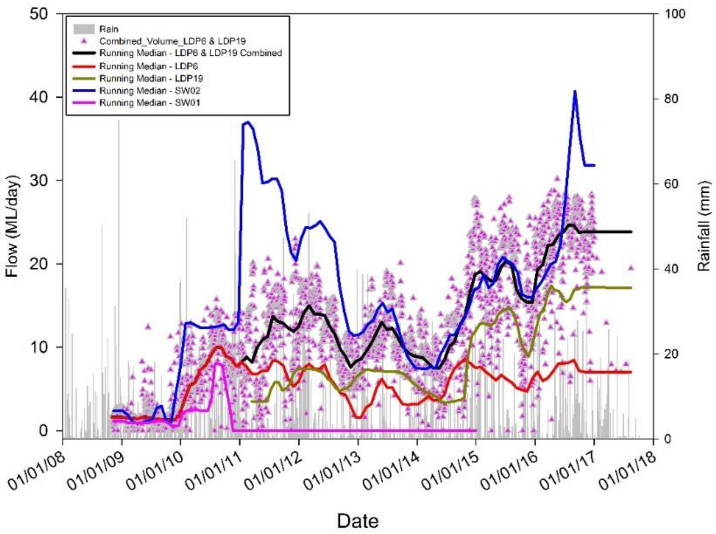


Figure 3. Time series of flow and comparison of running medians for SW01, SW02, LDP6, LDP19 and Combined LDP6 & LDP19. Source: UCML AEMR 2008-2016 and UCML monthly monitoring reports 2017.

In addition, WRM (2017) stated:

> *MCO had previously collected streamflow data at three monitoring sites (SW05 – Moolarben Creek, SW11 – Bora Creek and SW15 – Wilpinjong Creek), however these gauges were lost due to flooding in November 2010. SW05 was replaced by a monitoring site (in May 2013) maintained by Ulan Coal Mine Limited (UCML) downstream of Moolarben Dam and MCO has access to this data through a data sharing agreement. SW15 was replaced in May 2013 and SW11 in December 2013. MCO installed another two flow monitoring stations on Murragamba Creek and Eastern Creek in May 2013.*

Based on this statement, it would appear that MCO has flow monitoring in Wilpinjong, Murragamba, Eastern and Bora Creeks, but no flow monitoring in the Upper Goulburn River[10].

Advisian (2017) stated:

> Environmental flows are released from the dam in accordance with the licence conditions for this structure. Water licence works approval 20WA209953 requires that:
>
> *'Flow of not less than 7 L/sec pass out of the Moolarben Dam into Moolarben Creek downstream of the dam at all times, provided that when the flow into the stored water is less than 7 L/sec, the flow to be passed out of the dam wall shall be that flowing into the stored water for the time being'.*

---

[10] Although none of this data was presented in the RTS. A data sharing agreement with UCML will also not deliver appropriate flow data if the Goulburn River flow gauge (SW01) itself is not functional. It also delivers no information on whether flows are being released from Moolarben Dam in accordance with the stated water management licence requirements and how this might affect MCO's proposed discharge.

According to the *Ulan Coal Annual Review 2016* (Ulan Coal, 2016b), 145 ML was released from Moolarben Dam into Moolarben Creek during the 2016 reporting period in accordance with this condition.

There currently appears to be no appropriate daily monitoring of flows in the Goulburn River upstream of Ulan Creek and downstream of Moolarben Dam, the area where MCO are proposing their new discharge. As a result, MCO are unlikely to be able to appropriately assess the impact of their discharge on the environment in terms of its 'natural' flow regime. Any discharges to the Upper Goulburn River will also add to the discharges being released by UCML.

MCO has proposed a variable flow rate, ramping up over time as the mining progresses. It is noted that:

- At 20ML/day this discharge will be greater than the 90th percentile of flows in the Upper Goulburn River based on DLWC gauging data[11].
- At 10ML/day this discharge is equivalent to approximately the 85th percentile of flows in the Upper Goulburn River based on DLWC gauging data
- Any discharge from MCO will be in addition to discharges by UCML
- The cumulative impact of ~30-40 ML/day of continuous flow is of concern - 40ML/day equates approximately to the 95th percentile of flows in this area based on DLWC gauging data.
- Major geomorphic changes could occur in the river as the result of the combined (and sustained) maximum flow rates of up to 40-50 ML/day.

The IESC (2017) noted that:

> *..there will be more and longer low flow periods in the Goulburn River immediately downstream of the project site than at the gauging station. Low flows and flow variability are crucial to maintaining in-stream and riparian habitats that vary in size, substrate composition, flow and inundation (Rolls et al. 2012), and in many streams the native biota is adapted to the natural flow regime, including low flow. Artificially greater and more sustained flows may have the following impacts:*
> *a. Coarsen bed-sediments, reducing suitability of instream habitat for some water plants.*
>
> *b. Inhibit upstream migration by aquatic invertebrates and fish (especially small ones that cannot swim against the current). Many Australian native fish spawn at low flows, so this altered flow regime could potentially alter breeding success of some of these fishes.*
>
> *c. Altered conditions that may favour the invasion and establishment of exotic species that impact upon native ones.*

The IESC were also concerned about impacts from uncontrolled discharges, suggesting that

> *The proponent needs to assess the possible hydrological, water quality and ecological impacts to the Goulburn River of up to 1,200 ML of uncontrolled discharge, taking into consideration the cumulative impacts of uncontrolled discharge from the Ulan and Wilpinjong mines and the proposed Bylong mine*.

The RTS largely ignores the effects of MCO discharges on top of those of UCML (and other mines in the broader area). The cumulative impacts of both MCO and UCML discharges could be severe,

[11] Currently the longest and most consistent flow record for the Upper Goulburn River in this area. It is additionally noted that UCML discharges are often already greater than the 90th percentile of flows and any discharge will be additional to that released by UCML.

given their location high in the headwaters of the Goulburn River. There is currently no appropriate monitoring of flows in the Upper Goulburn River to assess flow-related impacts[12].

The quality (including ionic composition) of the proposed discharge waters and its environmental effects

Dundon (2006) discussed Groundwater-Surface Water Interactions in the area in the original EIS for Moolarben mine, finding:

> *There is abundant evidence in the large number of springs and seeps that the groundwater discharges to the surface throughout the area. However, with few exceptions, the volumes of individual spring and seep discharges are very small. Many seeps were only visible as patches of dampness or lush grass. The flow rate of the largest spring flow observed in the study area is estimated at less than 0.1 L/s. Nevertheless, the accumulation of groundwater discharges is sufficient to maintain semi-perennial flow in the major tributaries and virtually permanent flow in Goulburn River (either visible flow or flow within the sandy stream bed). Landowners report that a number of spring-fed dams are able to maintain permanent water through extended dry periods due to groundwater seepage.*
>
> *Groundwater baseflow comprised a significant component of total streamflow during the period of baseline monitoring. This is reflected by a close relationship in the water salinity and major ion chemistry between the groundwater and the surface water during periods of lower rainfall. Thus, in the Moolarben Creek – Lagoon Creek catchment, the surface water quality is generally saline like the typical groundwater from that area. The water quality in the Goulburn River is much less saline than that in the Moolarben Creek – Lagoon Creek system, indicating that the river probably derives most of its baseflow from other tributaries in which the groundwater is presumably of better quality, eg Ryans Creek and Sportsmans Hollow Creek, both of which drain granitic catchments to the west of the Permian basin margin.*

The RTS states at Response 8:

> *The dataset for UMC SW01 includes data from 36 sampling events for dissolved metals, taken at least monthly from December 2013 to July 2016 (with one month [January 2016] where sample results are not available).*
>
> *Based on the ANZECC Guideline, data from UMC SW01 for the period December 2013 to July 2016 has been adopted by Advisian (Attachment 1) to identify appropriate site-specific trigger values outlined in the ANZECC Guideline.*
>
> *Advisian recommended design criteria for metal concentrations for controlled release water (Table 4) based on the maximum of the ANZECC Guideline default trigger values and 80th percentile values from UMC SW01.*

---

[12] It is noted that neither the EA nor the RTS provide numerical analysis of recent flows for the Upper Goulburn River in the area of the proposed discharge.

When considering discharge of waters to natural systems, the addition of any contaminant has a potential for adverse impacts. The ANZECC guidelines do **NOT** recommend that the maximum of the ANZECC Guideline default trigger values or 80th percentile values from a reference site should be used to develop local water quality criteria - the approach taken by Advisian. It is also noted that only a small subset of metals/metalloid/non-metals have been analysed. Of the metals reported, the greatest discrepancy is in the values adopted is for Manganese. The ANZECC guidelines clearly state (footnote C) that the Manganese default guideline of 1.9 mg/L '*may not protect key test species from chronic toxicity'* – referring readers to Section 8.3.7 of the ANZECC Guidelines.

ANZECC (2000; Section 8.3.7) notes:

> *The change in salinity from fresh to saline waters will induce the precipitation of iron and manganese oxyhydroxides from both soluble ions and colloids, carrying with them other metals and organics.*

A more appropriate local water quality guideline value for Manganese (based on the data presented) would clearly be 0.39 mg/L.

It is also noted that there has been limited if any sediment sampling of the area to understand whether historical discharges have contaminated sediments[13] in this area or what the proposed discharge might add to sediment contamination in this regard.

In addition, at the 10 April 2018 meeting between agencies and Moolarben Coal representatives, OEH SD raised the issue of prior water quality data for the Upper Goulburn River (site 210046) which was potentially unaffected by the recent changes in the area. Whilst MCO have calculated local water quality criteria for some metals, a clear explanation of why data on other parameters (e.g. EC levels) have not been treated in an equivalent manner[14]. For example, earlier EC data (prior to the current UCML mining operations and discharges) were available from the NSW Office of Water database for Station 210046. Over the period 1968-1982 (n=50) the median conductivity recorded for Station 610046 was 432 µS/cm and the 80th percentile was 580 µS/cm. A similar situation arises for pH since the discharge could also potentially elevate pH levels in the stream making it more alkaline.

The ANZECC Guidelines should be used consistently when developing local water quality criteria and proposing trigger levels/discharge limits.

As identified earlier, Cañedo-Argüelles et al (2016) have also recently argued that salinity standards for specific ions and ion mixtures, not just for total salinity, should also be developed and legally enforced to protect freshwater life and ecosystem services.

The RTS stated:

> RGS Environmental concluded:
>
> - *Review of the available surface water monitoring data (specifically major ionic data) at sites both upstream and downstream of the proposed MCC discharge point indicates that mine affected water stored in mine storages (for measured analytes) currently has a similar ionic make-up to surface water in the Goulburn River.*

---

[13] The IESC has also raised this issue with the potential scouring of the diversion channel if 20ML/day is released continuously into this area.

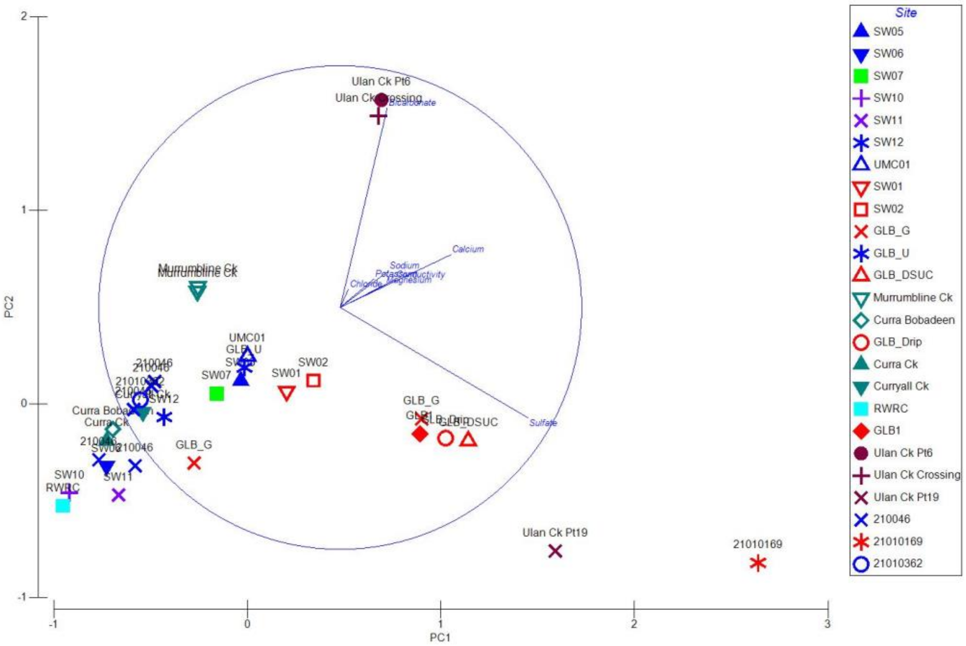
[14] Since they cover a longer period of record and are not confounded with recent changes in this area. Due to the lack of flow data, it can not be ascertained whether recent data for SW01 are biased to periods of no flow in the Upper Goulburn River.

- *On this basis, it is expected water discharged by MCO would have a similar ionic make-up to current water flows in the Goulburn River (including at monitoring sites downstream of current licensed discharges from the Ulan Mine Complex).*
- *The risk of individual major ions having adverse impacts to the aquatic ecology is low, which supports the findings of MPR (2017).*

Figure 4 illustrates a principal components analysis and comparison of available ionic composition data for the area. Points closer together in this graph have more similar ionic composition than points further apart[15]. There are major differences between Goulburn River surface waters and the MCO dam storages, open cut pits and underground sump. It is also clear that UCML discharges and Goulburn River water downstream of these discharges[16] have a very different ionic composition to the Goulburn River upstream of these discharges[17].

The statement that "*mine affected water stored in mine storages (for measured analytes) currently has a similar ionic make-up to surface water in the Goulburn River*" is incorrect.

There is nothing to suggest that MCO operations and discharges will operate in a different manner to other mines (if a treatment plant is built). Therefore, it can **NOT** be expected that *water discharged by MCO would have a similar ionic make-up to current water flows in the Goulburn River*



---

[15] It is noted that no data were available in the EA or RTS for the storages, open cut pits or underground sump for Sodium, Chloride or Potassium ions. This requires an explanation since Sodium and Chloride are usually the dominant ions in mine water discharges.

[16] Which itself potentially consists largely of mine discharge waters.

[17] ANOSIM on a similarity matrix calculated using the Gower metric on normalised data (see Clarke and Gorley 2006) yields statistically significant differences between upstream Goulburn River and Dam/storage ionic composition data. Since the majority of ionic composition data appears to be at least 5 years old, further data should be collected on the ionic composition of mine water, proposed discharge waters and surface water in the Goulburn River.

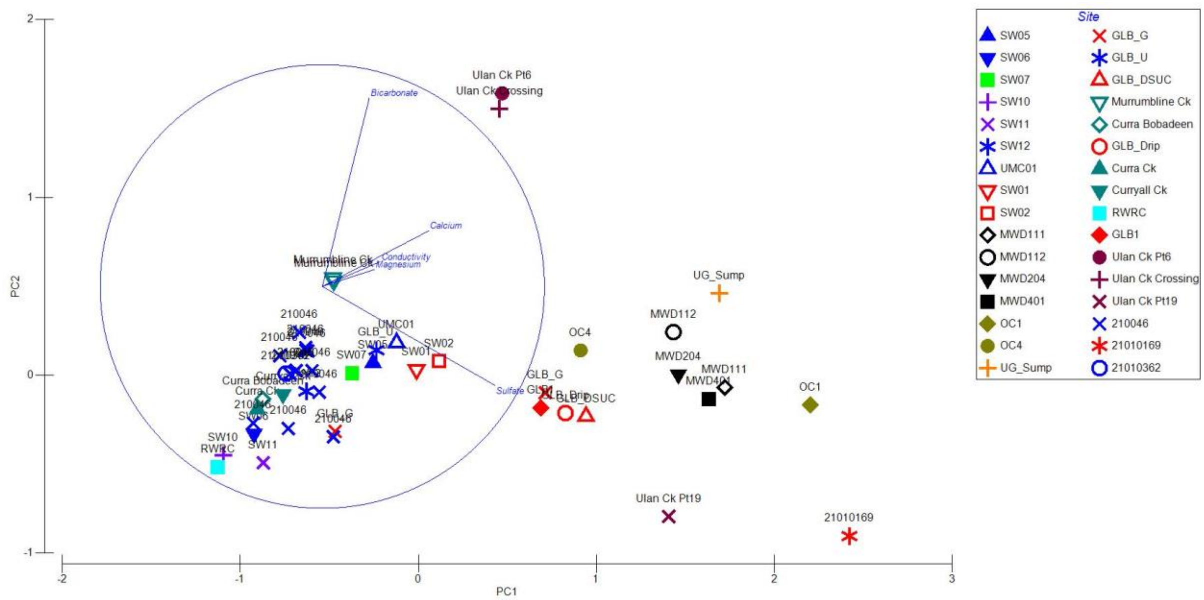


Figure 4. Principal components comparison of ionic composition data for the Upper Goulburn River. Symbols have been colour coded as red=Goulburn River d/s Ulan discharges (affected by recent discharges from UCML); dark blue= Goulburn River u/s Ulan discharges and downstream Moolarben Dam (where the discharge is proposed); purple=Bora Ck; cyan=tributary streams; brown=Ulan Ck (primarily UCML discharge waters); light blue=rainfall; Black=mine water dams; olive=open cut pits; orange=underground sump (these latter results are all mean levels). The vectors (variables) show increasing levels in the direction of the lines[18].

In reviewing the West Cliff mine discharge, OEH (2012) identified:

- High bicarbonate concentrations can be toxic to aquatic life
- Narrow gap between no bicarbonate toxicity and high bicarbonate toxicity
- Long-term (chronic) exposure to lower concentrations lead to toxic effects

OEH (2012) calculated trigger values for bicarbonate as:

- 95 % species protection level = 225 mg/L HCO_3^-
- 90 % species protection level = 261 mg/L HCO_3^-
- 80 % species protection level = 319 mg/L HCO_3^-

These numbers need to be divided by 1.22 to arrive at equivalent values for bicarbonate alkalinity (as $CaCO_3$) – the units commonly used for reporting bicarbonate values. It is clear from the available data (RGS 2018 Table 2) that bicarbonate levels in the dams and storages are approaching and at times exceeding the OEH (2012) derived bicarbonate trigger values for 95 % species protection.

Further analysis in this area is clearly required and it is recommended that ecotoxicity testing is undertaken on discharge waters to ascertain whether they are or are not toxic to aquatic life, prior to any disposal into surface waters. If the mine expansion is approved, it is recommended that a condition of consent specifies that the discharge is not to be toxic to aquatic biota.

[18] For example, indicating particularly high sulfate levels for OC1, 21010169 and Ulan Ck at LDP19 compared to other sites.

The RTS also states:

> *MPR (2017) assessed the potential impacts of the Modification on Aquatic Ecology, including consideration of any observed impacts of the historic discharges from the Ulan Mine Complex. MPR (2017) found no significant adverse impacts to aquatic ecology have been observed over the period 2004 to 2017 due to licensed discharges from the Ulan Mine Complex. Based on the above, MPR (2017) concluded that the proposed discharge of 20 ML/day at 900 µS/cm as sought by the Modification application would have negligible impacts on aquatic ecology habitat.*
>
> *MCO concurs with EPA's observation that there is limited potential for a mixing zone due to the location of the Moolarben Coal Complex in the upper reaches of the Goulburn River. On this basis, MCO will manage metals concentrations at the point of discharge to ANZECC Guideline limits (default and site specific), as outlined in Response 8.*

The issue of discharges approaching the 90th percentile of flows in the Upper Goulburn River based on DLWC gauging data has already been raised above. It is highly unlikely that the aquatic fauna would not respond to such changes and this is supported by IESC advice (IESC 2017).

The analysis undertaken by MPR (2017) did not include a comparison of community structure, nor was there any specific upstream/downstream hypothesis testing of community structure to support their conclusions. If the 2015 and 2016 aquatic monitoring reports (Ecological 2017, Biodiversity Monitoring Services 2015) are considered then it can be seen that:

- Sampling in 2015 & 2016 was undertaken by different organisations
- Some of the sites sampled in 2015 were not sampled in 2016 (in particular, the upstream Goulburn River site AQ1 - Goulburn River at Ulan township)
- There was no upstream/downstream discharge site community structure analysis undertaken
- The power of the design to detect any such difference is low
- On the limited data assessed (2015 and 2016 family-level community data), there appears to be statistically significant differences[19] between Goulburn River upstream discharge sites and Goulburn River downstream discharge sites in terms of community structure.

These results in combination with the proposed high flow rates clearly challenge the conclusions that:

no significant adverse impacts to aquatic ecology have been observed over the period 2004 to 2017; or
the proposed discharge of 20 ML/day at 900 µS/cm as sought by the Modification application would have negligible impacts on aquatic ecology habitat.

Further sampling in this area is clearly required and it is recommended that ecotoxicity testing is undertaken on (potential) discharge waters to ascertain whether they are or are not toxic to aquatic life, prior to any disposal into surface waters. If the mine expansion is approved, it is recommended that a condition of consent specifies that the discharge is not to be toxic to aquatic biota.

---

[19] Using ANOSIM on a similarity matrix calculated using the Bray Curtis metric and presence-absence data (see Clarke and Gorley 2006)

The lack of an adequate cumulative impact assessment for the Moolarben Coal expansion

As identified above the EA and RTS do not consider the cumulative impact of MCO operations on flow, salt load, contaminants or aquatic community structure.

RTS Response 16 States:

> *A cumulative assessment of the proposed discharges was undertaken by both Advisian (2017) and MPR (2017). Discharges from the Ulan Mine Complex were considered cumulatively with the proposed 20 ML/day releases for the Modification (in addition to background flow conditions) on surface water flows/quality and aquatic ecology.*
>
> *Advisian (2017) modelled and assessed the proposed licensed discharges of 20 ML/day cumulatively with the potential discharges from the Ulan Mine Complex (i.e. the 'high flow' scenario was developed based on data that included discharges from the Ulan Mine Complex at up to 30 ML/day) and concluded there would be negligible adverse change in downstream pH levels, EC or TSS concentrations (i.e. when compared to historic water quality and/or ANZECC Guideline trigger levels).*

In response to these statements it is noted that the MCO analysis of cumulative impacts did not consider:

- The combined salt loads from both the UMCL and MCL discharges potentially being approximately 35 times background loads for the Upper Goulburn River.
- At 20ML/day the MCO discharge will be greater than the 90th percentile of flows in the Upper Goulburn River based on DLWC gauging data[20].
- At 10ML/day the MCO discharge would be equivalent to approximately the 85th percentile of flows in the Upper Goulburn River based on DLWC gauging data
- Any discharge from MCO will be in addition to discharges by UCML
- The cumulative release of ~30-40 ML/day (possibly higher) equates approximately to the 95th percentile of flows in this area based on DLWC gauging data.
- A detailed and scientifically rigorous[21] analysis of upstream and downstream water quality has not been undertaken.

Earlier advice to EPA (OEH 2017) identified major differences in pH and EC as a result of UCML discharges.

Over the period 2009-2016, median conductivity for the monitoring sites were:

- LDP6= 796 µS/cm;
- LDP19= 790 µS/cm;
- SW01= 569 µS/cm; and
- SW02= 776 µS/cm.

---

[20] Currently the longest and most consistent flow record for the Upper Goulburn River in this area. It is additionally noted that UCML discharges are often already greater than the 90th percentile of flows and any discharge will be additional to that released by UCML.

[21] Including objective statistical testing of null hypotheses of 'No difference between upstream discharge and downstream discharge Goulburn River water quality constituents'.

The median levels above were comparable to the levels recorded at the time of OEH/EPA visit on the 4 August 2017:

- LDP6= 790 µS/cm;
- LDP19= 780 µS/cm.

The distribution of EC levels measured at LDP6, LDP19,and SW02 clearly exceeded those at SW01 (see Figure 5). The median EC of the discharges and SW02[22] were approximately 200 µS/cm higher than that of the upstream site SW01.

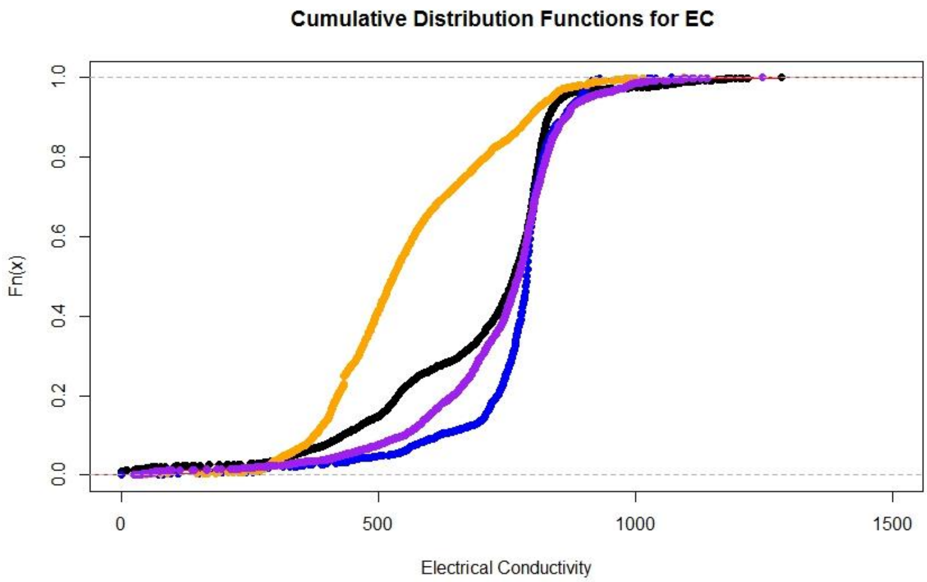


Figure 5. Electrical Conductivity concentration exceedance curve for SW01 (orange line), SW02 (purple line), LDP6 (black line) and LDP19 (blue line). Source: UCML AEMR 2008-2016 and monthly monitoring reports 2017.

There were also significant differences in the pH of waters released from LDP6 relative to upstream SW01 waters (see Figure 6). It is interesting though that the distribution of pH levels of the LDP19 discharge more closely approximates those of SW01 than does LDP6 or SW02. Over the period 2009-2016, median pH levels for the monitoring sites were:

- LDP6= 7.7;
- LDP19= 6.9;
- SW01= 7.3; and
- SW02= 8 µS/cm.

[22] This result for SW02 is not considered surprising when the water itself appears to primarily be mine discharge water.

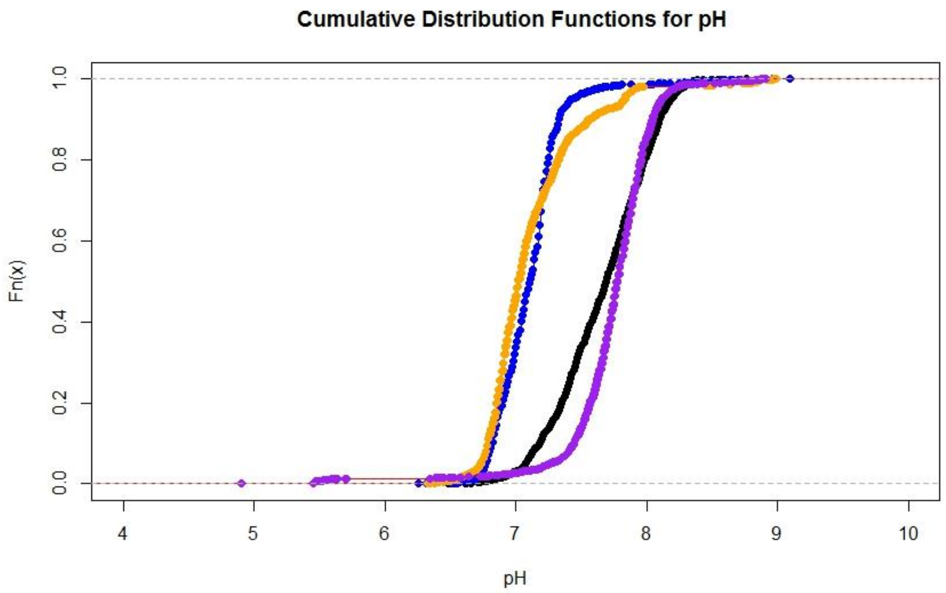


Figure 6. pH exceedance curve for SW01 (orange line), SW02 (purple line), LDP6 (black line) and LDP19 (blue line). Source: UCML AEMR 2008-2016 and monthly monitoring reports 2017.

Even earlier EC data (prior to the current UCML mining operations and discharges) were available from the NSW Office of Water database for Station 210046. Over the period 1968-1982 (n=50) the median conductivity recorded for Station 610046 was 432 µS/cm and the 80th percentile was 580 µS/cm.

The conclusion that *negligible adverse change in downstream pH levels, EC or TSS concentrations (i.e. when compared to historic water quality and/or ANZECC Guideline trigger levels)* is contradicted by such data analyses.

In addition, major geomorphic changes could occur in the river as the result of the combined (and potentially sustained) maximum flow rates of up to 40 ML/day (see also IESC 2017). These flow rates will potentially exceed the 95%ile of 'natural' flows in this area[23]. Sustained maximum flow rates of up to 40 ML/day will also likely have significant effects on aquatic communities in the Upper Goulburn River.

[23] Based on DLWC gauge data.

References

Advisian 2017. Controlled Water Release Impact Assessment for the Goulburn River. Moolarben Coal Operations Pty Ltd October 2017 Assignment No 26513 Moolarben Coal Complex Open Cut Optimisation Modification APPENDIX F

Biodiversity Monitoring Services 2015. Ecological Monitoring Program for Ulan Coal Mine 2015 Aquatic Fauna November 2015

Cañedo-Argüelles, M., C. P. Hawkins, B. J. Kefford, R. B. Schäfer, B. J. Dyack, S. Brucet, D. Buchwalter, J. Dunlop, O. Frör, J. Lazorchak, E. Coring, H. R. Fernandez, W. Goodfellow, A. L. González Achem,11 S. Hatfield-Dodds, B. K. Karimov, P. Mensah, J. R. Olson, C. Piscart, N. Prat,2 S. Ponsá, C.-J. Schulz, A. J. Timpano (2016). *Saving freshwater from salts* Ion-specific standards are needed to protect biodiversity. SCIENCE 26 February 2016, VOL 351 Issue 6276 914-916.

Clarke, K.L. and Gorley, R.N. (2006). Primer v6: User Manual/Tutorial. Primer-E Ltd.

Dundon, P.J. (2006) Moolarben Coal Mines Pty Limited Moolarben Coal Project Groundwater Assessment Peter J Dundon 8 September 2006 05-0158-R01j

Ecological 2017. Ulan Coal Mine - Aquatic Monitoring Spring 2016 Prepared for Ulan Coal Mines Limited February 2017

EPA (2013). Hunter Catchment Salinity Assessment Final Report State of NSW and Environment Protection Authority.

IESC (2017). Advice to decision maker on coal mining project IESC 2017-092: Moolarben Coal Project – Optimisation Modifications (EPBC 2017/7974) – Expansion

Moolarben Coal 2018. Moolarben Coal Complex Open Cut Optimisation Modification Response To Submissions Moolarben Coal Project Stage 1 Project Approval (05_0117) [Mod 14], Moolarben Coal Project Stage 2 Project Approval (08_0135) [Mod 3] May 2018 Project No. MCM-16-14 Document No. 00918376

NSW Office of Water (2009). PINNEENA Version 9.3. New South Wales Surface Water Data Archive 2009. ISSN 1449-6100.

OEH (2012). Chemical and Ecotoxicology Assessment of Discharge Waters from West Cliff Mine. Report to the NSW Environment Protection Authority August 2012. Office of Environment & heritage.

OEH 2017 Ulan Creek and Upper Goulburn River - Science Request. 18 October 2017

UCML (2005). Ulan Coal Mines Limited Annual Environmental Management Report For the period ending 18 November 2005.

UCML (2006). Ulan Coal Mines Limited Annual Environmental Management Report For the period ending 18 November 2006.

UCML (2008). Ulan Coal Mines Limited Annual Environmental Management Report 2007 / 2008 Reporting Period

UCML (2009). Ulan Coal Mines Limited Annual Environmental Management Report 2008/2009.

UCML (2011). Ulan Coal Mines Limited Annual Environmental Review 1st November 2010 – 31st December 2011

UCML (2016). Ulan Complex Report Annual Review 2016. Ulan Coal, Glencore.

WRM (2017). Moolarben Coal Complex Open Cut Optimisation Modification Site Water Balance and Surface Water Assessment 0926-21-F, 26 October 2017

Martin Krogh
Principal Scientist Major Assessments
Office of Environment and Heritage
4 June 2018