# Impact of the Mandalong Southern Extension EIS on surface water quality and aquatic ecosystems

9 December 2013. By Dr Ian A. Wright. Freshwater Scientist.

### Centennial Mandalong is currently causing water pollution

It is my professional opinion that the current coal mining operation (Centennial Mandalong) is currently polluting the surface waters of the Lake Macquarie catchment, according to Section 120 of the NSW *Protection of the Environment Operations* Act (1997). This is based on my assessment of water quality data provided in the Centennial Mandalong Environmental Data; the mine's waste water discharge licence (Environment Protection Licence 365) and the NSW *Protection of the Environment Operations Act* (1997). In addition this is supported by information provided in the Mandalong Southern Extension EIS and in particular in two sub-reports in Appendix P (Water Management Impact Assessment). These two reports in Appendix P are by GHD and are named 'Existing Water Quality Assessment Mandalong Mine Access Site Cooranbong Entry Site' and 'GHD Macroinvertebrate and Aquatic Ecology Report'.

The current mine operation is not meeting its EPA Environment Protection Licence (EPL) requirements. The only pollutants that are permitted to be discharged from the Colliery (according to EPL 365) are:

- Oil and Grease (10 milligrams per litre)
- pH (6.5-8.5 pH)
- Total Suspended Solids (50 milligrams per litre)

The mine discharge from the licenced discharge point generally meets the EPL discharge conditions for pH; Oil & Grease and TSS. The EPL licence for the mine (EPL 365) contains the following clause:

*'L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.'*

The self-reported data provided by 'Centennial Mandalong Environmental Monitoring Data' October 2013 includes data on a comprehensive suite of water quality attributes. Of most immediate concern is that the discharge from the mine to local waterways is highly saline. The self-reported data shows that the two samples reported their October 2013 report had electrical conductivity of 3820 and 4050 µS/cm.

The ANZECC (2000) *Water Quality Guidelines for Protection of Aquatic Ecosystems* (see table 3.3.2) provides guidelines for lowland rivers in south east Australia which include default trigger values of 125-2200 µS/cm, with associated text stating 'NSW coastal rivers are typically in the range 200–300 µS/cm'. This means the appropriate guideline for water salinity the Mandalong Southern Extension EIS is 300 µS/cm. The current mine discharge is 13.5 to 19.1 times higher than the guidelines. This indicates that the existing mine discharge has caused salinity pollution and this is in contravention of clause 'L2.3' of EPL 365.

The many metals reported in 'Centennial Mandalong Environmental Monitoring Data' also indicate that the mine is currently causing metal pollution, particularly for Nickel. Nickel concentrations of 59 to 61 µg/L are at levels higher than ANZECC (2000) guidelines ('Trigger Values of Toxicants' see Table 3.4.1). Other elevated metals of concern are Boron, Barium, Lithium, Molybdenum, and Zinc. Modification of stream geochemistry, according to 'Centennial Mandalong Environmental Monitoring Data' from the mine discharge to local surface waters indicate that highly elevated calcium, potassium, sulphur and sodium is another theme of water pollution.

It is evident that Centennial Mandalong is discharging mine wastewater into the local surface waters that includes pollutants at hazardous concentrations that may damage aquatic species (of most particular concern: Nickel and Salt).

My concern that the mine is currently polluting surface water quality, and that this is having strong adverse impacts on aquatic ecosystems, is also supported by information provided in the GHD report in Appendix P 'GHD Macroinvertebrate and Aquatic Ecology Report' and the GHD Report 'Existing Water Quality Assessment Mandalong Mine Access Site Cooranbong Entry Site.' These reports show that the pollutants salinity; zinc; nickel; and oxidised nitrogen are contaminating surface water and the metals (zinc and nickel) are also contaminating stream sediment at levels hazardous for ecosystems.

It is of great concern that none of these pollutants (salt, nickel, zinc and oxidised nitrogen) are permitted by the NSW EPA (as specified in Environment Protection Licence 365) to be discharged from the mine. It is recommended that a much more detailed assessment of water quality and stream ecosystems be conducted. I provide further detail in my conclusion about the need to conduct a more rigorous water quality and stream ecology study. Such a study is needed to specify discharge conditions for these pollutants (salt, nickel, zinc, oxidised nitrogen) that will achieve the aims of the Protection of the Environment Operations Act.

I strongly reject the continuation of the previous EPL 365 discharge conditions (based on oil & grease; pH and total suspended solids) for the proposed development. Effective minimisation of water pollution from the proposed development will require strict discharge conditions (based on ANZECC water quality guidelines) for salt, nickel, zinc and oxidised nitrogen in addition to the existing guidelines for oil & grease, pH and suspended solids.

Centennial Mandalong is currently not complying with its Environmental Protection Licence 365. It is polluting waters with pollutants not permitted under EPL 365 (Clause L 2.3).

**The Mandalong Mine Southern Extension Project provides inadequate data to enable a complete assessment of the proposed mine extension of the key issue of potential impacts on water resources**

In my opinion the extensive documentation provided as part of the EIS for the Mandalong Southern Extension EIS provides inadequate environmental and ecological data to enable a complete assessment of the future environmental impacts of the proposed development.

It is my expert opinion that this fails to satisfy the Director General's Environmental Assessment Requirements "SSD-5144" issued 20 March 2012. These assessment requirements include (under 'General Requirements' – see dot-point 4):

- detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes:
  a description of the existing environment, using sufficient baseline data;

The Director General's Environmental Assessment Requirements "SSD-5144" listed the following instructions under the 'key issues' with clear instructions that:
'*The EIS must address the following specific issues:*
*Water Resources - including: detailed assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including:*

- *detailed modelling of potential groundwater impacts; and*
- *impacts on riparian, ecological, geo-morphological and hydrological*

- *values of watercourses, including environmental flows;'*

**Impact of the proposal on surface water quality**

Further information on this issue is available in the GHD report in Appendix P 'Existing Water Quality Assessment Mandalong Mine Access Site Cooranbong Entry Site'.

This report offers inadequate data on existing water quality. For example, for 'upstream' water sampling sites 'SW008 and SW011' offer a relative rich data set for Salinity (Electrical Conductivity) of 57 and 60 observations. Salinity is a major issue for the current mine discharge (see 'Centennial Mandalong Environmental Monitoring Data' October 2013). However the EISA 'Appendix P' reports no Nickel data for the two sites 'SW008' and 'SW011'. Nickel is a key pollutant from this project, see Appendix P 'Macroinvertebrate and Aquatic Ecology Report, Cooranbong Entry Site' which highlights the water pollution and adverse ecological impact of salinity and nickel.

Nickel and zinc concentrations (presented in Appendix P Water Quality Assessment Mandalong Mine Access Site Cooranbong Entry Site') are often elevated at levels potentially toxic to aquatic ecosystems, but very limited historic data is presented to make a complete assessment of the changes in nickel and zinc (and other toxicants) due to the mine waste discharge.

The EIS uses an incorrect water quality guideline for salinity. It uses the default ANZECC (2000) for south eastern Australia lowland waterways of 2200 µS/cm. The detail of the relevant table in the ANZECC (2000) Table 3.3.2 has an explanatory note 'Low values are found in eastern highlands of Vic. (125 µScm-1) and higher values in western lowlands and northern plains of Vic (2200 µS/cm)'. As my report details previously, the ANZECC provides a very clear explanatory note that 300 µS/cm is the appropriate guideline for this area 'NSW coastal rivers are typically in the range 200–300 µS/cm'. In my opinion it is incorrect and misleading that the 2200 µS/cm value is used in this EIS. The implications of this is that the salinity pollution caused by the coal mine discharge, as described in the EIS and associated documents, is of a more damaging scale than the EIS describes.

**Impact of the current coal mine discharge (comparison of upstream sites 'SW13 and SW14') versus the sites below the mine discharge (LDP001 and SW16 and SW17)**

The following text contains my assessment of the impact of the mine on local surface waters (unnamed creek) from the data provided in 'Appendix B Existing Water Quality Assessment Mandalong Mine Access Site Cooranbong Entry Site'.

**pH**: The mine discharge is generally increasing water pH with pH downstream mildly to highly alkaline at LDP001, generally 7.5-9.0. This is much higher than upstream sites (SW16 and SW17) which had pH in the range 5.0 to 7.5.

**Salinity:** There was inadequate upstream salinity data presented from sites SW13, SW14 and SW15, with only data from July 2011 to early 2013. It was difficult to interpret the data from visual assessment of the figure 'B.2-3'; but electrical conductivity was mostly less than 500 µS/cm upstream of the project discharge site. In contrast, salinity downstream of the mine discharge was much higher.

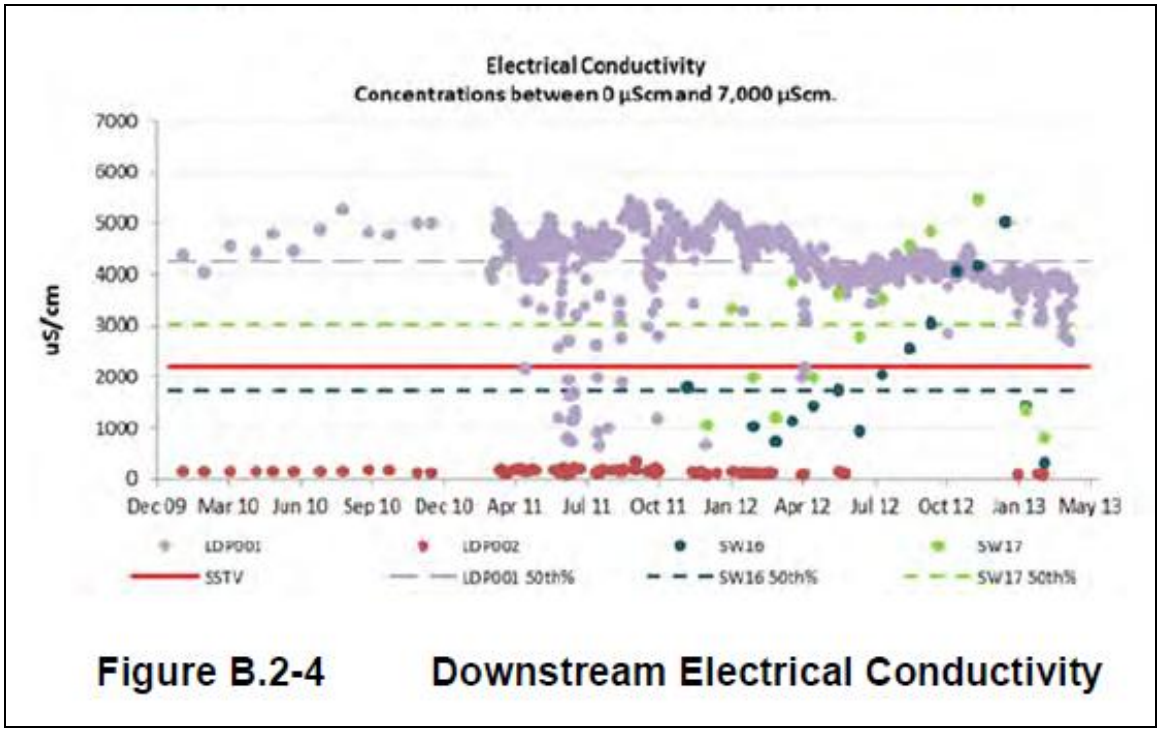


**Figure B.2-4 Downstream Electrical Conductivity**

Figure B.2-4 (from Appendix B) shows that a much more detailed dataset is available for sampling sites downstream of the mine discharge, with data from 2009 to early 2013 and very detailed regular observations from April 2011. This figure clearly shows that salinity levels are highly elevated below the mine and at site LDP001 are generally in the range 3000 to 5000 µS/cm. Such levels are indicative of saline pollution and are 10 to 16.6 times higher than the ANZECC (2000) trigger value for ecosystem protection. Although saline data collected upstream was inadequate, nonetheless the limited data was generally less than 500 µS/cm and demonstrates that the mine discharge is causing significant salinity pollution.

***Nickel:***

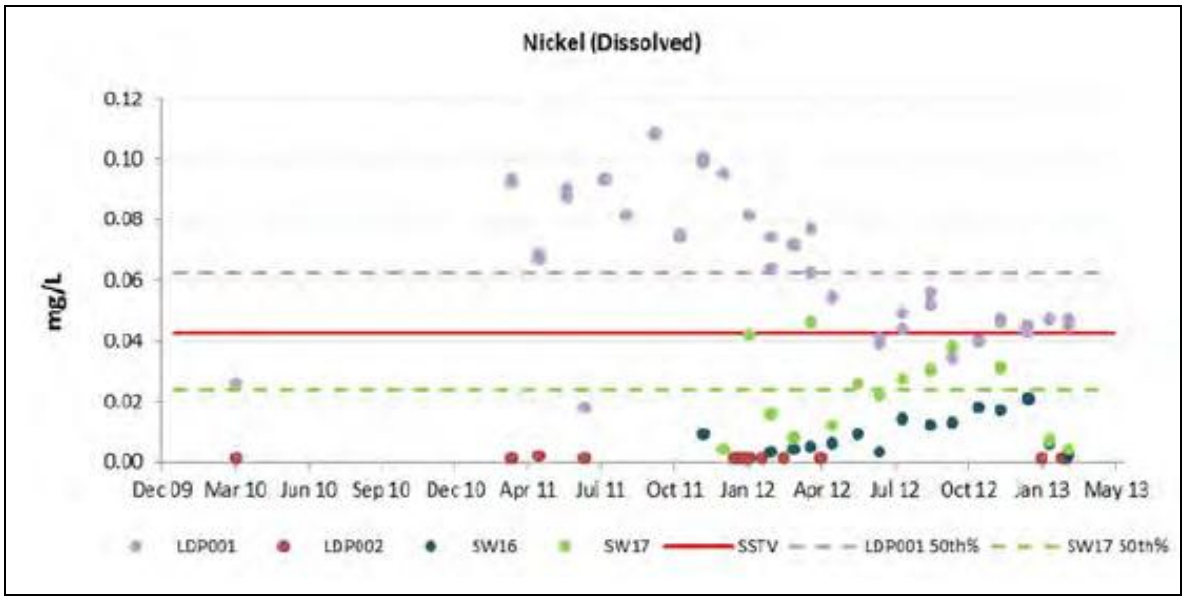


Figure B.2-27 (Nickel (Dissolved)) shows that downstream concentrations were highly elevated. Appendix B reports that nickel levels were below 0.04 mg/L. The mine discharge (LDP001) had nickel (dissolved) concentrations often higher than the 0.04 mg/L trigger value. This indicates that the mine is causing nickel pollution at levels hazardous to aquatic ecosystems. ANZECC guidelines suggest that nickel may be hazardous at levels of 0.008 to 0.017 mg/L. Hardness data is not provided to enable an

assessment of the appropriate ANZECC 'Hardness Corrected Nickel Trigger Value' for nickel levels and protection of aquatic ecosystems.

**Ecological impacts (macroinvertebrates)**

According to the GHD 'Macroinvertebrate and Aquatic Ecology Report – Cooranbong' the impact of the current mine discharge to aquatic ecosystems was assessed using a single collection of macroinvertebrates. A total of 6 sites were sampled with two of the sites selected as 'control' sites away from the mine discharge. Two sites represented the mine 'on-site impact' and one site 'downstream impact' and one site further downstream, also 'downstream impact'. The collection of freshwater macroinvertebrates was made on one occasion (24th and 25th July 2012). The methodology used followed AUSRIVAS methods and included family-level identification. The ANZECC (2000) water quality guidelines provide clear advice that AUSRIVAS is a method that has limitations for detecting and measuring ecological impacts. The data collected and reported in this EIS on macroinvertebrates is of poor quality and much more detailed data (based on spatially and temporally replicated data) is urgently required to enable a rigorous scientific assessment of the impact of the coal mine wastewater on aquatic ecosystems.

In my opinion this is an inadequate data set to make a complete scientific assessment of whether or not the mine discharging is causing any adverse impact to aquatic ecosystems. I have a number of concerns:

- For the scale of the impact and the task of detecting and measuring any impact a single round of samples is inadequate. Additional rounds of sampling (seasonal sampling would be appropriate).
- Collection of samples from mid-winter is questionable. As explained above, seasonal sampling should be repeated.
- The methods used are qualitative – for impact detection the relative abundance of invertebrates is very important. Multiple spatial quantitative samples should be collected at each sampling site on each occasion.
- The methods used do not involve replicated sampling. I would expect a pollution assessment study to have a rigorous spatial and temporal replicated sampling design.
- The methods used family-level assessment. Species-level would offer a more detailed assessment.
- In summary – the macroinvertebrate sampling was very coarse and offered very limited statistical 'power' to detect and describe any ecological impact.

The macroinvertebrate results yielded from this sampling did detect an ecological impact. The waterway is currently polluted and has degraded ecosystems yet this is based on an inadequate sampling program and poor quality data. It had very few sampling sites, did not conduct multiple repeated sampling. The MDS plot below shows that the 'impact site' appears to have a different assemblage of macroinvertebrates to control sites (and the single 'recovery' site. However the inadequate number of samples greatly limited the ability to test whether this was statistically significant. Further sampling of macroinvertebrates with a rigorous scientific design (including replicated spatial and temporal samples is required). I agree with the '5.0 Conclusion and Recommendation' sections of the GHD report 'Macroinvertebrate and Aquatic Ecology Report – Cooranbong' which also criticises the lack of spatial and temporal replication.

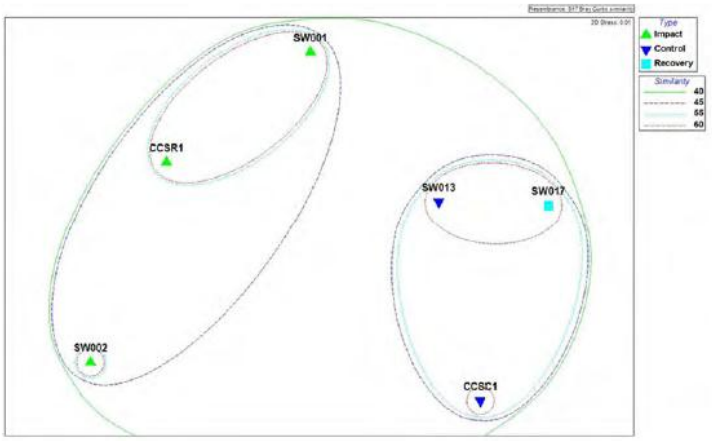


**Figure 3-12 MDS Plot of Macroinvertebrate Samples Displaying the Similarity of Sites Based on the Site Type**

The MDS plot (Figure 3-12) showed a grouping of 'impact' samples away from the control and 'recovery' site. This plot indicates a strong ecological impact – but the accompanying ANOSIM results reveal the inadequate statistical power (Table 3-4). From my experience the 'possible permutations' column should be in the thousands. This has influenced the statistical non-significance of the results, yet the 'R-Statistic' indicates a very different macroinvertebrate fauna is present in the impact compared to the control sites. See my previous comments in the text above the MDS plot for my recommendations on the urgent need for much more detailed macroinvertebrate data.

**Table 3-4 ANOSIM Results of In Situ and Laboratory Water Quality Variables Considering the Influence of Site Type**

| Groups (Site Types) | R Statistic | Significance Level % | Possible Permutations | Actual Permutations | Number >= Observed |
|---|---|---|---|---|---|
| Impact, Recovery | 1 | 25 | 4 | 4 | 1 |
| Impact, Control | 1 | 10 | 10 | 10 | 1 |
| Recovery, Control | 0 | 66.7 | 3 | 3 | 2 |

The text below (taken from the GHD report 'Macroinvertebrate and Aquatic Ecology Report – Cooranbong') provides clear support for my concerns that both water quality and aquatic ecosystems are adversely impact by the existing coal mine 'impact'. The authors conclude that contaminated water quality by salinity (they term this 'EC'); pH; oxidised nitrogen (they term this 'NOx') and dissolved nickel. They also mention zinc and nickel contaminated sediment, although they question the quality of the methods.

The following section of text is copied from the GHD Macroinvertebrate and Aquatic Ecology Report:

*'5. Conclusions and Recommendations*
*The limited nature of this study, in a low number of study sites and a lack of consideration for temporal and seasonal variation, may not have been sufficient to establish definitive causal relationships between water quality, aquatic ecosystem conditions and macroinvertebrate communities at this stage. However the following general statements can be made to summarise the aquatic assessment:*
 *Water quality at the impact sites was considered to be different to the control sites and parameters which were outside the ANZECC & ARMCANZ (2000) trigger values at impact sites (primarily EC, pH, NOx and dissolved nickel) were generally inside the triggers at control and recovery sites.*

*Although this did not seem to influence the presence of the known sensitive macroinvertebrate taxa, it was shown to be a likely cause of variation in the macroinvertebrate community composition at the impact sites. Further assessment of the toxicity of the discharge water is provided in GHD (2013).*
 *Sediment analysis reported some elevated total metal concentrations at the impact sites (primarily nickel and zinc), although the bioavailability of these metals is unclear based on the sampling that has been undertaken.*
 *Aquatic habitat across the study area was considered to be in a slightly to moderately modified condition and although there were some differences between impact and control, it was unclear the level of influence these variations may have on macroinvertebrate community composition.*
*Consideration could be given to improving overall ecosystem health of the discharge receiving aquatic habitat by:*
*– Removal and management of riparian weeds including Lantana.*
*– Improvement of flow through the systems in the aim of reducing sedimentation and sediment anoxia.'*

**My conclusions:**

The EIS documentation provides grossly inadequate data for an operation of this scale. However, the information is sufficient to show that the current mining operation is causing serious levels of water pollution and it currently fails to comply with its NSW EPA 'Environmental Protection Licence' (# 365). The current operation contaminates surface waters with salinity; elevated pH; nitrogen; zinc; nickel and a large number of other water attributes. The current operation also causes degradation to surface water ecosystems according to the macroinvertebrate data supplied by the GHD report. The EIS details the proposed increased in waste water discharges and this will probably cause a resulting increase in water pollution and degradation of aquatic ecosystems.

These issues are very serious and demand an urgent response.

I repeat my concerns that the information on surface water chemistry and ecology is inadequate. In my opinion it fails to meet the Director General's Requirements (DGR's) for the EIS. The Director General's Environmental Assessment Requirements "SSD-5144" issued 20 March 2012. These assessment requirements include (under 'General Requirements' – see dot-point 4):

- detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes:
  a description of the existing environment, using sufficient baseline data;

In particular, a single mid-winter round of macroinvertebrate sampling of stream macroinvertebrates, lacking spatial or temporal replication (with resulting very low statistical power) epitomises the inadequacies of 'baseline data' provided for this EIS. In my profession of water science such data would be unpublishable. If data of this standard was submitted to a quality scientific journal in this field, it is my opinion that it would be rejected. For such an important development it is my expectation that the data collected should meet all DGR's and be of publishable quality in professional industry journals.

I recommend that further macroinvertebrate and water chemistry sampling be conducted of a standard that is scientifically rigorous and would be of publishable quality. Water pollution and ecological damage from the existing coal mine is a major issue and it is not possible to form a strong conclusion about the impact of the existing coal mine, let alone make an assessment of future impacts in the absence of 'sufficient baseline data' for this key issue. In my opinion the macroinvertebrate and water chemistry survey needs to include more sampling sites and be repeated on several occasions. At each site replicated quantitative species-level macroinvertebrate data needs to be collected. The study should include multiple clean reference sampling sites (for invertebrates and water chemistry) located in naturally vegetated local catchments to provide a detailed set of 'reference' data to compare with the

coal mine affected sites, particularly the sites below the waste water discharge. This sampling needs to include all metals and other water quality attributes that are also reported in the other GHD report in Appendix P (‘Existing Water Quality Assessment Mandalong Mine Access Site Cooranbong Entry Site.’) and also conduct further assessment of sediment chemistry (as ‘Macroinvertebrate and Aquatic Ecology Report – Cooranbong’).