Department of Planning & Infrastructure

# Cobbora Coal Project

## Review of Surface Water Issues

October 2013

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# Summary

This report provides an assessment of the surface water aspects of the proposed Cobbora Coal Project and provides recommendations for conditions of approval relating to surface water management.

As its name indicates, the *Response to Recommendations of the Planning Assessment Commission Review Incorporating a Revised Preferred Project Report* (August 2013) (subsequently referred to simply as the '*Revised PPR*') documents a number of changes to the proposed mine plan that were made in response to a review by the Planning Assessment Commission. The main revisions relating to water management in general, and surface water in particular, include:

- Revised mine layout which would reduce the mine area from 4,130 ha to 3,765 ha, reduced length of haul roads and relocation of the mine infrastructure area;
- Changes to the mine staging so as to have a maximum of two active pits;
- Use of de-watering bores to extract the majority of groundwater before it enters the pits;
- Confirmation that tailings will be disposed of as a slurry to a single out-of-pit emplacement and three in-pit emplacements;
- Reduction of the final void from 143 ha to 118 ha, within a contributing catchment of 301 ha.

Whilst the *Revised PPR* provides new analysis in relation to tailings management, much of the surface water assessment, including the site water balance, relies on comparison between the areas of different mine land uses for the original mine plan (as documented in the *Preferred Project Report*, January 2013) (subsequently referred to simply as the '*PPR*') and the revised mine plan. Accordingly, the assessment provided in this report draws on the analysis or assessment provided in both the *Preferred Project Report* and any updated analysis in the *Revised PPR*.

The revised mine plan, as documented in the *Revised PPR*, provides an adequate general response to the PAC recommendations in relation to the reduced mine impact area and measures to reduce the water requirements. However, the revised mine plan lacks sufficient detail to adequately justify the claimed water savings.

## Tailings Disposal

The proposal to dispose of fine tailings as a slurry is a key aspect of the mine water balance analysis and the requirement for water sourced from the Cudgegong River. The *Revised PPR* provides details of additional characterisation of the proportion of fine tailings likely to be produced and further assessment of the thickener characteristics. These form the basis for a re-assessment of the options for disposal of tailings. The analysis indicates that the capital and operating costs of all options are a minor fraction of the overall cost of the project. The cost data presented in the *Revised PPR* has been analysed further and shows that the cost of pumping water from the Cudgegong River are of the same order of magnitude as the cost of greenhouse gas offsets associated with the energy requirements for other options. In weighing these two factors, a scheme that uses more water (a renewable resource) is probably more justifiable than a scheme that further contributes the greenhouse gas accumulation in the atmosphere. The analysis presented in the *Revised PPR* also demonstrates that slurry disposal is superior in terms of lowest NPV and least technical risk. Notwithstanding, CHC has committed to:

> *"CHC will monitor the development of dewatering technologies including undertaking testwork and piloting if a technology appears to be environmentally and economically*

*promising. As a minimum, a feasibility study will be undertaken to determine the preferred dewatering option before in pit tailings placement is required."*

The *Revised PPR* provides amended details of the proposed method of storage of tailings that would involve a single out-of-pit storage (to be used for the first few years) and three in pit storages. All the tailings storages would eventually be incorporated into the overburden emplacements.

### Mine Water Balance

Appendix E of the *Revised PPR* provides a comparison of the composition of the various land use elements within the mine footprint (mine pit, active overburden placement, etc.) and a re-assessment of the mine water demand for Mine Years 1, 4, 12, 16 and 20. The report concludes that:

> *"The tables indicate that the Project water demand for the May 2013 mine plan has significantly reduced for peak operational years when compared to the December 2012 mine plan."*

However, further water balance analysis undertaken for this report (based on data taken from the *PPR* and the *Revised PPR*) indicates that, because water demand for tailings disposal in Mine Year 8 (not included in the water balance analysis in the *PPR*) is predicted to be about 25% greater than the maximum assumed in the *PPR*, the maximum water demands for the revised mine plan are likely to be comparable to those predicted in the *PPR*. Notwithstanding, this and a number of apparent discrepancies in the water balance analysis are not sufficiently significant to indicate that the mine would have difficulty operating with water sourced from de-watering bores, surface runoff and water 'imported' from the Cudgegong River within the limits of CHC's high security water access licence entitlements of 3,311 ML/year.

### Groundwater 'Make'

The *Revised PPR* outlines the proposal to use de-watering bores rather than relying on collection of seepage into the mine pits and presents comparisons between the original and revised mine layout to justify the assertion that the overall volume of groundwater extracted would be less that that documented in the *PPR*. Further analysis of the data provided in the *Revised PPR* and the groundwater consultants indicates that from the perspective of the contribution of groundwater to the overall mine water balance, the available data supports the proponent's contention that:

> *"Any increase is likely to occur in the early stages of the project, and as the project progresses the volumes are likely to be similar to those that have already been modelled. Therefore, impacts will be similar to those already predicted."*

### Mine Water Storages

Potential impacts of the mine on the local rivers and creeks include:

- Potential for discharge of mine water into the local creeks. This could be from several sources including the out-of-pit tailings dam, mine water storages and sediment dams that capture runoff from overburden emplacements;
- Reduced flow in the creeks attributable to the catchment area 'lost' as a result of the area reporting to the mine water dams;

- Lowering of the groundwater leading to reduced groundwater baseflow into the creeks and reduced groundwater that is inferred to be an important contributor to maintaining a number of semi-permanent pools.

Accidental discharge from mine water dams or the out-of-pit tailings emplacement is an important environmental risk associated with the mine water management system. The design and operation of the various water storages are key factors in managing and mitigating these risks. For the tailings dam, the design considerations set out in Appendix C of the *Revised PPR* primarily focus on the requirements for the structural safety of the dam as set down in various guidelines issued by the NSW Dam Safety Committee (primarily relating to a 72 hour 'design' storm). However, the requirement for containment of decant water in the event of longer duration storms, the required capacity of the pump transfer system and the risk pump failure have not been adequately analysed.

Provided an appropriate Site Water Management Plan is prepared to ensure adherence to the principles for maintaining separation of different quality water, it is considered that the water quality impacts of the Project can be adequately managed. The Plan should include protocols for the monitoring water quality of water in the sediment dams prior to discharge.

## Impacts on Rivers and Creeks

The loss of flow in the local creeks as a result of a reduction in the contributing catchment area has been assessed in Appendix D of the Revised PPR. The analysis shows that, as a result of the anticipated increase in runoff from emplaced overburden (and after taking account of overburden runoff transferred to the mine water management system) the mine would actually lead to an increase in flow in the local creeks in all except dry years (as represented by the 10$^{th}$ percentile dry year).

The Sandy Creek is an ephemeral stream and processes that provide baseflow and sustain semi-permanent refuge pools in Sandy Creek and Laheys Creek are not well understood. The analysis presented in the *PPR* and *Revised PPR* does not clearly distinguish between localised baseflow contribution from the alluvium immediately adjacent to the creek following a high flow event and the baseflow from the regional groundwater system (which is implied in the analysis of the semi-permanent pools). Groundwater modelling for the project area has been undertaken for scenarios that represent two extremes:

- Permanent availability of water in the creeks to recharge the alluvial groundwater system;
- No groundwater recharge from creeks.

In practice, the available flow records show that there is some flow in Sandy Creek for about 50% of the time. Appendix D of the *Revised PPR* provides an analysis that reflects the ephemeral nature of the Sandy Creek by applying a seepage loss factor to the modelled annual groundwater contribution to streamflow, based on the proportion of time the stream was assumed to flow. This analysis included taking account of the effect of changes in catchment area and runoff from the overburden dumps (as described above) and considered three scenarios for groundwater losses that assumed flow in the creek occurred 100%, 60% or 20% of the time. For the 60% scenario (the closest approximation to the recorded flow), the analysis for years of full mine activity indicated that the annual flows in Sandy Creek would reduce by between 1% and 11% in a median year and by 42% to 54% in a 10$^{th}$ percentile dry year. The analysis also indicated that flows would increase by 4% in a 90$^{th}$ percentile wet year, presumably as a result of the increased runoff from overburden offsetting any increased groundwater loss.

Whilst the percentage flow reduction in a 10$^{th}$ percentile dry year may appear significant, the natural flow in such years is less than 30% of the flow in a median year. There are therefore likely to be extended periods (perhaps as much as 90% of the time) when there is no significant flow although no analysis has been undertaken to demonstrate this.

Given that the majority of the modelled groundwater river loss occurs in the Sandy Creek system, and this system provides minimal baseflow to the Talbragar River, the *Revised PPR* correctly concludes that the predicted flow impacts on the Talbragar River and Macquarie River are likely to be relatively minor.

## Final Landform

The *PPR* and *Revised PPR* provide no contour details for the final landform and do not indicate the layout of the associated surface drainage systems and their connection with the natural existing creeks.

In order to ensure that drainage is adequately considered the Site Water Management Plan should provide concept design details of the location of all surface drainage lines, including location, indicative cross sections, design flows, design velocities and any proposed scour protection.

## Final Void

The *Revised PPR* indicates that the revised mine plan has a final void area of 118 ha, compared to 147 ha in the PPR. However, while the void itself has been reduced, the contributing catchment remains the same (301 ha).

The *Revised PPR* contains a water and salt balance analysis based on multiple sequences of a modelled 1,000 year daily climate sequence. The analysis indicates that the void lake is expected to reach a median equilibrium level of about 372.5 m AHD after about 100 years after which the lake level can be expected to vary between 268 m AHD and a maximum of 278 m AHD depending on the short term climate. Importantly, the analysis indicates that:

- The void lake will continue to be a sink for regional groundwater;
- The maximum lake level would be approximately 6 m below the spill level;
- The void volume above the maximum water level would be approximately 4,200 ML

The *Revised PPR* indicates that, because the void lake would continue to be a sink for regional groundwater, the salinity would continue to progressively a peak of 150,000 mg/L after 100 years and is likely to continue to increase thereafter.

However, the analysis presented in the *PPR* and *Revised PPR* does not adequately account for the reduction in evaporation with increased salinity and does not address climate change effects. In particular, as an increase in salt concentration will result an exponential decrease in the evaporation rate, the long term predicted equilibrium lake level could be higher than determined from the existing analysis.

As part of the Site Water Management Plan, the sensitivity of the final lake level should be re-assessed to take account of salinity and climate change effects. The reassessment should include confirmation that the lake will continue to act as a groundwater sink and that the void topography will provide an appropriate freeboard between the spill level and the maximum equilibrium lake level. The opportunity should also be taken to review the final landform with the objective of minimising the total catchment area reporting to the final void.

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# 1 Introduction

## 1.1 Background

This report provides an assessment of the surface water aspects of the proposed Cobbora Coal Project and provides recommendations for conditions of approval relating to surface water management.

The Project and the supporting documentation have undergone a number of revisions since the original mine plan that was documented in the *Environmental Assessment* (EA) (September 2012):

- *Preferred Project Report and Response to Submissions (February 2013) (referred to as the '**PPR**' for purposes of this report);*
- *Water Balance and Surface Water Management System – Addendum* (March 2013);
- *Response to Recommendations of the Planning Assessment Commission Review Incorporating a Revised Preferred Project Report* (August 2013) (referred to as the '***Revised PPR***' for purposes of this report).

The *Revised PPR* includes a number of appendices that are simply referred to as 'Appendix A', 'Appendix B', etc. in this report.

## 1.2 Cobbora Coal Project

The proposed Cobbora Coal Project (the 'Project') is being developed by the Cobbora Holding Company Pty Limited (CHC), which is owned by the State of NSW. The Project is intended to extract up to 20 million tonnes per year of run of mine coal (ROM) from which 12 million tonnes of product coal will be supplied by rail for domestic and export markets. It was originally proposed that the Project would be constructed and operated by the CHC. However, on 1 July 2013, the NSW Government announced that it would not be constructing or operating the Project but that it will be leased or sold.

The Cobbora Coal Project as described in the *Revised PPR* would involve open-cut mining from three pits, a maximum of two of which would be operating at any time, within an overall disturbance area of 3,765 ha located within an area of 32,538 ha owned by the CHC. The mine would be serviced by a 28 km rail spur from the Dunedoo-Gulgong rail line and a 26 km pipeline from the Cudgegong River.

Figure 1.1 shows the location of the Project Application Area (including the corridors for the rail spur and pipeline) in relation to the main river systems in the Macquarie Valley. The mine itself would be located in the lower reaches of Sandy Creek and its major tributary Laheys Creek. The confluence of Sandy Creek with the Talbragar River is located about 2 km north of the Project Application Area as shown in greater detail in **Figure 1.2**. The Talbragar River is a tributary of the Macquarie River, which it joins approximately 6 km north of Dubbo.

In addition to surface runoff and groundwater inflow to the mine pits, water for the Project would be supplied from the Cudgegong River by means of releases from Windamere Dam for transfer to the mine via the pipeline. As shown on **Figure 1.1**, the Cudgegong River drains into Burrendong Dam which is operated in conjunction with Windamere Dam to provide regulated flow in the Cudgegong and Macquarie River systems.

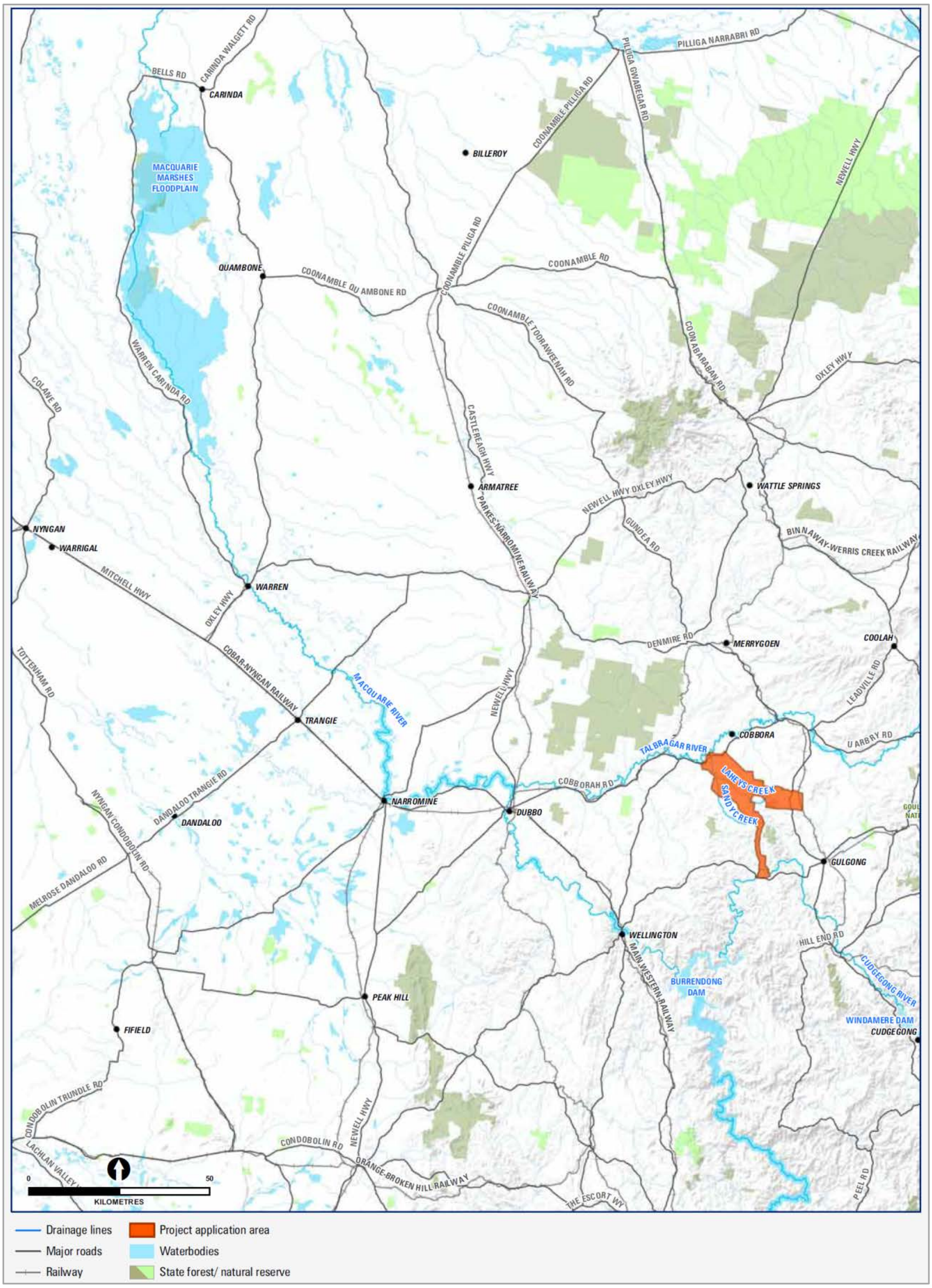


**Figure 1.1:**
**Location of Cobbora Project Application Area in Relation to Rivers, Roads and Towns**

(Source: *Surface Water Assessment*, (Appendix F to the *Preferred Project Report*), Figure 3-1)

As shown on **Figure 1.2**, Sandy Creek runs from south to north along the western side of the mine area. Laheys Creek runs approximately from south-east to north-west between sections of the mine and joins Sandy Creek approximately 1.5 km north-west of Mining Area B. Blackheath Creek (not shown on **Figure 1.2**) is a tributary of Laheys Creek which runs in an east-west direction immediately to the north of the Coal Handling and Preparation Plant (CHPP) and joins Laheys Creek immediately west of the Main Infrastructure Area.

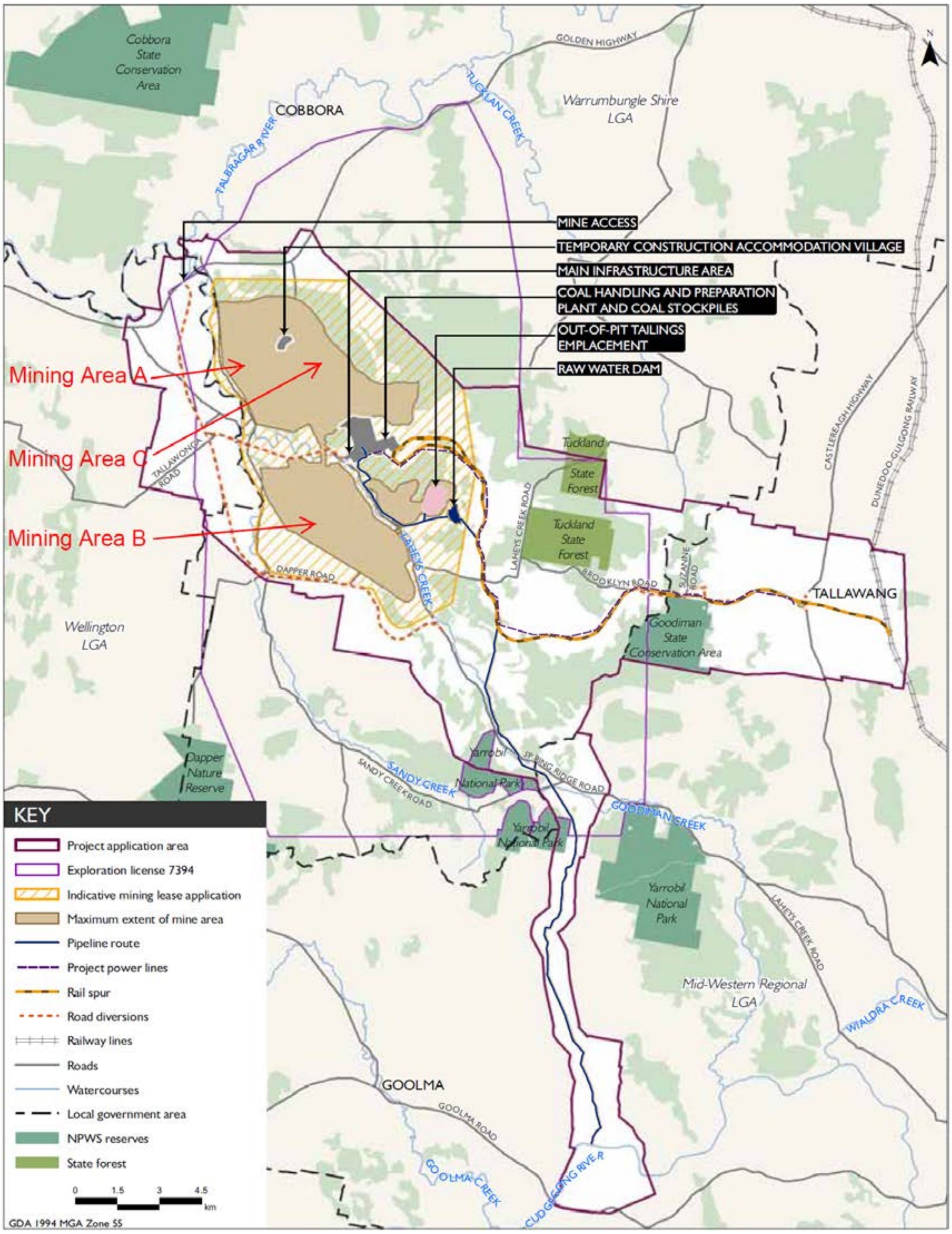


**Figure 1.2:**
**Layout and Key Features of the Proposed Cobbora Coal Project**

(Source: Based on *Figure 1.1 of the Revised PPR)*

## 1.3 Report Structure and Referencing

The progressive development of the details of the Cobbora Coal Project, the numerous topics that relate to surface water and the submissions provided by interested parties involve numerous cross references which are difficult to link in an orderly manner.

For purposes of this report, the adopted structure deals with individual technical topics and provides an assessment of the adequacy of the responses to matters raised in the Planning Assessment Commission (PAC) Review and key submissions related to each particular topic.

This report draws on a number of documents associated with the *PPR* and the *Revised PPR*. For simplicity the relevant appendices to the *Revised PPR*, as listed below, are referred to simply as Appendix A, etc.

Appendix A - *Revised mine plan technical and financial considerations*

Appendix B - *Tailings management review*

Appendix C - *Tailings storage facilities management plan*

Appendix D - *Response to PAC review of water modelling*

Appendix E - *Revised mine plan groundwater and surface water assessment*

Appendix F - *Revised mine plan mine rehabilitation strategy*

Sources of data from these appendices are referenced by the table or section number and the relevant appendix (eg Table 2.1 in Appendix A). To distinguish them from quoted sources, references to tables and figures in this review are differentiated by being in bold (eg **Table 2.1**).

# 2 Assessment

## 2.1 Project Overview and Proponent's Assessment Methodology

The *Revised PPR* presents revisions to the proposed Project, largely in response to issues raised by the PAC. The main revisions relating to water management in general, and surface water in particular, are:

- Changes to the mine layout which reduce the mine area from 4,130 ha to 3,765 ha;
- Reduction in the length of the haul roads requiring water for dust suppression;
- Relocation of the mine infrastructure area to a position adjacent to the CHPP;
- Changes to the mine staging so as to have a maximum of two active pits, leading to changes in the staging of rehabilitation as illustrated in **Figure 2.1**;
- Use of de-watering bores to extract the majority of groundwater before it enters the pit;
- Confirmation that tailings will be disposed of as a slurry (supported by further analysis of the water and energy requirements for alternative treatment and disposal methods);
- Tailings disposal to a single out-of-pit emplacement and three in-pit emplacements;
- Reduction of the final void from 143 ha to 118 ha, within a contributing catchment of 301 ha.

The surface water assessment presented in the *Revised PPR* is based on:

- Re-assessment of operational water requirements based primarily on:
  - Re-analysis of the CHPP efficiency and the proportion of fine material in the ROM feed, as set out in detail in Appendix B;
  - Re-assessment of haul road areas at each stage of mining based on the revised mine plan (no details of areas provided for comparison with the original mine plan);
- Re-assessment of the groundwater contribution to overall water budget based on the ratio between the pit surface area below the natural groundwater level for the revised mine plan compared to the original. (This analysis does not, however, take account of the proposed use of dewatering bores);
- Re-assessment of the changes in land use types as a result of the changed mine plan. These areas, which are generally less than the original mine plan, are used to justify the assessment that the water requirements for the revised mine plan will be less than the original mine plan;
- Re-analysis of the water and salt balance in the final void based on the revised void configuration.

Appendix D *Response to PAC Review of Water Modelling* provides explanation for apparent discrepancies in accounting for baseflow losses in the *PPR Surface Water Assessment* (January 2013).

Much of the assessment of surface water impacts contained in the *Revised PPR* is based on an interpretation of the analysis for the original mine as set out in the *PPR*. The interpretation is largely directed towards demonstrating that the revised mine plan will have less impact that the original mine plan. Accordingly, in the absence of specific assessment of particular aspects of the potential mine impact in the *Revised PPR*, the assessment in this report assumes that the impact predicted for the original mine plan in the *PPR* represents a likely upper limit of impact.

This review assumes that, in the absence of any insurmountable hurdles, project approval would be subject to a range of conditions including the requirement for the preparation of a Site Water Management Plan that would require approval by the Director General prior to project commencement.

## 2.2 Key Issues

From a surface water management perspective the key issues relating to the revised mine plan are:

- The potential impacts of the Project on the surface water systems (local creeks and the Talbragar River) in terms of:
  - Changes in groundwater baseflow that help to sustain ecosystem function, particularly riparian vegetation and pools;
  - Changes in overall surface water resources as a result of reduction in catchment area;
  - Changes in water quality as a result of reduced baseflow or discharge of 'polluted' surface water from the mine (eg sediment and salt from overburden runoff, runoff from 'dirty' mine areas such as the coal stockpiles, leakage or overflow from the out-of-pit tailings emplacement);
  - Salinity in Sandy Creek and Talbragar River;
- Water use efficiency and overall site water balance, particularly minimisation of the 'take' of water from the Cudgegong River;
- Impacts of the mine infrastructure (bridges, culverts, overburden, levees etc) on fluvial processes and flooding;
- Potential impact of the proposed final void.

## 2.3 Mine Layout

### 2.3.1 PAC Recommendations

The PAC recommended a number of revisions to the mine layout relating to surface water management. **Table 2.1** summarises the PAC recommendations and the corresponding revisions to the mine plan.

**Table 2.1: PAC Recommendations and Corresponding Revisions to the Mine Plan**

| PAC Recommendation | Revised Mine Plan |
|---|---|
| • Relocate B-OOPE waste rock emplacement (overburden dump) and tailings emplacement areas; | • Size of the B-OOP E waste rock emplacement reduced; |
| • Minimise the area exposed at each mine stage; | • Total impacted area reduced from 4,130 ha to 3,765 ha<br>• Reduced area of the land exposed at each stage of mining (see Figure 2.1);<br>• Reduced length of operational haul roads (and hence reduced water requirements for dust suppression);<br>• Reduced land area requirements for mine support infrastructure and CHPP. |
| • Reduce the number of simultaneously active mining areas; | • Simultaneous mining generally confined to two areas at any one time; |
| • Minimise intrusion of mining in areas A and C into the main remnant vegetation corridor (on the north eastern portion of the site); | • Reduced disturbance of remnant vegetation corridor north and north east of mining areas A and C; |
| • Minimise the extent of any final void. | • Final void confined to one location and reduced from 143 ha to 118 ha; |

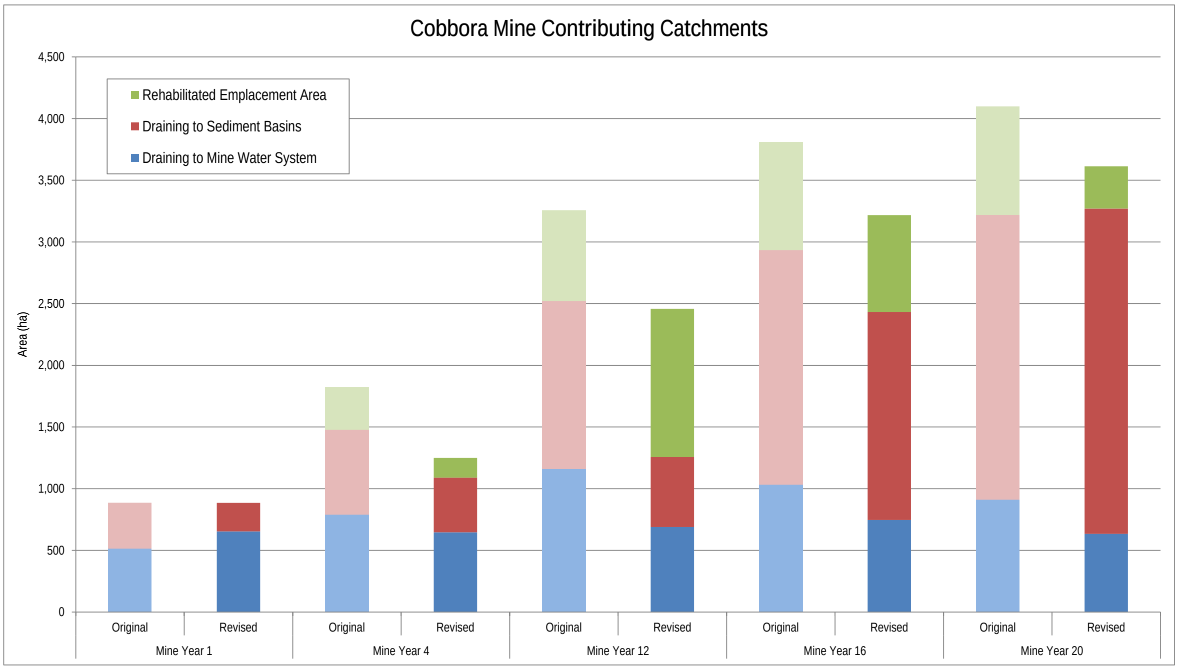


**Figure 2.1:**
**Comparison of Contributing Catchment Areas for Original and Revised Mine Plans**
(Source: *Tables 2 to 6 of Appendix E of the Revised PPR)*

### 2.3.2 Assessment

As shown in **Figure 2.1**, the revised mine plan (solid colours) provides a reduced area of the mine at all stages, with the final mine impacted area, including haul roads, reduced from 4,130 ha to 3,765 ha.

The revised mine plan also provides for a reduction in the area of the remnant void from 143 ha to 118 ha. However, the catchment area contributing to the remnant void is understood to remain the same (301 ha) as for the analysis provided in the *Water Balance and Water Management System – Addendum* (March 2013).

The revised mine plan provides an adequate general response to the PAC recommendations in relation to the reduced mine impact area. However, the revised mine plan lacks some details (eg comparison of haul road areas) to adequately justify the claimed water savings.

Apart from cross sections provided in Figure 3.13 in the *Revised PPR*, no elevation details are provided in any of the mine plans. It is therefore not possible to assess the overall impact of the revised mine plan on the surrounding environment, particularly the interactions between any drainage lines and catchments to be constructed within the final landform and the existing drainage systems. This issue is reviewed further in **Section 2.11**.

## 2.4 Tailings Treatment and Disposal

The PAC recommended that, unless the proponent demonstrates that an alternative tailings treatment method would satisfy best practice standards, tailings should be treated mechanically to minimise water requirements. Various aspects relating to tailings treatment, storage and associated water management issues are covered in the following Appendices to the *Revised PPR*:

- Appendix B - *Tailings management review*;

- Appendix C – *Tailings storage facilities management plan;*
- Appendix E – *Revised mine plan groundwater and surface water assessment.*

### 2.4.1 Proposed Treatment

Appendix B provides a detailed analysis and justification for conventional processing of fine tailings to produce a slurry for disposal to one of four locations:

- An out-of-pit emplacement located to the south-east of the infrastructure area, within an area that will subsequently be covered by the out-of pit overburden emplacement B-OOP E;
- Three in-pit emplacements (two in Mine Area A and one in Mine Area C).

Since the preparation of the *PPR* (on which the PAC Review was based), CHC has undertaken further testing of coal samples and assessment of thickener performance, which has led to the following revisions of the quantity of tailings to be disposed of and the volume of water required to convey tailings as a slurry:

- Average tailings over the life of the mine reduced from 5.5% to 4.5% of ROM (approximately 18% reduction in the mass of tailings);
- An increase in the density of the thickener underflow to 40% by mass compared to 30-35% assumed for the *PPR* (representing a saving of 20-35% of water required per tonne of tailings).

Based on these assumptions, the expected savings in water required for disposal of tailings would be in the order of 35-45% of the original estimate. However, Section 3.2.1 of Appendix B quotes the overall water requirement over the life of the mine as being reduced from 36.2 GL to 29.6 GL (a reduction of only 18%).

Appendix B provides an updated analysis of the relative merits of various technologies for the treatment of tailings. The analysis takes account of the revised mine plan and assessment of tailings quantities as outlined above and also provides a justification for the proposed tailings emplacement as meeting 'best practice standards'. The analysis and justification are based on consideration of the following factors which are assessed in terms of their overall ranking:

- Water savings;
- Greenhouse gas (GHG) production associated with the treatment process;
- Net present value (NPV) of the capital and operating costs;
- Technological risk.

For each factor, the assessment involved a simple ranking (1 – 6) for each factor and then cumulating the ranking scores to give the overall ranking score presented in Table 4.6 of Appendix B. Any scoring and ranking scheme involves an element of subjective judgement which, in this instance, assumed that each of the four factors should be given equal weight.

**Table 2.2** and **Table 2.3** have been derived from the data presented in Appendix B together with a number of additional assumptions or interpretations from the following sources:

- Average annual water use for tailings treatment is taken from Table 4.1;
- Average annual GHG derived from the life of mine data in Table 4.2;
- Pumping costs taken to be $390/ML at current prices based on the quoted data in Section 4.5.2;

- Carbon cost has conservatively been assumed at $10/t. (If current European costs prevail once the carbon price in Australia is allowed to float, the cost would be about $6.50/tonne);
- The net present value for water supply and the cost of carbon have been calculated assuming 7% discount rate for a time series of demands that follow the pattern of tailings production derived from the ROM tonnages in Table 2.1 of Appendix A and Table 7.1 of Appendix C.
- NPV of capital and operating costs is taken from Table 4.3;
- The levelised cost per tonne of coal is calculated assuming total production of 220 Mt over the life of the mine;
- The marginal levelised cost is the difference from the tailings emplacement (base case).

**Table 2.2: Features of Tailings Treatment Options**

| Treatment Option | Average Net Water Use (ML/year) | Average GHG (t $CO_2$-e/year) | NPV Pumping Cost ($M) | NPV Carbon Costs ($M) | NPV Capital and Operating ($M) | Product Coal Levelised Cost ($/t) | Marginal Additional Levelised Cost ($/t) |
|---|---|---|---|---|---|---|---|
| Tailings Emplacement | 1,151 | 2,400 | $0.50 | $0.27 | $116.30 | $0.53 | $0.00 |
| Secondary Flocculation | 995 | 2,657 | $0.43 | $0.29 | $121.60 | $0.55 | $0.02 |
| Belt Press Filter | 625 | 3,919 | $0.27 | $0.43 | $149.10 | $0.68 | $0.15 |
| Paste Thickener | 849 | 3,386 | $0.37 | $0.37 | $135.50 | $0.62 | $0.09 |
| Solid Bowl Centrifuge | 452 | 9,795 | $0.19 | $1.08 | $134.80 | $0.61 | $0.08 |
| Pressure Filter | 452 | 2,600 | $0.19 | $0.29 | $184.00 | $0.84 | $0.31 |

Key aspects of the data in **Table 2.2** are:

- The costs of water pumping from the Cudgegong River are of the same order of magnitude as the cost of greenhouse gas offsets. In weighing these two factors, a scheme that uses more water (a renewable resource) is probably more justifiable than a scheme that further contributes the greenhouse gas accumulation in the atmosphere;
- The NPV of the costs of pumping and accounting for GHG are trivial in comparison to the other capital and operating costs.
- The pit optimisation model results shown in Figure 2.1 of Appendix A indicate that the cost of production would be in the range of $40 to $60/tonne. Compared to these costs, the levelised cost of any of the tailings treatment options are trivial ($0.53-$0.84/tonne).
- Section 5 of Appendix B reviews the environmental assessments for the Watermark and Boggabri Coal Projects, both of which propose the use of mechanical dewatering. In support of the proposed use of slurry disposal at Cobbora, the proponent argues that:

  > *"The Boggabri coal resources are generally low ash, high volatile, high energy thermal coal with some seams exhibiting high volatile metallurgical coal characteristics. The Watermark coal is PCI or semi-soft coking coal with low ash 10% and secondary product with 18% ash. These coals would typically sell for 20% to 30% more than the Project coal at 24% to 26% ash. This allows more freedom to explore and implement alternatives to conventional tailings storage facilities."*

As the levelised costs of the treatment options are of the order of only 1% of the cost of production, the main justification for avoiding mechanical dewatering relates to the additional GHG emissions that would result from the electricity used in the process.

As noted above, any scoring and ranking scheme involves an element of subjective judgement. For purposes of assessing the sensitivity of the final ranking to the scoring method, **Table 2.3** presents an alternative ranking to that presented in Table 4.6 in Appendix B:

- The 'Unweighted Ranking' is taken from the last column of Table 4.6;
- The relative ranking is normalised to give a value of 1.0 for the tailings emplacement;
- The relative NPV of capital and operating costs is normalised to give a value of 1.0 for the tailings emplacement;
- The relative risk presents the normalised risk scores taken from Table 4.5 of Appendix B;
- The final column is the product of relative NPV multiplied by the relative risk.

**Table 2.3: Ranking and Scoring of Tailings Treatment Options**

| Treatment Option | Unweighted Ranking | Relative Ranking | Relative NPV | Relative Risk | Relative NPV x Risk |
|---|---|---|---|---|---|
| Tailings Emplacement | 9 | 1.00 | 1.00 | 1.00 | 1.00 |
| Secondary Flocculation | 12 | 1.33 | 1.05 | 1.07 | 1.12 |
| Paste Thickener | 15 | 1.67 | 1.17 | 1.13 | 1.32 |
| Belt Press Filter | 15 | 1.67 | 1.28 | 1.40 | 1.79 |
| Solid Bowl Centrifuge | 16 | 1.78 | 1.16 | 1.53 | 1.78 |
| Pressure Filter | 17 | 1.89 | 1.58 | 1.33 | 2.11 |

The treatment options in **Table 2.3** are listed in the order of the unweighted rankings in Table 4.6 of Appendix B. The alternative scoring presented in the final column of **Table 2.3** indicates a similar order except that the Solid Bowl Centrifuge scores marginally better (lower score) than the Belt Press Filter.

### 2.4.2 Water Requirements and Sources

Based on the revisions to the percentage of tailings, the improved efficiency of the thickener and the revised mine plan, **Figure 2.2** shows a comparison of the predicted annual water demand to convey tailings for disposal.

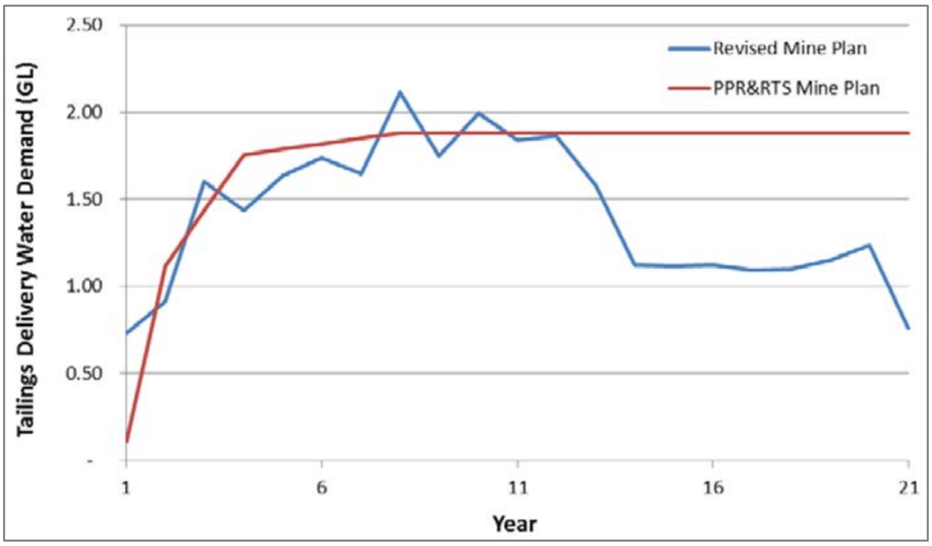


**Figure 2.2:**
**Comparison of Annual Water Requirements for Tailings Conveyance**
*(Source: Figure 3.1, Appendix B)*

**Table 2.4** summarises the components of the CHPP water balance as set out in Section 3.2.1 of Appendix B.

**Table 2.4: Components of Washery Water Balance**

| Washery Water Inputs | Washery Water Losses |
|---|---|
| Tailings return water | Coarse rejects water |
| Mine water | Product coal water |
| Raw water | Water to tailings |
| Inherent and free water in ROM feed | |

Appendix B also states (Section 3.2.1) that:

> *"An average of 42% of input water is lost to coarse rejects water and product coal water. These losses have been accounted for in the site water balance as net water quantities were used."*

The basis of this estimate is not provided, and it is not clear whether this proportion has been adjusted to reflect the reduction in water requirements for fine tailings disposal to account for reduced percentage of fine tailings and improved efficiency of the thickener. Assuming that the water 'lost' in coarse rejects and product coal is a relatively constant percentage of the mass of each, compared to the assessment provide in the *PPR* the proportion of the total water 'lost' to these sources could be expected to increase if the volume of water required for tailings disposal decreased.

**Table 2.5** provides an assessment of the overall water balance for the CHPP for a number of specific mine years, most of which are used for the water demand summary presented in Table 9 of Appendix E. The figures presented in **Table 2.5** have been derived as follows:

- Water to Tailings — From **Figure 2.2** (assumed to be all water that is not otherwise lost to coarse rejects water and product coal – i.e. 58% of the total CHPP input);
- Product Coal and Coarse Rejects — Assumed to represent 42% of CHPP input;
- Total Washery Water Demand — Sum of Water to Tailings (58%) and water lost in coarse rejects and product coal (42%);
- Tailings Return Water — Assumed to be 30% for years 1 and 4 and 15% for subsequent years (from Table 7 in Appendix E);
- CHPP Make-up Water (A) — Calculated from data listed above
- CHPP Make-up Water (B) — From Table 9 in Appendix E

**Table 2.5** indicates that there are some discrepancies in the estimates of the volume of CHPP make-up water derived from data presented in Appendix B compared to Appendix E:

- For Years 1 and 4 the estimates of make-up water are comparable;
- The water balance analysis in Appendix E (and previous reports) only examines mine Years 1, 4, 12, 16 and 20, on the basis that these are representative years. However, the analysis in **Figure 2.2** (reproduced in Column 2 of **Table 2.5**) indicates that Year 8 now represents a 'worst case' in terms of water requirements for tailings disposal (about 25% [638 ML] greater than the Year 12 estimate in Table 9 of Appendix E);

- For mine Years 12 to 20 estimates of the tailings return water from both sources are comparable, but the estimated CHPP make-up requirements differ by as much as 40% in Year 20.

**Table 2.5: CHPP Water Components**

| Mine Year | Water to Tailings (ML/year) | Product Coal and Coarse Rejects (ML/year) | Total CHPP Water Demand (ML/year) | Based on Figure 2.2 | | Appendix E, Table 9 | |
|---|---|---|---|---|---|---|---|
| | | | | Tailings Return Water (ML/year) | CHPP Make-up Water (ML/year) | Tailings Return Water (ML/year) | CHPP Make-up Water (ML/year) |
| 1 | 750 | 545 | 1,295 | 225 | 1,070 | 219 | 1,178 |
| 4 | 1,430 | 1,035 | 2,465 | 429 | 2,036 | 431 | 2,069 |
| 8 | 2,100 | 1,520 | 3,620 | 315 | 3,305 | | |
| 12 | 1,850 | 1,340 | 3,190 | 278 | 2,913 | 280 | 2,667 |
| 16 | 1,120 | 810 | 1,930 | 168 | 1,762 | 168 | 2,119 |
| 20 | 1,225 | 190 | 1,415 | 184 | 1,231 | 165 | 2,108 |

It appears that the water requirements and outputs for the CHPP have been calculated based on different assumptions in Appendix B compared to Appendix E, leading to apparent discrepancies. Without access to the detailed modelling results, the source of these discrepancies cannot be determined. A possible source of minor discrepancies could be in the estimates for the percentage of tailings water returned to the mine water system. Section 8.7 of Appendix C quotes recoverable water as 25-30% for the out-of-pit emplacement and 10-15% for the in-pit emplacements. The return flow estimates in Table 7 of Appendix E use the upper limits of these ranges. Notwithstanding, the apparent discrepancies identified above are not sufficiently significant to indicate that the mine would have difficulty operating with water sourced from de-watering bores, surface runoff and water 'imported' from the Cudgegong River (see **Section 2.4.4)**.

### 2.4.3 Tailings Disposal

The revised tailings disposal strategy is set out in Appendix C. The essential features of the revised proposal, compared to the *PPR*, are summarised in **Table 2.6**.

**Table 2.6: Comparison between Original and Revised Tailings Storage**

| Original | Revised |
|---|---|
| • Two out-of-pit emplacements – total capacity 14 $Mm^3$; | • Single out-of-pit emplacement – capacity 7.4 $Mm^3$; |
| • Six in-pit emplacements – total capacity 53 $Mm^3$ | • Three in-pit emplacements – total capacity 27.9 $Mm^3$ |
| • Total tailings storage capacity 67 $Mm^3$ | • Total tailings storage capacity 35.3 $Mm^3$ |

The differences between the total tailings storage capacity requirements are primarily attributable to the reduction in the proportion of tailings as a result of further characterisation of coal properties and the increased density of the tailings slurry (see **Section 2.4.1**).

Each of the proposed in-pit tailings emplacements have a notional capacity of 9.3 $Mm^3$ but could, presumably, be increased if required. A critical aspect of the proposed tailings disposal strategy is the use of the out-of-pit emplacement to take all tailings for the first four years. The schedule in Table 7.1 of Appendix C indicates that the first of the in-pit emplacements would be available to receive tailings at the beginning of Year 5, by which time the out-of-pit emplacement would be about 80% full. (To aid consolidation, the remaining 20% of capacity is proposed to be filled at a reduced rate over Years 5 and 6, at the same time as disposal of the remainder of the tailings to the first in-pit emplacement.)

Even if the volume of tailings generated in the early years exceeds the current estimates, the proposed filling schedule provides significant flexibility. In addition, the availability of some in-pit storage could, presumably, be brought forward if necessary.

The out-of-pit tailings emplacement is proposed to be located about 2 km south-east of the Mine Infrastructure Area in an area that would eventually be included in the out-of-pit emplacement to receive overburden from Area B. The design elevation of the embankment is 445 m AHD (Section 7.2 of Appendix C). Section 9.1 of Appendix C states that a minimum of 2 m of freeboard will be maintained in all tailings storage facilities. This indicates that the final tailings level would be 443 m AHD. Based on the rehabilitation details provided in Section 10 of Appendix C and the quoted maximum elevation of the out-of-pit overburden emplacement (450 m AHD), capping on the out-of-pit tailings emplacement would comprise:

- Low permeability capping of at least 1 m (finished level approximately 444 m AHD);
- Capillary break layer (minimum 1.2 m) comprising coarse overburden – notional 5.7 m thick (finished level 449.7 m AHD);
- Topsoil minimum 0.3 m thick (finished level approximately 450 m AHD).

### 2.4.4 Assessment

Following the PAC's *Review Report*, the proponent has undertaken a review of the mine plan as well as further testing of the coal samples to assess the proportion of fine tailings that would be generated by the washing process. In addition, the proponent has carried out further detailed assessment of the features of the various tailings treatment technologies including the density of the tailings slurry that could be produced from the thickener stage. These further investigations and assessments are documented in Appendix B. Further details of the proposed tailings emplacements are set out in Appendix C.

Notwithstanding the PAC's recommendation that tailings should be treated mechanically, the proponent's preferred option remains the use of conventional tailings disposal as a slurry. The proponent justifies the retention of slurry disposal on a number of grounds, principally:

- The further testing of coal samples has led to a significant reduction in the mass of tailings to be produced (from life of mine 5.5% tailings to 4.5%);
- Further assessment of thickener efficiency has led to a significant reduction in the water requirements per tonne of tailings (12-25%). In turn, this is claimed to reduce the risk of shortage of water during dry climate sequences;
- The reduction in tailings mass and water requirements has led to a significant reduction in the tailings storage capacity required (about 45%) and only requires a single out-of pit tailings emplacement (which would eventually be incorporated into an out-of-pit overburden emplacement);
- The trade-off between water use (for slurry disposal) and greenhouse gas emissions associated with the energy required for mechanical dewatering;
- The relative NPV of mechanical dewatering compared to conventional slurry disposal (16% - 53% higher);
- The higher technical and operational risks associated with mechanical dewatering.

The case put forward by the proponent is finely balanced:

- While the combination of reduced tailing fraction and greater thickening efficiency implies a reduction in water requirements of the order of 35-45%, the overall life of mine reduction is only 18%. A further consideration is that the revised mine plan actually leads to a more than 10% increase in water demand for coal processing in Year 8 compared to the original plan. However, any potential risk of water shortfall in Year 8 could be mitigated by ensuring that there was sufficient carry-over in storage at the beginning of the year;
- The costs of water pumping from the Cudgegong River are of the same order of magnitude as the cost of greenhouse gas offsets. In weighing these two factors, a scheme that uses more water (a renewable resource) is probably more justifiable that a scheme that further contributes the greenhouse gas load;
- The evidence put forward by the proponent indicates that the cost (expressed as NPV) and technical risk is biased towards the use of conventional slurry disposal.

Based on these considerations, the proponent has provided an adequate argument for the use of conventional slurry disposal in this instance. The analysis also justifies the proposal as representing an appropriate balance of environmental, economic and social factors.

The concluding paragraphs of Appendix B state:

> *"CHC is also committed to minimising and recycling water usage on-site, to limit the necessity to draw on licenced entitlements. This is further supported by the extraction strategy agreement with State Water Corporation which will maximise the amount of water taken from operational surplus flows rather than releases from Windamere Dam.*
>
> *As the mine develops, knowledge of the resource will increase, as will the understanding of the suitability of alternative tailings management technologies. CHC is committed to monitoring the development of dewatering technologies including undertaking testwork and piloting if a technology appears to be environmentally and economically promising. As a minimum before CHC begins planning for the move to in-pit tailings placement a feasibility study will be undertaken to determine the preferred dewatering option going forward."*

The commitments set out in these paragraphs are reflected in the commitments 16, 18, 19 and 23 in Table 16.1 of the *Revised PPR*.

Notwithstanding some apparent discrepancies in the water demand analysis, these are not sufficiently significant to indicate that the mine would have difficulty operating with water sourced from de-watering bores, surface runoff and water 'imported' from the Cudgegong River.

## 2.5 Site Water Balance

### 2.5.1 Water Requirements

As outlined in **Section 2.3**, the *Revised PPR* provides responses to the recommendations of the PAC's *Review Report* and provides for changes in the mine layout and staging as outlined in **Table 2.1** and **Figure 2.1**.

Tables 7 to 9 of Appendix E compare the following water demands for the original (December 2012) and revised (May 2013) mine plans for Years 1, 4, 12, 16 and 20:

- CHPP make up water requirements (losses to tailings, coarse rejects and product coal);
- Haul road dust suppression;

- Mine infrastructure area;
- Potable supply;
- Overall water demand.

**Table 2.7** summarises the average proportion of total water demand for different purposes for the original and revised mine plans (derived from Table 9 in Appendix E). The table shows that:

- In general, CHPP make-up water is almost double the requirement for dust suppression;
- The revised mine plan will require proportionately more water to be used for make-up for the CHPP.

**Table 2.7: Average Proportion of Water Demand for Different Purposes**

| Water Demand | Percentage of Total | |
|---|---|---|
| | Original Mine Plan | Revised Mine Plan |
| CHPP Make-up (ML/y) | 61% | 64% |
| Haul Road (ML/y) | 35% | 31% |
| MIA Demand (ML/y) | 4% | 4% |

In the context of the data in **Table 2.7,** the following statement in Appendix B (Page 3) requires clarification.

> *"As haul road dust suppression requires the most water, the demand for dust suppression water has been significantly reduced in the revised mine plan."*

#### 2.5.1.1 CHPP Make-up Requirements

As discussed in **Section 2.4.2**, the estimates of CHPP water make-up requirements are a function of a number of significant assumptions, particularly:

- The proportion of make-up water 'lost' in coarse rejects and product coal (assumed to be 42%. No comparative value is quoted for the original (December 2012) CHPP process);
- Fine tailings as a percentage of the mass of ROM (assumed to average 4.5% over the life of the mine compared to 5.5% for the original analysis (December 2012));
- The volume of water required to convey tailings (assumed to be 60% by mass compared to 65-70%);
- The percentage of water returned from deposited tailings (assumed to be 30% for out-of-pit emplacement and 15% for in-pit emplacement). As noted in **Section 2.4.2**, the estimates adopted in Table 7 of Appendix E are at the upper end of the range quoted in Section 8.7 of Appendix C.

The overall effect of these estimates is that there remains some uncertainty about the volume of make-up water required to operate the CHPP. Based on the analysis in **Table 2.5,** it appears that the peak demand for make-up for the CHPP under the revised mine plan would be of the order of 3,000 to 3,500 ML in Year 8. This compares with a maximum of 2,524 ML/year quoted in Tables 2.3 to 2.5 in the *Water Balance and Surface Water Management System - Addendum* (March 2013).

#### 2.5.1.2 Dust Suppression

The water requirements for dust suppression are largely a function of the area of active haul road at any particular stage of mining. However, the actual length of haul roads taken into account in deriving the estimates of dust suppression requirements are not clearly stated in the *PPR* or the *Revised PPR*. **Table 2.8** summarises the haul road lengths and area inferred from the following sources:

- Haul road lengths derived from:
  - Original mine plan: Figures 3.3 - 3.9 of the *PPR*;
  - Revised mine plan: Figures 3.1 - 3.7 of Appendix A to the *Revised PPR*.
- Haul road areas derived from areas of haul roads and infrastructure areas from Tables 2 – 6 of Appendix E minus the infrastructure areas shown on:
  - Figure 3.3 of the *PPR*;
  - Figure 3.2 of the *Revised PPR*.

While it is recognised that not all haul roads would be active on any particular day, the differences in haul road area do not appear to be consistent with the lengths of haul road apparent on the relevant figures.

**Table 2.8: Estimated Haul Road Lengths and Areas**

| Mine Year | Haul Road Length (km) | | Implied Haul Road Area (ha) | |
|---|---|---|---|---|
| | Original Mine Plan | Revised Mine Plan | Original Mine Plan | Revised Mine Plan |
| 1 | 14.3 | 8.7 | 28 | 60 |
| 4 | 20.9 | 13.4 | 87 | 83 |
| 8 | 25.0 | 13.5 | | |
| 12 | 27.4 | 13.6 | 123 | 81 |
| 16 | 37.4 | 11.4 | 164 | 81 |
| 20 | 37.8 | 12.7 | 129 | 81 |

**Table 2.9** summarises the quoted estimates of the dust suppression water demands for the original mine plan and the revised mine plan (from Table 7 of Appendix E) and the water demands expressed as:

- ML/year per kilometre of haul road;
- ML/ha of haul road.

The data in **Table 2.9** shows that the water usage per ha of haul road is reasonably consistent between the original and revised mine plan and infers that the haul roads shown for the revised mine plan would be used for a larger proportion of the time.

**Table 2.9: Estimated Haul Road Dust Suppression Water Demands**

| Mine Year | Haul Road Dust Suppression Demand (ML/year) | | Haul Road Dust Suppression Demand (ML/km/year) | | Haul Road Dust Suppression Demand (ML/ha/year) | |
|---|---|---|---|---|---|---|
| | Original Mine Plan | Revised Mine Plan | Original Mine Plan | Revised Mine Plan | Original Mine Plan | Revised Mine Plan |
| 1 | 376 | 761 | 26.3 | 87.0 | 13.4 | 12.7 |
| 4 | 968 | 907 | 46.3 | 67.6 | 11.1 | 10.9 |
| 12 | 1,651 | 1,098 | 60.2 | 80.6 | 13.4 | 13.6 |
| 16 | 1,603 | 1,053 | 42.8 | 92.5 | 9.8 | 13.0 |
| 20 | 1,371 | 1,290 | 36.3 | 101.5 | 10.6 | 15.9 |

Although Table 9 of Appendix E does not quote water requirements for Year 8, the haul road lengths derived from Figures 3.1 - 3.7 of Appendix A to the *Revised PPR* indicate that haul road water demands can be expected to be of the order of 1,000 ML/year.

#### 2.5.1.3 Net Evaporation from Water Storages

**Table 2.10** summarises data from Tables 2-3 to 2-5 of the *Water Balance and Water Management System – Addendum* (March 2013) for the evaporation losses (net of rainfall) from the various dams in the mine water management system. Although this data specifically refers to the original mine plan described in the *Environmental Assessment* and the *PPR*, the annual evaporation losses for the revised mine plan can be expected to be similar. (The significantly higher evaporation losses for a 90th percentile wet year are attributable to the mine water dams having significantly greater water surface as a result of the increased average volume).

**Table 2.10: Evaporation from Dams in the Water Management System**

| Mine Year | 10th Percentile Dry Year | 50th Percentile Median Year | 90th Percentile Wet Year |
|---|---|---|---|
| 1 | 334 | 81 | 238 |
| 4 | 498 | 217 | 130 |
| 12 | 601 | 272 | 1,178 |
| 16 | 543 | 257 | 984 |
| 20 | 496 | 236 | 440 |

These losses are not accounted for in the water demand summary presented in Table 9 of Appendix E.

#### 2.5.1.4 Other Water Uses

As indicated in **Table 2.7**, water requirements for CHPP make-up and haul road dust suppression comprise 95-96% of the total site water demands. The other water demands are expected to be relatively constant once the mine reaches full production:

- Mine infrastructure area 150 ML/year;
- Potable water supply 15 ML/year.

#### 2.5.1.5 Total Water Demand

**Table 2.11** summarises the revised mine water demand estimates as set out above (particularly **Table 2.5**). These estimates include Year 8, which has the highest estimated demand for water to pump tailings (see **Figure 2.2**) and which is not taken into account in Table 9 of Appendix E. The data in the final column of **Table 2.11** is the total estimated demand for the original mine plan taken from Table 9 of Appendix E.

The data in the second last column of **Table 2.11** shows that the increased water demand for tailings disposal in Year 8 might actually lead to a slight increase in the maximum demand for water compared to the original mine plan. This is contrary to the conclusion set out below Table 9 in Appendix E:

> *"The tables indicate that the Project water demand for the May 2013 mine plan has significantly reduced for peak operational years when compared to the December 2012 mine plan."*

**Table 2.11: Estimated Project Water Requirements**

| Mine Year | CHPP Make-up (ML/year) | Dust Suppression (ML/year) | MIA Demand (ML/year) | Potable Supply (ML/year) | Median Year Evaporation (ML/year)[1] | Total Demand (ML/year)[2] | |
|---|---|---|---|---|---|---|---|
| | | | | | | Revised (Updated) | Original |
| 1 | 1,070 | 761 | 9 | 5 | 81 | 1,926 | 605 |
| 4 | 2,036 | 907 | 140 | 10 | 217 | 3,310 | 3,418 |
| 8 | 3,305 | 1,000 | 150 | 15 | 250[3] | 4,720 | |
| 12 | 2,913 | 1,098 | 150 | 15 | 272 | 4,448 | 4,612 |
| 16 | 1,762 | 1,053 | 150 | 15 | 257 | 2,980 | 4,549 |
| 20 | 1,231 | 1,290 | 150 | 10 | 236 | 2,917 | 4,291 |

**Notes** 1: From Table 2.10
2: Including median year evaporation
3: Estimate based on other mine years

## 2.5.2 Water Sources

The Cobbora Coal Project proposes to draw water from a number of sources to meet the project water requirements, primarily:

- Groundwater extracted from de-watering bores and minor seepage into the pits;
- Surface runoff reporting to the mine pits, mine water dams and tailings dams;
- A proportion of surface runoff reporting to sediment dams;
- 'Imported' water from the Cudgegong River (for which the Project holds high security water access licences for 3,311 ML/year).

### 2.5.2.1 Groundwater

For the revised mine plan described in the *Revised PPR*, the proponent proposes to use de-watering bores to remove the bulk of groundwater that would otherwise report to the pit. Appendix E provides an analysis of the difference in the surface area of the mine pits below the existing water table and argues that the proportion of the pit area below the water table can be used as a proxy for the mine inflows. There is a difference of opinion between the groundwater consultants and the reviewers as to whether the perimeter of the pit should be used at the basis for analysis, rather than the wall and floor area.

In subsequent correspondence, the surface and groundwater consultants (Parsons Brinkerhoff) provided a spreadsheet which set out the wetted perimeter of the pit at relevant stages of mine development. **Table 2.12** provides a summary of the pit area and pit perimeter below the water table.

**Table 2.12: Pit Area and Perimeter below the Water Table**

| Mine Year | Pit Area Below WT (ha) | | Pit Perimeter Below WT (km) | |
|---|---|---|---|---|
| | Original | Revised | Original | Revised |
| 1 | 13.9 | 96.4 | 2.4 | 14.4 |
| 4 | 260.3 | 257.9 | 22.4 | 22.1 |
| 12 | 643.5 | 296.8 | 40.5 | 27.2 |
| 16 | 586.4 | 451.6 | 36.4 | 27.7 |
| 20 | 524.6 | 498.2 | 42.6 | 31.4 |

The original estimates of groundwater inflow to the pit (Tables 2-3 to 2-5 of the *Water Balance and Surface Water Management - Addendum*, March 2013) have been interpolated based on the ratios of original and revised pit area and pit perimeter to derive the groundwater inflow profiles shown in **Figure 2.3** and summarised in **Table 2.13**.

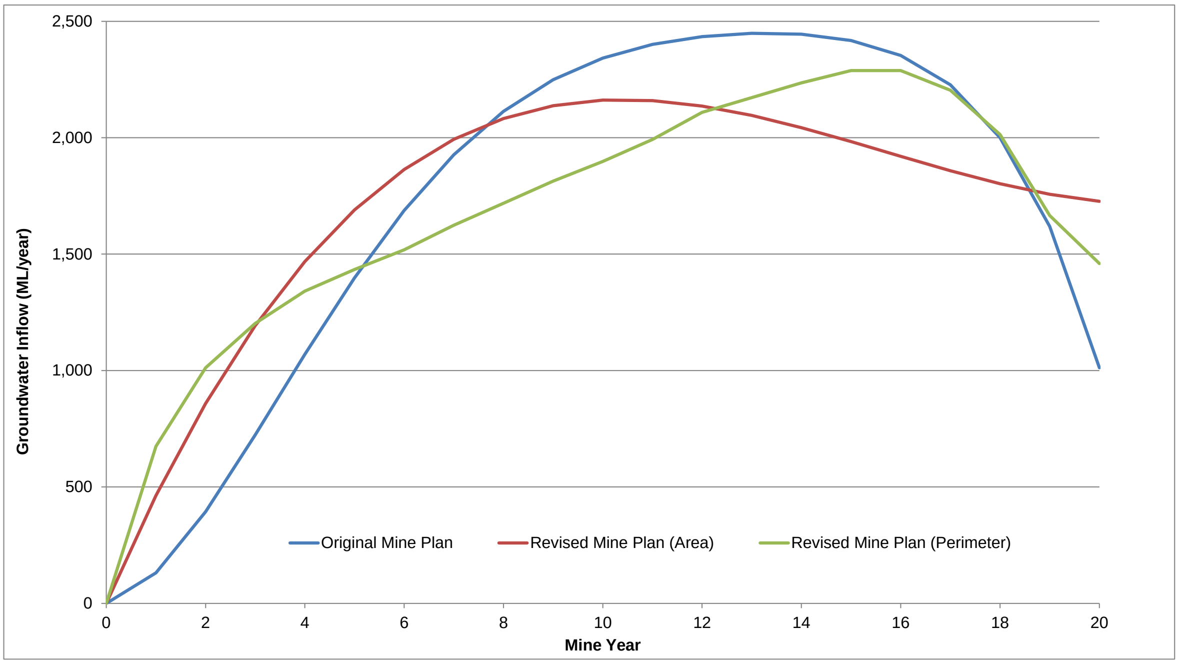


**Figure 2.3: Estimated Mine Pit Inflows**

**Table 2.13: Interpolated Estimates of Groundwater Inflow**

| Mine Year | Original Mine Plan | Revised Mine Plan (Area Based) | Revised Mine Plan (Perimeter Based) |
|---|---|---|---|
| 1 | 131 | 463 | 675 |
| 4 | 1,069 | 1,468 | 1,341 |
| 8 | 2,113 | 2,083 | 1,719 |
| 12 | 2,434 | 2,136 | 2,109 |
| 16 | 2,353 | 1,920 | 2,289 |
| 20 | 1,012 | 1,727 | 1,459 |

As shown in **Figure 2.3**, whichever basis is adopted for estimating groundwater inflows, the revised plan is likely to lead to increased groundwater flows in the early years and lower inflows during the later years. The peak inflows are likely to be of the order of 6-12% less than the predicted peak for the original mine plan.

The analysis set out above is based on the original groundwater modelling which assumed that all groundwater would report to the mine pits. The *Revised PPR* includes a proposal to utilise de-watering bores in order to minimise the evaporative losses that would occur with groundwater seepage direct to the pit. No separate analysis has been undertaken of the location or effectiveness of the groundwater bores needed to achieve the same de-watering as would occur with free groundwater seepage into the pit.

In a response to a submission by the NSW Office of Water (NOW), the proponent responded (email dated 9 September 2013):

> *"A dewatering borefield may result in a slightly increased overall volume of groundwater being intercepted during the duration of the project. Any increase is likely to occur in the early stages of the project, and as the project progresses the volumes are likely to be similar to those that have already been modelled. Therefore, impacts will be similar to those already predicted.*
>
> *The benefits of the dewatering borefield for on-site groundwater management are:*
>
> - *more accurate metering of intercepted groundwater as bore headworks will be fitted with metres;*
> - *minimising evaporation losses - losses will only occur once groundwater enters storage dams, not through evaporation as it seeps into the pit; and*
> - *the water entering the storage dams will be cleaner and less saline than water pumped from sumps in the base of the pit.*
>
> *The location and number of dewatering bores will be optimised by modelling prior to mining to ensure maximum efficiency. The optimisation of the borefield will allow details such as; bore design (depth, screen placement and diameter), location of bores, number of bores required, pumping rates, and the temporal succession of bore installation and decommissioning to be considered. For example, during initial stages dewatering bores will located within the mine pit area, and as mining approaches these bores will be decommissioned and newer bores will be installed. Key to designing the borefield is the mine plan and mining sequence, with a view to dewatering just marginally ahead of mining as it progresses. Identification of faults and zones of higher transmissivity within the mine area will be targeted for the location of dewatering bores."*
>
> *It is likely that some groundwater will continue to seep into the pit even with a dewatering borefield, and pumping from the base of the pit will still be required. Therefore, in pit leakage of contaminants would not be really present a higher risk with the instillation of the dewatering borefield."*

From the perspective of the contribution of groundwater to the overall mine water balance, the data in **Figure 2.3** and **Table 2.13** supports the proponent's contention that:

> *"Any increase is likely to occur in the early stages of the project, and as the project progresses the volumes are likely to be similar to those that have already been modelled. Therefore, impacts will be similar to those already predicted."*

However, depending on the placement of any de-watering bores located outside the pits, the proposed use of de-watering bores may increase the groundwater drawdown along Laheys Creek and Sandy Creek. This issue is discussed further in **Sections 2.8**, **2.9** and **2.10**.

A further groundwater related issue that does not appear to have been canvassed is the increased rainfall infiltration into overburden within the pit, and the subsequent additional recharge to in-pit groundwater.

#### 2.5.2.2 Surface Runoff

Tables 2 – 6 in Appendix E provide a comparison of different land use areas between the original and revise mine plans. In general these tables show a reduction in the active mine area in all years except Year 1, while the active overburden emplacement area is reduced for all years. However, no analysis is presented to demonstrate the effect of the changes in catchment areas on runoff into the mine water management system and the sediment dams, or the overall demand for water from the Cudgegong River. The material presented in Appendix D (page 6) argues that that because the mine footprint will be less, the overall impact of the mine will be less:

> *"Harvested (from sedimentation dams) and imported (from the Cudgegong River) water volumes are presented in the Surface Water Report Appendix E Addendum Tables 2-3 to 2-5. For mining year 20 under the reference dry year conditions the harvested volume is 123 ML and the imported volume is 2,400 ML, approximately 900 ML below the full entitlement from the Cudgegong River. For mining year 20 under the reference wet year conditions the harvested volume is 104 ML and the imported volume is 400 ML, approximately 2,900 ML below the full entitlement from the Cudgegong. This demonstrates that there is a low probability that the full entitlement from the Cudgegong River will be required and that moderate volumes of water can be harvested from the sedimentation dams under the 25% pumping rule under a range of climate conditions."*

In order to provide confirmation of the validity of this assertion, and in particular to assess the potential impact of the maximum water use for CHPP makeup in Year 8, further analysis has been undertaken based on the runoff data presented in Tables 2-3 to 2-5 of the *Water Balance and Surface Water Management System – Addendum* (March 2013). **Table 2.14** summarises the runoff characteristics of the different land surfaces accounted for in the water balance analysis expressed as:

- Depth of runoff (mm) in dry, median and wet years
- Runoff as a percentage of rainfall in dry, median and wet years;
- Percentage of total mine runoff attributable to each source.

Aspects of note in relation to the data in **Table 2.14** are:

- The modelled runoff from overburden and mine pits, expressed as a percentage of rainfall, are within the expected range for the climate of the area;
- In general, the range between different land uses and climate conditions is much greater than the range between the minimum and maximum runoff for any land use and climate.
- Modelling indicates that runoff from the natural land surface is relatively insignificant in dry and median years (2 mm and 6-7 mm respectively), but can be significant in wet years (84-86 mm);
- As would be expected, modelled runoff from the mine pits is significantly higher than from the overburden dumps;

- On average, runoff to the mine water dams contributes about twice as much as runoff to the sediment dams. In the case of the runoff captured in the sediment dams, the mine would have the opportunity to retain water for reuse or discharge excess to the environment subject to the availability of storage capacity and the quality of water in the sediment dams.

**Table 2.14: Mine Runoff Characteristics for Dry, Median and Wet Years**

| | 10th Percentile Dry Year (Table 2-3) | | | 50th Percentile Median Year (Table 2-4) | | | 90th Percentile Wet Year (Table 2-5) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min | Ave | Max | Min | Ave | Max | Min | Ave | Max |
| **Runoff (mm/a)** | | | | | | | | | |
| Raw water dam | 2 | 2 | 2 | 6 | 6 | 6 | 86 | 86 | 86 |
| Sedimentation dams | 18 | 20 | 21 | 37 | 41 | 44 | 168 | 185 | 193 |
| Mine water dams and pits | 49 | 74 | 125 | 92 | 135 | 223 | 266 | 343 | 503 |
| Clean water/highwall dams | 1 | 2 | 2 | 6 | 6 | 7 | 84 | 84 | 86 |
| **Runoff (% of Rainfall)** | | | | | | | | | |
| Raw water dam | 0.5% | 0.5% | 0.5% | 1.0% | 1.0% | 1.0% | 10% | 10% | 10% |
| Sedimentation dams | 4% | 5% | 5% | 6% | 7% | 7% | 20% | 22% | 23% |
| Mine water dams and pits | 12% | 19% | 31% | 15% | 22% | 37% | 32% | 41% | 60% |
| Clean water/highwall dams | 0.4% | 0.5% | 0.6% | 1.0% | 1.1% | 1.2% | 10% | 10% | 10% |
| **Runoff (% of Mine Total Volume)** | | | | | | | | | |
| Raw water dam | 0.1% | 0.1% | 0.3% | 0.1% | 0.2% | 0.5% | 0.6% | 1.0% | 2.2% |
| Sedimentation dams | 24% | 30% | 41% | 26% | 33% | 44% | 36% | 44% | 55% |
| Mine water dams and pits | 58% | 69% | 75% | 55% | 66% | 73% | 39% | 52% | 62% |
| Clean water/highwall dams | 0.1% | 0.3% | 0.6% | 0.2% | 0.6% | 0.9% | 0.9% | 2.4% | 3.5% |

**Table 2.14** shows that the modelled runoff from rehabilitated overburden that reports to the sediment dams ranges from an average of 0.5% in 10th percentile dry years to 22% in 90th percentile wet years. This compares with a long term (1900 – 2010) modelled average runoff from rehabilitated overburden (>4 years) of 4.7% (from Table 3.9 in Appendix E of the *Surface Water Assessment* for the *PPR*). The same table quotes the long term modelled average runoff from 'undisturbed' land as 3.1% of rainfall. This increase in average runoff from overburden compared to 'undisturbed' provides the basis for the claimed increase in runoff that would partially offset loss of baseflow due to lowered groundwater levels as a result of mining (see **Section 2.8.2**).

At the same time that the surface water modelling indicates that there is expected to be an increase in surface runoff, the groundwater modelling assumes enhanced in-pit groundwater recharge through overburden.

No justification has been provided for increases in both runoff and groundwater recharge which imply that the available water for evapotranspiration will be reduced. A possible explanation for this could be that the proposed soil on areas of overburden intended for grazing or woodland is limited to 200 – 300 mm (Section 5.4.2 of Appendix G of the *PPR*) immediately overlying 'as placed' overburden (without ripping). Assuming the modelled average runoff from rehabilitated overburden (4.7%) is correct, 95.3% of incident rainfall would still infiltrate. However, given the relatively small soil water storage capacity of the shallow soil, there would be greater opportunity for water to drain through the root zone than occurs in deeper natural soil profiles. Accordingly, a larger proportion of incident rainfall wold drain past the root zone and eventually contribute to groundwater in the pit.

Subsequent analysis undertaken for purposes of preparing a Site Water Management Plan and the associated Site Water Balance would benefit from further assessment of this issue and justification of any related assumptions.

#### 2.5.2.3 Water 'Import' from Cudgegong River

CHC holds high security water access licences for 3,311 ML/year from the Cudgegong River. The company has committed to minimising its use of water from this source for operational purposes and to maximise the use of groundwater (from dewatering bores) and runoff (primarily from the active mine area and overburden). The volume of water that needs to be imported to meet mine operational needs each year will depend on the stage of mining, the climate conditions prevailing in any particular year, groundwater inflows and the operational water demands.

Appendix E *in the PPR Surface Water Assessment* presents results of water balance modelling for the Cobbora Coal Project for selected 'representative' Mine Years (1, 4, 12, 16 and 20), but omits Year 8 (which is predicted to have the highest demand for CHPP make-up under the revised mine plan). For each mine year, the water balance model has been run for a 111 year climate sequence of daily rainfall and evaporation, with the state of the mine remaining static. This approach is not able to take account of any significant year to year changes in the mine plan, but provides sufficient information to gain an understanding of the main components of the mine water balance and the key water sources and demands. Further refinement of the modelling will be required once specific details of the water management facilities have been determined. The water balance model will also require periodic review and updating (say every 5 years) as operational experience is gained.

**Table 2.15** provides estimates of the mine water balance and the volume of water required from the Cudgegong River based on demand and mine water source estimates described above.

Specific assumptions and sources for the analysis in **Table 2.15** are:

- Surface runoff characteristics set out in **Table 2.14** and land use areas set out in Tables 2 – 6 of Appendix E and assuming that the volume of overburden runoff directed to the mine water management system varies from 100% in a dry year to 25% in a wet year;
- Groundwater available to the mine assuming that only 90% of the theoretical inflow to the pit (last column of **Table 2.13**) would be captured by the proposed dewatering bores;
- Mine water demands area set out in **Table 2.5**, **Table 2.9**, **Table 2.10** and **Table 2.11** above;
- Water storage volumes at the beginning of each year are as per Tables 2-3 to 2-5 of the *Water Balance and Surface Water Management System – Addendum* (March 2013);
- The available water to meet mine demand (second last line in **Table 2.15)** is the water from all internal mine water sources plus the volume of storage at the beginning of the year (from tables 2-3 to 2-5 of the *Water Balance and Surface Water Management System – Addendum* (March 2013).
- Sufficient water is imported from Cudgegong to achieve an end of year storage of at least the end of year storage listed in Tables 2-3 to 2-5 of the *Water Balance and Surface Water Management System – Addendum*.

### Table 2.15: Indicative Mine Water Balance for Revised Mine Plan (Including Year 8)

| Water Balance Component | Data Source | Units | 10th percentile dry year | | | | | | 50th percentile median year | | | | | | 90th percentile wet year | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Year 1 | Year 4 | Year 8 | Year 12 | Year 16 | Year 20 | Year 1 | Year 4 | Year 8 | Year 12 | Year 16 | Year 20 | Year 1 | Year 4 | Year 8 | Year 12 | Year 16 | Year 20 |
| **Mine Water Sources** | | | | | | | | | | | | | | | | | | | | |
| Raw water dam | Addendum Tables 2-3 to 2-5 | ML/a | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 44 | 44 | 44 | 44 | 44 | 44 |
| Mine water dams and pits | Per ha runoff from Addendum Tables 2-3 to 2-5 | ML/a | 486 | 480 | 495 | 512 | 554 | 471 | 886 | 875 | 900 | 933 | 1,010 | 859 | 2,246 | 2,219 | 2,290 | 2,366 | 2,562 | 2,177 |
| Clean water/highwall dam | Addendum Tables 2-3 to 2-5 | ML/a | 2 | 3 | 4 | 5 | 2 | 1 | 6 | 11 | 14 | 17 | 6 | 4 | 71 | 152 | 190 | 234 | 78 | 57 |
| Potential groundwater | Table 2.13 - pit perimeter | ML/a | 675 | 1,341 | 1,719 | 2,109 | 2,289 | 1,459 | 675 | 1,341 | 1,719 | 2,109 | 2,289 | 1,459 | 675 | 1,341 | 1,719 | 2,109 | 2,289 | 1,459 |
| Groundwater percentage | Assumed | | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% |
| Sedimentation dams | Per ha runoff from Addendum Tables 2-3 to 2-5 | ML/a | 45 | 118 | 215 | 315 | 232 | 116 | 94 | 245 | 450 | 656 | 482 | 242 | 426 | 1,113 | 2,045 | 2,975 | 2,185 | 1,096 |
| Percentage to WMS | Assumed | % | 100% | 100% | 100% | 100% | 100% | 100% | 50% | 50% | 50% | 50% | 50% | 50% | 25% | 25% | 25% | 25% | 25% | 25% |
| Sedimentation dams to WMS | Calculated | ML/a | 45 | 118 | 215 | 315 | 232 | 116 | 47 | 123 | 225 | 328 | 241 | 121 | 107 | 278 | 511 | 744 | 546 | 274 |
| Total Mine Water Sources | | | 1,141 | 1,809 | 2,262 | 2,731 | 2,849 | 1,902 | 1,549 | 2,219 | 2,689 | 3,179 | 3,320 | 2,300 | 3,075 | 3,900 | 4,582 | 5,286 | 5,290 | 3,866 |
| **Demands** | | | | | | | | | | | | | | | | | | | | |
| CHPP make-up | Table 2.5 | ML/a | 1,070 | 2,036 | 3,305 | 2,913 | 1,762 | 1,231 | 1,070 | 2,036 | 3,305 | 2,913 | 1,762 | 1,231 | 1,070 | 2,036 | 3,305 | 2,913 | 1,762 | 1,231 |
| Dust Suppression | Table 2.9 | ML/a | 761 | 907 | 1,000 | 1,098 | 1,053 | 1,290 | 761 | 907 | 1,000 | 1,098 | 1,053 | 1,290 | 761 | 907 | 1,000 | 1,098 | 1,053 | 1,290 |
| Dam net evaporation losses | Table 2.10 | ML/a | 334 | 498 | 550 | 601 | 543 | 496 | 81 | 217 | 250 | 272 | 257 | 236 | 238 | 130 | 500 | 1,178 | 984 | 440 |
| MIA water demand | Table 2.11 | ML/a | 9 | 140 | 150 | 150 | 150 | 150 | 9 | 140 | 150 | 150 | 150 | 150 | 9 | 140 | 150 | 150 | 150 | 150 |
| Potable supply | Table 2.11 | ML/a | 5 | 10 | 15 | 15 | 15 | 10 | 5 | 10 | 15 | 15 | 15 | 10 | 5 | 10 | 15 | 15 | 15 | 10 |
| Total Demand | | ML/a | 2,179 | 3,591 | 5,020 | 4,777 | 3,523 | 3,177 | 1,926 | 3,310 | 4,720 | 4,448 | 3,237 | 2,917 | 2,083 | 3,223 | 4,970 | 5,354 | 3,964 | 3,121 |
| **Storage and Import** | | | | | | | | | | | | | | | | | | | | |
| Storage - Start of Year | Addendum Tables 2-3 to 2-5 | ML | 1,155 | 594 | 957 | 1,662 | 787 | 586 | 604 | 556 | 572 | 579 | 558 | 563 | 1,882 | 1,298 | 2,690 | 4,423 | 3,792 | 2,056 |
| Storage - End of Year | Addendum Tables 2-3 to 2-5 | ML | 842 | 545 | 657 | 780 | 563 | 555 | 791 | 731 | 921 | 1,248 | 1,104 | 731 | 2,255 | 1,862 | 3,784 | 6,034 | 5,459 | 3,311 |
| Total Mine Sources + Starting Storage | Calculated | ML | 2,296 | 2,403 | 3,219 | 4,393 | 3,636 | 2,488 | 2,153 | 2,775 | 3,261 | 3,758 | 3,878 | 2,863 | 4,957 | 5,198 | 7,273 | 9,709 | 9,082 | 5,922 |
| Import from Cudgegong | Calculated | ML | 725 | 1,733 | 2,458 | 1,164 | 450 | 1,244 | 564 | 1,266 | 2,380 | 1,938 | 463 | 785 | 0 | 0 | 1,482 | 1,679 | 341 | 510 |

Figures in red estimated

**Table 2.16** summarises the requirements for water imports from the Cudgegong River at the following stages of the development of the mine plan:

- EA = Original analysis in Table 6-4 of Appendix E to the *Surface Water Assessment* (Appendix E of the *Environmental Assessment*) (September 2012);
- PPR = Table 6-4 of Appendix E of the *PPR Surface Water Assessment* (January 2013);
- Add'm = Table 2-6 of the *Water Balance and Surface Water Management System – Addendum* (March 2013);
- Revised = Analysis for the revised mine plan as set out in **Table 2.15.**

**Table 2.16: Estimates of Water Requirements for Import from the Cudgegong River**

| Year | 10th percentile dry year | | | | 50th percentile median year | | | | 90th percentile wet year | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EA | PPR | Add'm | Revised | EA | PPR | Add'm | Revised | EA | PPR | Add'm | Revised |
| 1 | 0 | 120 | 120 | 725 | 40 | 160 | 120 | 564 | 0 | 0 | 0 | 0 |
| 4 | 2,360 | 1,820 | 1,840 | 1,733 | 1,720 | 1,300 | 1,300 | 1,266 | 520 | 360 | 360 | 0 |
| 8 | | | | 2,458 | | | | 2,380 | | | | 1,482 |
| 12 | 1,700 | 2,600 | 580 | 1,164 | 1,100 | 1,840 | 960 | 1,938 | 0 | 380 | 400 | 1,679 |
| 16 | 1,880 | 2,520 | 1,220 | 450 | 1,200 | 1,780 | 1,040 | 463 | 0 | 400 | 380 | 341 |
| 20 | 2,960 | 3,240 | 2,400 | 1,244 | 2,160 | 2,540 | 1,660 | 785 | 220 | 400 | 400 | 510 |
| Max | 2,960 | 3,240 | 2,400 | 2,458 | 2,160 | 2,540 | 1,660 | 2,380 | 520 | 400 | 400 | 1,679 |

The data in **Table 2.16** indicate that, based on comparable assumptions to those contained in the earlier estimates, the revised mine plan is unlikely to have significantly reduced requirement for imported water. Part of the explanation for this may be that Year 8 is predicted to have a 30% increase in requirement for CHPP make-up water (3,305 ML/year – see **Table 2.5**) compared to the original mine plan for full mine production (2,524 ML/year – see Tables 2-3 to 2-5 of the *Water Balance and Surface Water Management System – Addendum*, March 2013).

The maximum estimated requirement for imported water for any year of the original mine plan (Tables 2-3 to 2-5 of the *Water Balance and Surface Water Management System – Addendum*, March 2013) is 2,400 ML/year in Year 20 for a 10th percentile dry year. However, the *Addendum* (page 9) also notes that the driest year on record would have a requirement for 2,920 ML. By analogy, the revised mine plan could be expected to have a comparable maximum for imported water.

The approximate analysis set out above, indicates that the revised mine plan can be expected to be capable of operating within the limits of CCH's licence for extraction of water from the Cudgegong River.

### 2.5.3 Life of Mine Water Demands

The *Revised PPR* (Section 6.4 and Section 4.2 of Appendix E) concludes that:

> *The water demands are increased for the early years reflecting the more rapid development, but are significantly reduced for the peak mining years by up to 22%; therefore, the new mine plan will place significantly less demand on imported water from the Cudgegong River source, and will allow CHC greater flexibility in trading unused water allocation back into the market for agricultural use.*

This conclusion is consistent with the revised assessment of the water requirements for tailings disposal (Section 6 of Appendix B):

> *The life of mine water to tailings reduces from 36.2 GL to 29.6 GL but its peak, over a nominal period of two years, is estimated to increase by 0.23 GL/y.*

These assessments imply that the revised mine plan can be expected to significantly reduce the life of mine water demand from the Cudgegong River. However, analysis of the total demand for site operations for median rainfall years (as set out in **Table 2.15** compared to values derived from Table 2-4 in the *Water Balance and Surface Water Management System - Addendum*[March 2013]) indicates that, overall, the revised mine plan is likely to reduce water demand by about 8% over the life of the mine.

## 2.6 Water Storages

Accidental discharge from mine water dams or the out-of-pit tailings emplacement is an important environmental risk associated with the mine water management system. The design and operation of the various water storages are key factors in managing and mitigating these risks.

### 2.6.1 Tailings Dams

Section 8.4 of Appendix B describes the proposed basis for setting the water and flood storage capacity of the tailings storage facilities, particularly the out-of-pit tailings storage facility. Diversion drains are proposed that would confine the contributing catchment to the storage area itself. Section 8.4 correctly notes that flood storage volume only becomes an operational consideration when the tailings storages are nearing capacity. The proposed freeboard is claimed to be based on the NSW Dam Safety Committee guidelines for tailings dams and references Guideline 'DSC3RF'. This appears to be a typographical error and the relevant Guideline should be '*Tailings Dams* - DSC3F' which cross references to the procedures for assessing the failure consequences (*Consequence Categories for Dams* - DSC3A) and flood storage capacity (*Acceptable Flood Capacity for Dams* – DSC3B).

The explanation for the proposed freeboard for the out-of-pit tailings dam is quoted as being based on a 1 in 1,000 year 72 hour design storm, but the derivation of this design objective is unclear. The DCS Guideline *Tailings Dams* – DSC-3F specifies that, in addition to defining the consequence category (from DSC3A), the freeboard for tailings dams must take account of the following factors:

- Beach freeboard;
- Pond recovery time;
- Operational freeboard; and
- Environmental containment freeboard.

Section 9.1 of Appendix C states that a minimum of 2 m of freeboard will be maintained in all tailings storage facilities, but it is unclear how this relates to the consideration of freeboard for environmental containment and dam safety. The detailed design, operational procedures and monitoring schedule for the out-of-pit tailings dam will need to be approved by the NSW Dam Safety Committee and will need to clearly set out the basis for the adopted design in line with the relevant Dam Safety Committee guidelines and any additional OEH requirements for environmental containment.

For in-pit tailings storages the proposed arrangements would involve:

- Placement of mine waste to limit the up-slope catchment area;

- No spillway;
- Maximum fill level set to ensure no risk of overflow.

Further detailed analysis will need to be undertaken to establish the maximum fill level relative to natural ground level at the edge of the pit, based on the same considerations as those for the freeboard for out-of-pit tailings dam.

### 2.6.2 Mine Water Dams

Appendix E of the *PPR Surface Water Assessment* identifies four categories of mine water dams based on the runoff source:

1) Infrastructure sedimentation dams receiving runoff from the heavy vehicle wash bay (SD1), MIA western catchment (SD2) and MIA south-eastern catchment (SD3);
2) Infrastructure water storage dams receiving runoff from the CHPP, coal stockpiles and train loading facility (MWDs 1, 2, 8, 10 and 11);
3) Pit water dams receiving water pumped from the pit. These dams (MWDs 3, 5, 6, 7 and 13) will typically be 'turkeys nest' dams which only receive water by pumping from the pits or other dams and will have minimal local catchment areas.
4) Process water dam, (MWD 4) to be located near the CHPP, which will receive a mix of water types from other dams for reuse onsite (mainly for supply to the CHPP). From the system diagrams (Figures 4.6 to 4.10 of Appendix F of the *PPR Surface Water Assessment*) it appears that MWD4 will also be a 'turkeys nest' dam.

Because the last two categories of dams will only receive water by pumping from pits or other storages, accidental overflow would only occur if pumping controls failed. The risk of this occurring is low and the volume of discharge that might occur before being noticed is likely to be small.

Appendix E of the *PPR Surface Water Assessment* describes the infrastructure sedimentation dams as being designed to capture runoff from a 20 year ARI 72 hour storm assuming a runoff coefficient of 0.85, with an additional 20% capacity for sediment storage. The water management system diagrams (Figures 4.6 to 4.10) indicate the intention to pump water from these dams to MWD3, with any overflow discharging to a licenced discharge point. The ability of this system to minimise the risk of discharge is heavily dependent on the capacity of the pumps that would transfer water to MWD3. As water collected in these dams can be expected to carry high concentrations of coal dust and possibly oil, any discharge to the environment would be undesirable. Accordingly, it would be desirable for the capacity of these sediment dams to be confirmed using the same methodology as that used to determine the size of the mine water dams (see below).

Appendix E of the *Surface Water Assessment* describes the infrastructure water storage dams as having been initially sized to capture local catchment runoff from a 100-year ARI 72-hour storm event assuming a runoff coefficient of 0.85. The capacity of these dams was then confirmed by water balance modelling, with the dams being sized to achieve no discharge when operated as part of the overall site water management system under historical climate conditions.

Appendix D provides a response to the suggestion in the PAC report that a freeboard of 1 m should be provided for these dams and argues that 0.5 m would be sufficient because the design approach takes account of all sequences of rainfall within the historic record (not just 72 hour 'design storms').

The design approach using continuous water balance modelling is considered superior to the adoption of a notional 'design storm'. However, the analysis described above is heavily dependent on the assumed pump rates for transfer of water from the infrastructure water storage dams to other mine water dams. In practice, the ability to prevent overflow will also be dependent on the serviceability of the pumps as the storage nears full capacity as a result of an extended period of wet weather.

In view of the potential for overflow of water from these dams (with high concentrations of coal dust, sediment and salt) to significantly impact on Laheys Creek and Sandy Creek, the final design warrants a greater element of conservatism than the 'standard' 500 mm which is based primarily on dam safety considerations rather than potential environmental impacts.

### 2.6.3 Sediment Dams

Section 2.3.1 of Appendix E to *PPR Surface Water Assessment* sets out the design criteria for the sediment dams. The dams are proposed to be designed and operated in accordance with the requirements for Type F/D sediments as set out in *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction — Mines and Quarries* (DECCW, 2008). The adopted 95$^{th}$ percentile 5 day design rainfall depth for "sensitive' receiving environments (63.3 mm) is consistent with the data in Figure 6.6 of *Managing Urban Stormwater: Soils and Construction* and, compared to Dubbo (50.7 mm), is likely to be slightly conservative.

The adopted design runoff coefficient of 0.4 is justified on the basis that the runoff coefficients quoted in Table F2 of *Managing Urban Stormwater: Soils and Construction* (range 0.37 – 0.79) relate primarily to compacted soils on urban land development sites. Compared to the average annual runoff of 20% for a 90$^{th}$ percentile wet year (see **Table 2.14**) derived from AWBM using historic daily rainfall, storm runoff coefficient for overburden of 0.4 appears reasonable.

On the basis of the adopted design criteria, Table 6.2 of *Managing Urban Stormwater: Soils and Construction — Mines and Quarries* lists the expected average overflow frequency as 1-2 spills per year. Paragraph 4 of the advice provided to SEWPaC by the Independent Expert Scientific Committee notes this expected overflow frequency and states:

> "*Consideration should be given to sedimentation dams being redesigned to contain a larger storm event (1 in 1000 year average recurrence interval) to minimise the potential for downstream water quality and ecological impacts.*"

The adoption of a 1,000 year ARI design storm (estimated rainfall depth more than four times the adopted design depth) is not considered warranted in view of the fact that the proposed design already provides for a 95$^{th}$ percentile rainfall, which complies with the established guidelines for mines and quarries.

The design criteria include spillway capacity to convey the runoff from a 100 year ARI storm. This is consistent with the requirements for basins with an operational life of more than three years which discharge to 'sensitive' environments (as set out in Table 6.1 of *Managing Urban Stormwater: Soils and Construction — Mines and Quarries*).

### 2.6.4 Water Retention in the Mine Pit(s)

Section 6.1.3 of Appendix E of the *PPR Surface Water Assessment* provides an analysis of the frequency and magnitude of in-pit flooding based on the 111 year water balance analysis. The maximum stored volume in all three original pits are summarised in **Table 2.17**.

**Table 2.17: Maximum In-pit Water Storage Volume**

| Mine Year | Maximum Stored Volume (ML) | | | |
|---|---|---|---|---|
| | Area A | Area B | Area C | Total |
| 1 | 176 | 166 | 0 | 342 |
| 4 | 806 | 894 | 401 | 2,100 |
| 12 | 1,023 | 1,671 | 1,678 | 4,272 |
| 16 | 718 | 2,345 | 2,162 | 5,225 |
| 20 | 1,414 | 1,973 | 662 | 4,049 |

Figures 6.13 and 6.14 in Appendix E of the *PPR Surface Water Assessment* illustrate the corresponding worst case flooded area in each pit:

- Area A 14 ha (Year 20);
- Area B 27 ha (Year 16);
- Area C 35 ha (Year 16).

No comparable analysis has been prepared for the revised mine plan. However Appendix A, Section 3.5 acknowledges that, compared to the original plan, the revised mine plan will increase the risk of the mine being unable to produce coal if flooding occurs. This is illustrated by the mining schedule in **Figure 2.4** which shows that after Year 14, only Area B would be operating.

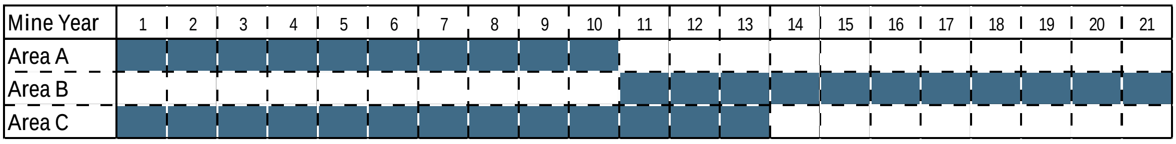


**Figure 2.4:**
**Revised Mining Sequence**
(*Source: Appendix A, Section 3.1*)

While the configuration of the mine pit in Area B may be slightly different for the revised mine plan, the data in **Table 2.17** indicates that the risk of water needing to be stored in the active pit is highest during Years 14 onwards when there will only be one pit operating. The Mine Water Management Plan will need to consider contingencies for Years 14 onwards such as injection into the in-pit overburden in Area A or C, or enlargement of one of the mine water dams.

## 2.7 Runoff Management and Impact Mitigation

The proposed management of runoff from different sources would involve the considerations set out below.

### 2.7.1 Tailings Dams

All decant water and any seepage below the out-of-pit tailings dam will be returned to the mine water management system. Section 5.3.3 of Appendix E to the *PPR Surface Water Assessment* quotes a proposed pump rate of 13 ML/day, but does not provide an explanation of how this value was derived. Section 8.5 of Appendix C sets out the proposed arrangements for return of decant water (and incident rainfall) to the mine water management system:

> *The tailings decant water will be one of the main sources of water for the CHPP. Decant water will be pumped from the decant pond into the mine water system, which then goes to the*

*CHPP. The pumps operate manually and are to be operated to minimise the stored volume in the decant pond, including after rainfall.*

In order to minimise the risk of uncontrolled discharge, the return pipeline and pump will require sufficient capacity to return:

- All decant water (assumed to be 30% of the water used to convey tailings). Based on the water requirements for tailings conveyance in Mine Year 4 set out in **Table 2.5**, a pump rate of about 1.5 ML/day would be required;
- Incident rainfall from the proposed 1,000 year ARI 72 hour design storm as required for dam safety purposes. The dam safety guidelines for tailings dams require the analysis to take account of the time required to restoration the storage volume. For the proposed out-of-pit tailings dam (approximately 60 ha surface area), the 1,000 year ARI 72 hour storm would only contribute about 200 mm depth of water (120 ML). This depth is significantly less than the 2 m freeboard between the maximum tailings level and the dam spillway described in Appendix C. However, the analysis does not take account of longer duration rainfall events.

As part of the final design of the mine water management system the adequacy of the proposed freeboard should be demonstrated by a separate daily water balance analysis for the tailings dam using the available historic rainfall record (similar to the analysis undertaken for the mine water dams as set out in Appendix E of the *PPR Surface Water Assessment*). The analysis should demonstrate the ability of the dam to retain incident rainfall and tailings decant water under extreme conditions such as breakdown of the return pump coincident with the worst case historic rainfall sequence. In addition the operating regime for manual operation of the decant pumps will need to be clearly specified in the Site Water Management Plan.

### 2.7.2 Mine Water Storages

The sizing of the mine water dams has been undertaken using the site water balance model and, as set out in Appendix E of the *PPR Surface Water Assessment*, makes provision for 0.5 m freeboard above the maximum water level achieved throughout a 111 year historic climate sequence. The ability of the mine to avoid discharge of from any of the mine water dams is also a function of the rate at which mine water can be transferred between storages, and the ability to retain mine water in one or more mine pits in the event of water storages nearing capacity.

Sections 5.3.3 and 5.3.4 in Appendix E of the *PPR Surface Water Assessment* set out the proposed pump rates and operating rules that were assumed for purposes of the water balance analysis. These aspects will need to be tested further during the detailed design process and the operating rules clearly specified in the Site Water Management Plan.

### 2.7.3 Sediment Dams

Discharge from the sediment dams could occur in one of three ways:

- Transfer to one of the mine water dams at a rate sufficient to empty the dam within 5 days after the end of a storm. (This assumes that sufficient pumping capacity is available at each sediment dam when required and that the required pipelines are in place);
- Subject to the water meeting discharge water quality standards (principally suspended sediment and salt concentrations), controlled release at a rate sufficient to empty the dam within 5 days after the end of a storm (This assumes that the outlet from each sediment dam includes manual control to permit appropriate water quality testing prior to discharge);
- Uncontrolled discharge in the event of storm runoff exceeding the capacity of the dam (expected to occur 1-2 times per year on average).

The decision regarding transfer of water to the mine water system or release to the environment involves balancing consideration of a reduction of flow in the local creeks against the merits of minimising the importation of water from the Cudgegong River. Appendix D (pages 5 and 6) describes the approach adopted for purposes of water balance modelling:

> *"The mine water system has been designed to harvest sedimentation dam water up to a point, but balanced so as to avoid significant impacts on the flow regime in the creeks downstream. A range of rules were tested during development of the water balance model for harvesting from sedimentation dams; (1) no sedimentation dam water harvesting; (2) pump from sedimentation dams to mine water dams when mine water dams fall below 25% full; and (3) pump from sedimentation dams to mine water dams when mine water dams fall below 50% full. The results of these early tests are summarised below for mining year 20 in Table 8:*

***Table 8 – Annual flow impacts at Sandy Creek outlet***

| ***Climate condition*** | ***Impact on creek flow – mining year 20*** | | |
|---|---|---|---|
| | ***0% rule*** | ***25% rule*** | ***50% rule*** |
| *10%ile (dry) year* | *+11%* | *-5%* | *-5%* |
| *50%ile (median) year* | *+12%* | *+5%%* | *+3%* |
| *90%ile (wet) year* | *+2* | *+2%* | *+1%* |

> *The 25% rule was chosen as the preferred operating procedure as it was found to provide a moderate volume of water to reduce reliance on the Cudgegong River entitlement while keeping the reductions in dry year flow within 5% assuming that the resulting impacts will be acceptable."*

The satisfactory operation of the '25% rule' will depend on the relevant facilities (pumps, pipelines and outlet controls) being in place as well as detailed operating rules governing the decision as to where retained water is to be directed on each particular occasion (to the mine water management system or off-site) depending on the contents of the mine water storages and the quality of water in the sediment dams. Details of the facilities required to implement the proposed management regime and the decision rules will need to be clearly set out in the Site Water Management Plan.

## 2.8 Flow Regime in Local Creeks

The *Revised PPR* has responded to the issues raised in the PAC Review in Appendix D – *Response to PAC Review of water modelling* and Appendix E – *Groundwater and surface water assessment*. Further details are provided below.

### 2.8.1 Changes in Catchment Area

The potential impact of the revised mine plan (May 2013) on the flow regime in local creeks due to changes in mine catchment areas was assessed in Appendix E by comparing the changes in area from the original (December 2012) mine plan for the following land uses:

- cleared area;
- topsoil stockpile;
- active mine;
- haul road/ infrastructure;
- tailings emplacement area;
- active overburden emplacement;
- rehabilitated emplacement area;
- established rehabilitated area.

The proposed changes of area were not explicitly re-modelled in the water balance analysis. Instead, it was assumed that if the area of the various land uses reduce or remain very similar to the original mine plan, and the rate of mining (determined as the rate of change of each land use type listed above between the milestone years) will be less than or similar to that of the original mine plan, then it could be inferred that the impacts of the Project will be less than or similar to those already determined for the original mine plan.

**Table 2.18** below shows the comparison in land use areas for the original and the revised mine plan, based on Tables 2 to 6 of Appendix E.

**Table 2.18: Land Use Areas (ha) for Original and Revised Mine Plans**

| Land use type | Year 1 | Year 4 | Year 12 | Year 16 | Year 20 |
|---|---|---|---|---|---|
| Dec-12 Mine Plan | | | | | |
| Cleared Area | 256 | 135 | 126 | 143 | 64 |
| Topsoil Stockpile | 8 | 4 | 227 | 113 | 130 |
| Active Mine | 50 | 292 | 537 | 471 | 444 |
| Haul Road/ Infrastructure | 173 | 232 | 391 | 912 | 1,350 |
| Tailings Emplacement Area | 38 | 132 | 736 | 875 | 874 |
| Active Overburden Emplacement | 363 | 686 | 970 | 987 | 958 |
| Rehabilitated Emplacement Area | | 340 | 268 | 309 | 274 |
| Established Rehabilitated Area | | | 391 | 912 | 1,350 |
| May-13 Mine Plan | | | | | |
| Cleared Area | 123 | 123 | 152 | 103 | 37 |
| Topsoil Stockpile | 87 | 58 | 121 | 91 | 92 |
| Active Mine | 221 | 190 | 150 | 286 | 239 |
| Haul Road/ Infrastructure | 245 | 268 | 266 | 266 | 266 |
| Tailings Emplacement Area | 65 | 65 | 1,203 | 785 | 342 |
| Active Overburden Emplacement | 144 | 386 | 409 | 399 | 252 |
| Rehabilitated Emplacement Area | | 159 | 266 | 266 | 266 |
| Established Rehabilitated Area | | | 158 | 1,287 | 2,384 |

The *Revised PPR* concludes that land use area comparison demonstrates:

- More rapid development of mining in the early years compared to the original mine plan, with higher areas of active mine, haul road/ infrastructure, tailings emplacement and topsoil stockpiling.
- During peak mine years (Year 4 onwards), the revised mine plan is less extensive, with subsequent significant reductions in areas of active mine, active overburden emplacement and active tailings emplacement.
- During the peak mining years (Year 4 onwards), the disturbed areas (active mine, active overburden emplacement, active tailings emplacement) are reduced and the rehabilitated areas (rehabilitated and established rehabilitated emplacement) are increased.
- The reduction in disturbed areas and increase in rehabilitated areas during peak mining indicates that surface water impacts of the new mine plan will not be greater than the original mine plan in terms of volumes of runoff from contaminated/disturbed areas.

Analysis of the areas provided in **Table 2.18** confirms that, with the general reduction in area for the active overburden emplacement and the active mine, overall the impacts on the downstream flow regime should be no worse than for the original mine plan.

Notwithstanding these changes in catchment area, because of the expected increased runoff from the overburden compared to the existing landscape and the proposed adoption of the '25% rule' for transfer of water from sediment dams to the mine water management system, it is expected that the total flow in Sandy Creek will actually increase in median and $90^{th}$ percentile (wet) years (see Table 8 from Appendix D quoted in **Section 2.7.3** above).

As stated in Appendix D of the *Revised PPR*, the potential impacts of the mine extend downstream to the Talbragar River below its confluence with Sandy Creek, but continue to diminish downstream due to the increasing influence of the larger Talbragar catchment. The Sandy Creek sub-catchment is approximately 8% of the area of the Talbragar River catchment at the Sandy Creek and Talbragar River confluence and approximately 1% of the Macquarie River catchment at the Talbragar River and Macquarie River confluence. Therefore, the Sandy Creek sub-catchment is a very small portion of the Macquarie River catchment system. The impacts of these changes on flow in Sandy Creek and the Talbragar River are set out in **Section 2.8.2** below.

### 2.8.2 Changes in Flow Regime

Appendix D of the *Revised PPR* provides a response to the PAC Review of water modelling. The Appendix combines information from the *Surface Water Assessment* (Appendix to F to the *PPR*) and *Groundwater Assessment* (Appendix to E to the *PPR*) to respond to the PAC Review Report. A summary of the response, and commentary on its appropriateness, is provided below.

The PAC review found that the *PPR* focused on surface runoff into the creeks and did not take into account the predicted loss of baseflow attributable to groundwater drawdown. The review recommended that baseflow losses be taken into account in assessing the predicted impacts of mining on the flow regime in Laheys Creek and Sandy Creek.

In response, the *Revised PPR* quantitatively assessed the potential changes in annual flow in Sandy Creek and the resulting impact on flows in the Talbragar River by estimating the combined annual streamflow from surface water modelling with estimates of potential seepage losses from the creeks determined from the groundwater model.

The surface and groundwater systems were modelled using different approaches and software, with different spatial and temporal resolutions. Groundwater impacts were modelled with yearly time steps and a relatively coarse grid structure to assess regional impacts. Surface water flows in Sandy Creek were obtained from the AWBM rainfall runoff model developed for the mine water balance analysis. The AWBM was used to assess changes in catchment runoff and stream flow for each tributary with daily time steps under a number of rainfall scenarios.

The groundwater model included a number of conservative assumptions to allow for adequate licensing of surface water and groundwater take and to provide conservative predictions of groundwater drawdown impacts to the environment and bore users. The groundwater model overestimated the losses from the creeks, as it assumed that the creeks supply a continuous source of water that can be impacted by drawdown of the water table. This is an appropriate assumption for the purpose of water licencing, as it overestimates the river losses due to drawdown caused by mining. In reality, the Sandy Creek system is ephemeral.

In addition, the elevation of the river cells in the model are defined using a regional DTM based on 10 m contour data, which the *Revised PPR* states may also result in an overestimate of the increase in seepage to the groundwater system as a result of drawdown. Without further explanation of this statement, it is assumed that this would be due to inaccuracies due to the coarseness of the model, which could equally result in an underestimate in the increase of seepage to the groundwater system.

The *Revised PPR* found that a direct combination of the surface water and groundwater model outputs had limitations due to the conservative assumptions made for the groundwater model. A revised approach was therefore provided to address the issues raised in the PAC Review. To better reflect the ephemeral nature of the Sandy Creek, a seepage loss factor was applied to the annual groundwater contribution to streamflow, based on the amount of time the stream was assumed to flow. The following scenarios were assessed in the *Revised PPR*:

1. No reduction in groundwater model river losses
2. 40% reduction in groundwater model river losses
3. 80% reduction in groundwater model river losses.

Scenario 1 is the conservative base case assessment as it assumes that there will be the maximum available loss from the groundwater contribution to the river flows. Scenario 2 assumes that groundwater loss can occur for 60% of the time, reducing the amount of river losses from the groundwater model outputs by 40%. This assumption is based on the modelled AWBM surface water flow duration curves provided in Figures 5-1 to 5-3 of Appendix C to the *PPR Surface Water Assessment*. Scenario 3 assumes that groundwater loss can occur for 20% of the time, reducing the amount of river losses from the groundwater model outputs by 80%. No explanation is given for the adoption of this factor, other than it represents dry conditions.

Annual flows (without the mine) for the representative dry, median and wet years in the historical climate sequence (mine years 0 (baseline), 1, 4, 12, 16, 20, post mining and post recovery) were adjusted by the predicted change in flow from the daily surface runoff model and the groundwater model for each of the 3 scenarios. The results were provided at the downstream reach of Sandy Creek and at Elong Elong on the Talbragar River downstream of the confluence with Sandy Creek. The results, in terms of **percentage change in annual flows** compared to pre-mine conditions, for the three scenarios are summarised in **Table 2.19** below.

The results in **Table 2.19** demonstrate:

- For Scenario 1, in a median year there may be reductions in annual flow in Sandy Creek compared with baseline (pre-mining) conditions of up to 21% and a negligible reduction (2%) in annual flow in the Talbragar River at Elong Elong. In a dry year the estimated reduction in annual flow may be up to 86% in Sandy Creek and 9% in the Talbragar River. This would a very conservative (and possibly unrealistic) upper bound of the impact on the river system.
- For Scenario 2, in a median year the maximum reduction in flow is 11% in the Sandy Creek system and 1% (negligible) for the Talbragar River at Elong Elong. In a dry year the losses may be up to 54% and 6% respectively. This is the indicative likely impact on the river system.
- For Scenario 3, there would be a negligible reduction in flow in the Sandy Creek system and the Talbragar River at Elong Elong in a median year. In a dry year, the reductions may be up to 21% and 2% respectively. This is indicative of the lower bound impact on the river system.
- Flow increases are predicted for both locations in a wet year due to increased runoff from the modified surface water catchments, which compensates for the river losses to groundwater.

**Table 2.19: Predicted percentage change in annual flow for seepage loss scenarios**

| Year | Scenario 1: 0% seepage loss | | | Scenario 2: 40% seepage loss | | | Scenario 3: 80% seepage loss | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10th%ile dry year | 50th%ile median year | 90th%ile wet year | 10th%ile dry year | 50th%ile median year | 90th%ile wet year | 10th%ile dry year | 50th%ile median year | 90th%ile wet year |
| Sandy Creek Outlet | | | | | | | | | |
| Baseline | - | - | - | - | - | - | - | - | - |
| 1 | 7 | 6 | 4 | 7 | 6 | 4 | 7 | 6 | 4 |
| 4 | -25 | 2 | 4 | -16 | 5 | 5 | -7 | 7 | 5 |
| 12 | -66 | -8 | 3 | -42 | -1 | 4 | -18 | 7 | 4 |
| 16 | -78 | -12 | 4 | -49 | -3 | 4 | -21 | 6 | 5 |
| 20 | -86 | -21 | 3 | -54 | -11 | 4 | -21 | -1 | 5 |
| Post mining | -71 | -21 | 9 | -38 | -11 | 9 | -5 | -1 | 10 |
| Post recovery | 12 | 4 | 11 | 12 | 4 | 11 | 12 | 4 | 11 |
| Elong Elong at Talbragar River | | | | | | | | | |
| Baseline | - | - | - | - | - | - | - | - | - |
| 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 4 | -3 | 0 | 0 | -2 | 1 | 1 | -1 | 1 | 1 |
| 12 | -7 | -1 | 0 | -5 | 0 | 0 | -2 | 1 | 0 |
| 16 | -9 | -1 | 0 | -5 | 0 | 0 | -2 | 1 | 1 |
| 20 | -9 | -2 | 0 | -6 | -1 | 0 | -2 | 0 | 1 |
| Post mining | -8 | -2 | 1 | -4 | -1 | 1 | -1 | 0 | 1 |
| Post recovery | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |

The Sandy Creek system is ephemeral. However, the analysis presented in the *PPR* and *Revised PPR* is not clear on the distinction between baseflow conditions associated with filling and drying of isolated pools and discharge from temporary storage in the alluvium compared to perennial low flow fed by groundwater discharge (which is implied in the analysis of the semi-permanent pools (see **Section 2.8.3** below).

Given that the majority of the modelled groundwater river loss occurs in the Sandy Creek system, and this system provides minimal baseflow to the Talbragar River, the *Revised PPR* concludes that the predicted flow impacts to the Talbragar River are likely to be relatively minor. This is reflected in the results provided in **Table 2.19**.

It is noted that the analysis is based on an annual time step and it is not possible to the impacts of the river system on a daily time scale. It is possible that periods of no flow under existing conditions will extend for longer due to the impacts of the mine.

**Table 2.19** indicates that there may be up to 54% losses in the annual flows in Sandy Creek under Scenario 2 in a dry year. The PAC Review required clarification of the proposed mechanisms for offsetting losses to the creek system. The *Revised PPR* stated that a management plan will be developed based on the ongoing surface water monitoring program that will continue through the operational life of the mine to offset the residual losses to the system during and post mining. In addition, the proponent has committed to developing an aquatic monitoring strategy to detect changes to the quality and quantity of water in the semi-permanent pools in Laheys and Sandy Creeks. A River Monitoring Committee (including Fisheries NSW, NSW Office of Water and other appropriate agencies) will be formed to review the results from this strategy and to assist formulate adaptive management measures.

### 2.8.3 Semi-Permanent Pools

The PAC review identified the following issues requiring further clarification in relation to semi-permanent pools:

- potential groundwater drawdown impacts on the semi-permanent pools;
- details of how releases from the mine could positively affect the semi-permanent pools; and
- potential additional loss of flow in Laheys Creek and Sandy Creek as a result of the baseflow losses.

In the absence of detailed survey and water balance modelling for each individual refuge pool, the impacts on the pools has been assessed in the based on the water table drawdown predicted by the groundwater model. The assessment aimed to determine potential impacts on refuge pools that persist during extended dry conditions by focussing on groundwater drawdown impacts rather than flow impacts on the refuge pools, given that pools that persist during extended dry periods are likely to be sustained by groundwater.

Table 7 in Appendix D presents the results of the refuge pool assessment from Appendix A in the *PPR Surface Water Assessment* together with the results of more recent sensitivity analysis of drawdown. The additional model sensitivity runs were carried out to assess the potential groundwater drawdown impacts in the vicinity of nearby refuge pools on Sandy and Laheys Creeks, under the highly conservative assumption that the creeks provide no recharge to the groundwater systems when they are flowing. For this scenario the groundwater model predicts between 5 m and 22 m of drawdown would occur within the coal measures underlying the refuge pools. This amounts to between 4 m and 14 m greater drawdown than the modelling reported in the EA which assumed that creeks provide recharge to groundwater. The impacts on refuge pools are provided graphically in **Figure 2.5** below.

The base case assessment of the refuge pools predicted that Pools 3, 6 and 10 would lose groundwater supply due to drawdown and Pool 5 would also be at risk. The conservative case modelled in the sensitivity analysis predicts that Pool 5 would lose supply and Pool 3 would be affected earlier (by Year 12 rather than by Year 16 in the base case).

The *Revised PPR* states that CHC is committed to providing contingency measures for pools that could be affected by drawdown. An aquatic monitoring strategy will be developed to detect changes to the quality and quantity of water in semi-permanent pools. A River Monitoring Committee will be formed to review the results from this strategy and to assist formulate adaptive management measures. These measures may include releasing water from the mine site to fill pools. It may be necessary to transport the water by pipe or water truck if gravity feed is not possible for upstream locations or where water transmissions losses are unacceptable for downstream locations.

It is recommended that the proposed strategy for monitoring and managing the pools addresses water quality and temperature requirements for maintenance of the aquatic ecology in the pools. In view of the existing saline conditions in Sandy Creek, it may be necessary to shandy raw water from the Cudgegong River with groundwater to mimic existing water quality conditions.

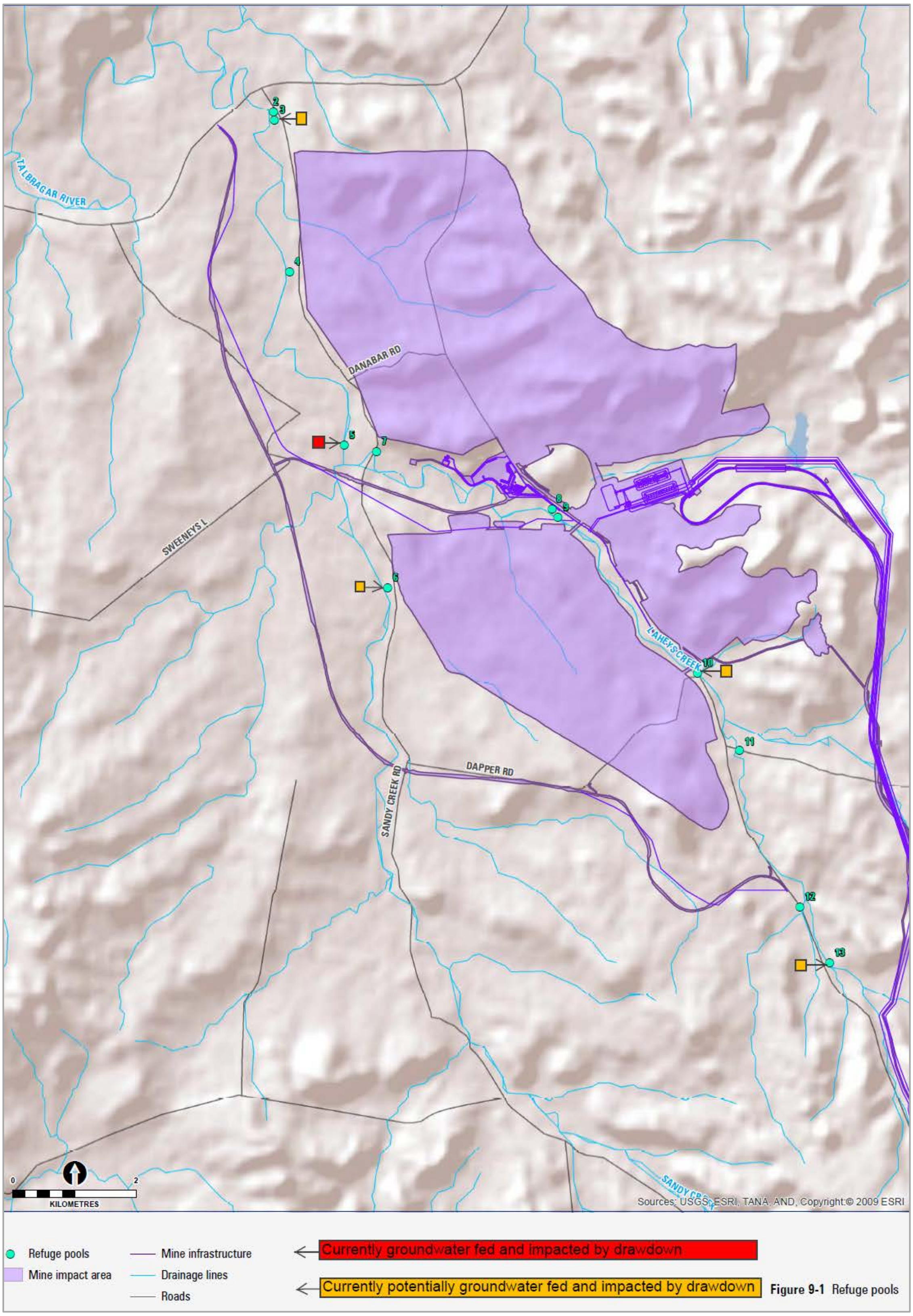


**Figure 2.5:**
**Refuge Pool Location and Potential Impacts**

(Source: Base map - Figure 9-1 of Appendix A in Appendix F of the *Preferred Project Report*, January 2013)

It is expected that in a case where no recharge to the aquifers occurs via the streams during high flow events then the predicted inflow to the mine pits will be slightly less in the long term. However most inflow will be initially derived from aquifer storage and therefore mine inflows in the first several years should not differ under such a scenario. The numerical groundwater model estimates that a maximum of 480 ML/year may be lost from the surface water systems towards the end of mining, and in the years following the end of mining. This amounts to between 10% and 15% of maximum predicted groundwater inflows to the mine. Therefore the uncertainty in groundwater inflows to the mine as a result of uncertainty in the assumptions associated with recharge from the streams will be of the same order (10 to 15%).

### 2.8.4 Regional Impacts

#### 2.8.4.1 Talbragar River

The PAC Review requested further analysis of the impacts on the Talbragar River, in particular further clarification regarding the magnitude, location and progression over time of baseflow and surface runoff losses to the surface water systems.

Information addressing the potential impacts on the Talbragar River was provided in Appendix D of the *Revised PPR* and is summarised in Section 2.6.2 above. The results summarised in Table 2.17 above indicate that for the highly conservative case adopted in the EA groundwater modelling, the maximum reduction in annual flow at Elong Elong on the Talbragar River is 9% for the reference dry year. However, taking into account the conservative nature of the groundwater model, this reduction is more likely to be in the range of 2 to 6%.

The majority of the loss is attributed to the streams of the Sandy Creek system adjacent to the mining areas (the lower 3 km of Blackheath Creek, the lower 8 km of Laheys Creek and the lower 11 km of Sandy Creek). The combined loss in these reaches is transferred to the Talbragar River downstream of its confluence with Sandy Creek. The loss transferred to the Talbragar River is loss due to increased infiltration during high flow conditions. There is no loss of baseflow in the Talbragar River due to baseflow reductions in the Sandy Creek system.

The PAC Review requested clarification regarding offsetting of cumulative base-flow losses in Talbragar River from Ulan Coal Mine by discharge from treated mine water from Ulan post mining (as proposed in the *PPR Surface Water Assessment*). In response, the *Revised PPR* stated that Sandy Creek does not contribute significant baseflow to the Talbragar River and therefore the Project has minimal to negligible impact on flows downstream in the Talbragar River, notwithstanding any proposed releases from the Ulan mine.

#### 2.8.4.2 Cudgegong River

CHC proposes to prepare an Extraction Strategy Agreement with State Water that would involve operating the pump on the Cudgegong River so as to ‘mop-up’ excess flows in the Cudgegong before they enter Burrendong Dam. The PAC Review found that the utility of this operational strategy appears questionable, as any ‘mopping-up’ may subsequently require additional bulk transfer of water from Windamere Dam.

The *Revised PPR* assessment concluded that, although mine water demand is increased for the early years due to the more rapid development proposed in the revised mine plan, it would be reduced by up to 22% for the peak mining years. The new mine plan would therefore place significantly less demand on imported water from the Cudgegong River source and would allow CHC greater flexibility in trading unused water allocation back into the market for agricultural use.

While it is acknowledged that the requirement for transfer of water from the Cudgegong River will, in most years allow some unused water allocation to be placed on the open market for agricultural use, the analysis in Section 0 suggests that for much of the time the demand for the revised mine plan will be comparable to that for the original mine plan.

#### 2.8.4.3 Independent Expert Scientific Committee

The Independent Expert Scientific Committee's (IESC) submission dated 18 April 2013 identified the following potential issue relating to regional impacts:

- *Insufficient information to reasonably understand potential impacts on regional water balance (surface and groundwater) and regional cumulative impacts.*

Correspondence from SEWPaC (20 September 2013) indicates that satisfactory responses have been provided in the *Revised PPR*.

## 2.9 Water Quality in Local Creeks

Appendix B of the *PPR Surface Water Assessment* included details of routine water quality monitoring undertaken at three sites on Laheys Creek and Sandy Creek and two sites on the Talbragar River. The water quality data indicates that Laheys Creek and Sandy Creek have significant naturally occurring sources of salinity and are strongly influenced by agricultural activities on the catchment. The water quality data indicates that Sandy Creek, Laheys Creek and the Talbragar River could be described as representing 'moderately to highly disturbed' aquatic systems.

These data have been used as a basis for modelling water quality over a 30 year period in order to provide a basis for proposed water quality objectives that reflect local conditions based on the procedure set out in the ANZECC Guidelines. Notwithstanding the effort involved in modelling, the resulting water quality objectives are very little different from the values that could have been derived from direct statistical analysis of the monitoring data.

The PAC Review recommended that the water quality monitoring data be re-analysed and revised water quality objectives be provided in the Site Water Management Plan, along with monitoring protocols and statistical tests designed to detect any change in water quality associated with mining activity.

This issue was not addressed in the *Revised PPR*. However the following commitments were made in respect of surface water monitoring:

6. Surface water monitoring programs will be provided in the groundwater and surface water plans to detect any AMD.
20. Surface water will be monitored upstream and downstream of the mine.
49. An aquatic monitoring strategy will be developed to detect changes to the quality and quantity of water in the semi-permanent pools in Laheys and Sandy Creeks. A River Monitoring Committee (including Fisheries NSW, NSW Office of Water and other appropriate agencies) will be formed to review the results from this strategy and to assist formulate adaptive management measures.

The EPA, (letter dated 8 March 2013) provides recommendations for conditions of approval that would require the preparation of a Site Water Management Plan to address a number of water quality matters including:

- Setting of water quality the trigger values for investigation derived from assessment against water quality objectives (WQOs) determined using either ANZECC (2000) default trigger values or site specific WQOs determined in accordance with ANZECC (2000) and DEC (2006) procedures.
- The development of sediment basin salinity, acidity and metal trigger values that prompt investigations of the causes of elevated salinity, acid or metal levels and the implementation of mitigation measures.

The water quality data reported in Appendix B of the *PPR Surface Water Assessment* indicates that the water quality in the local watercourses is sufficiently different from the ANZECC default trigger values for aquatic ecosystems to warrant the preparation of site specific trigger values. While the water quality dataset quoted in Appendix A of the *PPR Surface Water Assessment* contains 23 records collected over a period of a little more than two years from the five monitoring sites, a larger dataset would provide improved confidence in the analysis to justify:

- Site specific trigger values for ambient water quality in Sandy Creek and Laheys Creek;
- Trigger values for salinity, acid or metals in sediment basins. (In addition to meeting the standard sediment concentration for discharge (50 mg/L), the proponent has committed not discharging water with elevated salinity from the sediment basins. This would require water to be transferred from sediment basins to the mine water management system in the event of elevated salinity.)

It is recommended that the requirement for ongoing baseline surface water monitoring prior to the commencement of mine construction be required as a condition of approval, particularly Sandy Creek and Laheys Creek. Any ongoing water quality monitoring program should also consider the value of establishing baseline conditions in the creek systems upstream and downstream of the proposed mine. (SW2 is located downstream of the southern extent of the mine footprint and SW3 is upstream of the northern extent of the mine.) Two additional monitoring locations should be considered (consistent with the commitment to monitor water quality upstream and downstream of the mine):

- Laheys Creek about 1.5 km upstream of SW2;
- Sandy Creek near the junction of Sandy Creek Road and Cobbora Road (access from either Sandy Creek Road or the creek crossing on Cobbora Road).

### 2.9.1 Discharge from Cleared and Overburden Areas

As stated in **Section 2.8.1** above, the *Revised PPR* assumes that if the area of the various land uses reduce or remain very similar to the original mine plan then it could be inferred that the impacts of the Project will be less than or similar to those already assessed. **Table 2.18** above summarises the change in area of the various land uses, including the areas that would drain to sediment dams (cleared areas, soil stockpiles, active overburden emplacement and rehabilitated emplacement areas [prior to full establishment of vegetation]). **Figure 2.6** summarises this information graphically and shows that the area draining to sediment dams for the revised mine plan would generally be in the range of 55% to 60% of the original mine plan. The total runoff from these areas can therefore be expected to of the order of 55% to 60% of the estimates for the original mine plan and, provided the runoff from the overburden area is adequately managed, that the impacts would be no worse than for the original mine plan.

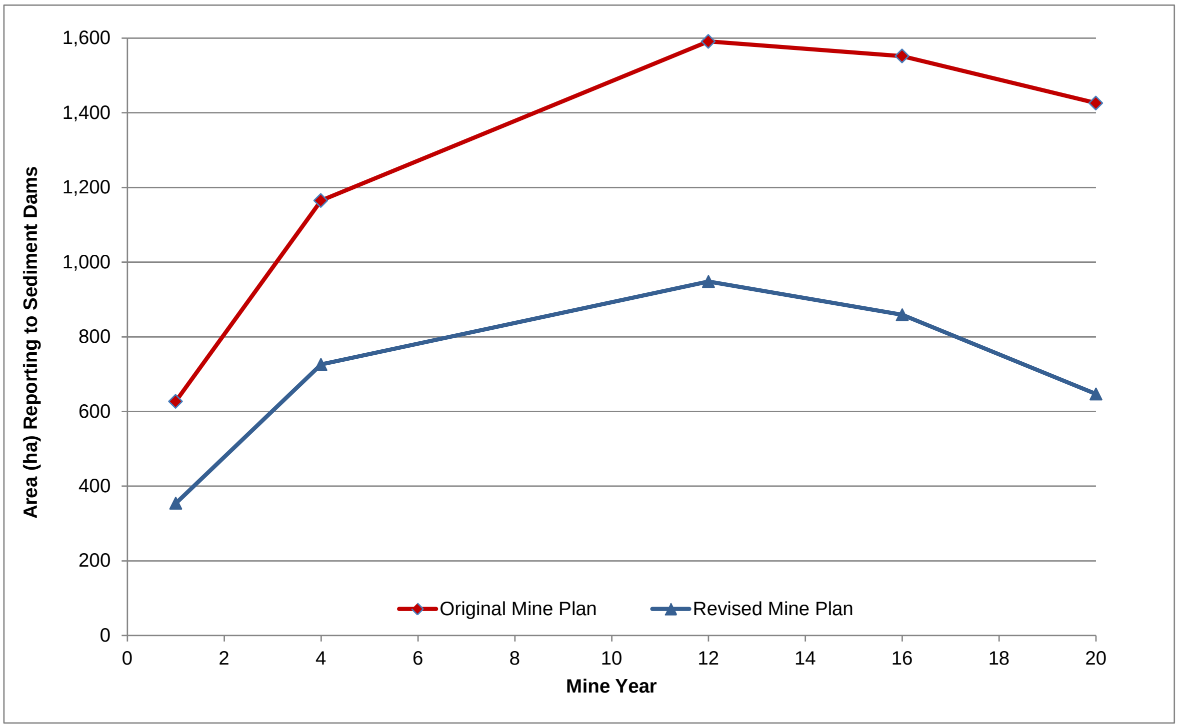


**Figure 2.6:**
**Area reporting to sediment dams for original and revised mine plans**

The *Revised PPR* states that mine water management will focus on separating:

- Clean water - diverted around disturbed areas and returned to the environment;
- Sediment laden runoff from disturbed mining areas - harvested and used on site (in line with the 25% rule – see **Section 2.6.3**) or discharged from sedimentation dams into creeks if water quality criteria are met;
- Runoff from infrastructure areas - harvested and pumped to the process water circuit for re-use. This water will not be discharged from the site;
- Water from the base of the pit - pumped to the process water circuit for re-use. This water will not be discharged from the site.

In addition the *Revised PPR* states that groundwater bores will be used to dewater the mine pit area, but is not explicit regarding where this water will be directed. As this water is likely to have elevated salinity, this water should only report to the process water circuit for re-use.

Provided an appropriate Site Water Management Plan is prepared to ensure adherence to these principles for maintaining separation of different quality water, it is considered that the water quality impacts of the Project can be adequately managed. The Plan should include protocols for the monitoring water quality of water in the sediment dams prior to discharge.

### 2.9.2 Independent Expert Scientific Committee

The IESC's submission dated 18 April 2013 identified the following potential issues relating to water quality:

- Insufficient information to reasonably understand potential impacts on downstream water quality – particularly salinity:

- The increased risk of salinity as a result of surface discharge and groundwater drawdown resulting from the proposed project may have significant ramifications for downstream users and ecosystems;
- The proponent has not considered the potential impacts on the surrounding creeks and water quality as a result of uncontrolled discharge from the mine water dams. The sedimentation dams are currently designed to contain 95 per cent of a 5 day storm event (63.3 mm), which means that they have the potential to overflow approximately 1 to 2 times per year. Consideration should be given to sedimentation dams being redesigned to contain a larger storm event (1 in 1000 year average recurrence interval) to minimise the potential for downstream water quality and ecological impacts.

It was noted in the *PAC Review* that the sediment dams would not reduce total dissolved solids and salinity. The only way that some control could be exercised over saline discharge from the sediment dams (or any other dissolved characteristic such as metals, nitrogen, or pH) would be for all water that exceeded the adopted discharge criteria to be transferred to a mine water dam. This might involve a change in the operating strategy from that adopted for purposes of the water balance analysis.

The PAC Review concluded that provided the following facilities are in place and the required management practices are followed, there is no reason why the mine would significantly impact on water quality in Sandy Creek or the Talbragar River:

1. Mine water management facilities are designed and managed so as to retain runoff from pits and all active mine areas without discharge;
2. Facilities are provided to allow the transfer of water from sediment dams to the mine water dams in the event that the water does not comply with the discharge water quality criteria.

It is considered that the information provided in the *PPR* and *Revised PPR* generally addresses the issues raised by the IESC:

- Information has been provided to characterise the existing downstream water quality. As recommended above, ongoing baseline monitoring should continue prior to the commencement of the Project to enable appropriate trigger values to be determined in accordance with the ANZECC Guidelines. The Site Water Management Plan should identify appropriate discharge water quality requirements to protect the downstream water quality;
- It is not considered appropriate or consistent with current best practice to require sedimentation dams to contain discharge for an event of 1,000 ARI. The sedimentation dams have been designed in accordance with the procedures outlined in *Managing Urban Stormwater Soils and Construction Volume 2E Mines and quarries* (DECC, 2008), which is the acceptable standard for NSW.

## 2.10 Fluvial Processes and Flooding

The *PAC Review* noted that the mine facilities would have minimal impact on the flood regime except in a few locations which require further assessment and detail, particularly in relation to flow velocities and sour protection in the immediate vicinity of some crossings where sharp drops in flood levels imply high velocities and the potential for scour. In addition, details were required of the protection of the toe of the overburden dump on the western side of Laheys Creek which will be a permanent feature of the landscape after mining ceases.

Specifically, the *PAC Review* found that the further details will be required in relation to:

- The impacts of structures on channel and floodplain velocities in the immediate vicinity of the proposed crossings;
- Measures to control scour in the immediate vicinity of the structures where excessive velocities are likely to occur;
- The design standard to be adopted for protection of the toe of the overburden dump on the western side of Laheys Creek (Mine Zone B).

In response, the *Revised PPR* states that the impacts of the crossing structures on local channel and floodplain velocities are available from the flood model and the model predictions of the changed velocity profiles will be used to inform:

- The design of scour protection measures such as energy dissipation aprons and basins at the inlets and outlets of culverts;
- Assessment of extreme flood event scour potential at abutments and piers of bridges and design of measures to protect the structures under these events;
- Assessment of extreme flood event scour potential along the areas of the flood protection levees and overburden dumps and dams that are at risk of flooding; and
- Design of measures to protect these structures from erosion during extreme events.

Existing and future flood velocities at Crossings 4, 5 and 7 are provided in Table 9 in Appendix D of the *Revised PPR* and are reproduced in **Table 2.20** below.

**Table 2.20: Existing and future case flood velocities at key crossing structures**

| Crossing No. | 100 year ARI | | 2,000 year ARI | |
|---|---|---|---|---|
| | Existing Velocity (m/s) | Future Velocity (m/s) | Existing Velocity (m/s) | Future Velocity (m/s) |
| 4 | 1.1 | 1.4 | 0.9 | 1.0 |
| 5 | 0.5 | 0.5 | 0.9 | 0.6 |
| 7 | 1.0 | 1.2 | 1.3 | 3.8 |

Velocities at Crossings 4 and 5 are relatively low for extreme events and standard scour protection measures will be adopted for these crossings. Crossing 7 has significantly higher velocities for the 2,000 year ARI event and will require significant scour protection for this permanent structure.

The *PPR* states that 2,000 year ARI velocities will be used to design the scour protection around the toe of flood protection levees, overburden dumps and sedimentation dams that are located at the edge of the creek floodplains.

Details of the proposed scour protection works will need to be specified in the Site Water Management Plan for approval prior to construction.

## 2.11 Final Landform

Figure 3.14 of the *Revised PPR* shows the proposed final land use which would comprise a mixture of woodland and grazing with some cropping areas on the south-western side of Area C. Cross sections of the proposed final landform are provided in Figure 3.15 of the *Revised PPR*. However, these figures lack sufficient contour detail to provide an overall understanding of the proposed landform and the proposed arrangements for co-ordinated orderly surface drainage from the final land surface into the existing creek system.

Although it is not evident from Figure 3.14, Section 3.13.1 of the *Revised PPR* states that the revised final landform eliminates depression areas that were originally proposed for Area A and Area C. Accordingly, issues relating to possible capillary rise within the overburden (see Attachment 1 to Appendix D) are no longer relevant.

In view of these issues, conditions of approval should contain requirements for:

- Submission of more detailed landform plans as part of the Site Water Management Plan. These landform plans should including sufficient detail of the location and indicative design characteristics (longitudinal and cross sections) of the proposed surface drainage systems to demonstrate the proposed principles for drainage of the final landform;
- Preparation of updated final landform plans (and associated rehabilitation staging) at, say, Mine Years 5, 10 and 15.

## 2.12 Final Void

The revised mine plan includes a final void in the south-west corner of Area A. While the area of the void itself (below natural ground level?) has been reduced from 143 ha to 118 ha, the revised landform would lead to an increase in the contributing catchment from 242 ha in the original mine plan to 301 ha (24% increase).

Appendix E summarises the results of the water and salt balance analysis undertaken for the revised void geometry (depth, volume and surface area) which takes account of groundwater inflow and runoff from the surrounding catchment. The same groundwater inflow – level relationship was adopted as for the December 2012 mine plan. To address uncertainty in adopting this previous relationship, a sensitivity test of the water and salt balance model was also undertaken with an increased groundwater inflow of 50%.

The water and salt balance analysis utilised a 1,000 year synthetic rainfall and evaporation sequence based on the statistics of local rainfall and evaporation. Key findings from this analysis are:

- Maximum lake level of 377.5 m AHD;
- Freeboard to spill level of 6.5 m (implied spill level 384 m AHD);
- Volume of void between the maximum lake level and spill level of about 4,200 ML;
- Peak salinity after 100 years 150,000 mg/L.

The *Revised PPR* states that, as for the original mine plan, the final void lake for would act as a groundwater sink.

Figure 8.4 in Appendix E of the *PPR Surface Water Assessment* shows the adopted groundwater inflow relationship for the final void. This figure shows that at a lake level of 377.5 m AHD, the groundwater inflow would be about 550 $m^3$/day. The figure also shows that a lake level of 384 m AHD (the inferred spill level), the inflow would be 460 $m^3$/day. It is unclear how groundwater inflow could continue to occur while the lake was spilling, presumably at natural ground level.

A number of aspects of the analysis of equilibrium lake level require clarification in terms of their potential impacts on maximum equilibrium lake level and salinity:

- There is no assessment of the potential long term effects of climate change;
- The analysis overlooks the fact that the evaporation rate will decline as the water increases in salinity. The general form of this relationship is shown in **Figure 2.7** which shows that at

the predicted salinity of 150,000 mg/L after 100 years, the evaporation rate would be about 86% of that for fresh water.

While these effects may offset each other, further analysis is warranted at the time of the preparation of the Site Water Management Plan to confirm the groundwater inflow relationship as well as take account of the sensitivity of the equilibrium lake level to climate change and salinity effects.

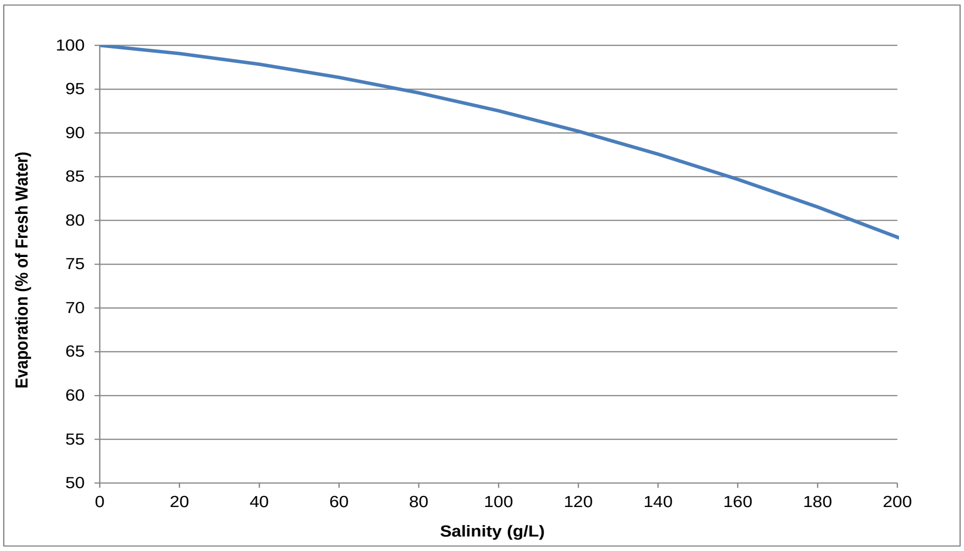


**Figure 2.7:**
**Effect of Salinity on Evaporation**

The re-assessment of the long term performance of the void lake should confirm that:

- The lake would remain a groundwater 'sink';
- The maximum equilibrium lake level would provide an appropriate freeboard before spillage could occur into the natural environment

From Figure 3.14 in the *Revised PPR*, it appears as though the composition of the catchment draining to the pit would be:

- The void itself: 118 ha (as quoted above);
- Natural land to the south-west of the void: approximately 30 ha;
- Rehabilitated overburden: 153 ha (total catchment of 301 ha minus the void and natural landform).

From inspection of the landform depicted in Figures 3.14 and 3.15 of the *Revised PPR*, there would appear to an opportunity to carry out minor changes to the landform in order to significantly reduce the contributing catchment area draining to the void. In particular, the area of grazing land along the north-east boundary of the void could be sloped away from the void and a drainage line created in the middle of this area or along the foot of the slope on the north-east side of this area. Such adjustment to the final landform would have the effect of reducing the catchment area draining to the void and further reducing the equilibrium water level.

For the original mine plan described in the *PPR*, the minimum top-of-void level is quoted as 407 m AHD whereas the revised mine plan is quoted as having a minimum top-of void level (384 m AHD). The reasons for this difference (23 m) is not apparent from inspection of Figure 3.14 in the *Revised PPR*. If necessary, it would appear that further protection against the risk of overflow from the void could be provided by minor adjustment of the landform and levels near the north-west corner of the pit.

In conclusion, Section 3.2.3 of Appendix E states:

> "*Further work would be required at the operational stage to determine a final void lake management solution as part of a mine closure plan. This work would be based on further monitoring data collected through the operational phase to develop a more detailed understanding of the long term behaviour of the final void lake.*"

While it is appropriate for the future conditions (water level and salinity) to be reassessed at the time of the preparation of a Mine Closure Management Plan, it is unclear what is intended by "*a final void lake management solution*".

# 3 Commitments and Suggested Conditions of Approval

## 3.1 Proponent's Commitments

Table 16.1 of the *Revised PPR* provides a summary of key commitments, including those listed below that relate to aspects of the surface water assessment. It is assumed that these commitments will be reflected in any conditions of approval for the project. Any suggestions for amendment or clarification of these commitments are set out in **Section 3.2** below.

6 Surface water monitoring programs will be provided in the groundwater and surface water plans to detect any AMD.

10 The following contaminated water storages will be lined with clay to achieve a permeability of 1 x $10^{-9}$ m/s or less with a recompacted clay liner at least 90 cm thick (or an equivalent geosynthetic liner):

- the out of pit tailings storage facility; and
- mine water dams.

16 As much water as practical will be recycled on site.

17 Water will be managed to ensure sufficient is available for operations and that any excess water does not increase flooding or cause material downstream quality impacts.

18 CHC will enter into an extraction strategy agreement with State Water Corporation to help minimise transmission losses from the Cudgegong River and maximise the use of excess flows in the lower reaches of the river.

19 Excess water access licence entitlements will be sold back into the market wherever practical.

20 Surface water will be monitored upstream and downstream of the mine.

21 All contaminated water (runoff from pit, plant and all mine active areas) will be captured and retained on site within the mine water dams.

22 Where water from sediment dams does not comply with discharge criteria then it will be transferred to the mine water dams.

23 CHC will monitor the development of dewatering technologies including undertaking testwork and piloting if a technology appears to be environmentally and economically promising. As a minimum, a feasibility study will be undertaken to determine the preferred dewatering option before in pit tailings placement is required.

24 Flocculants will be used in sedimentation dams that have low ecotoxicity and records will be maintained of the flocculants used on the site, product ecotoxicity information and application rates.

25 Sedimentation basins will be designed, constructed and operated in accordance with only the following guidelines:

- *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom 2004); and
- *Managing Urban Stormwater: Soil and Construction: Volume 2E Mines and Quarries* (DECC 2008).

26 CHC will prepare surface water management plans (SWMPs) in consultation with EPA and NOW and to the satisfaction of the Director General of the DP&I. The construction SWMP will be finalised prior to the start of construction and the operations SWMP will be finalised prior to the start of the initial box cut.

49 An aquatic monitoring strategy will be developed to detect changes to the quality and quantity of water in the semi permanent pools in Laheys and Sandy creeks. A River Monitoring Committee (including Fisheries NSW, NSW Office of Water and other appropriate agencies) will be formed to review the results from this strategy and to assist formulate adaptive management measures.

68 The following management measures will be implemented to limit dust emissions:

- watering of travel routes (75% control efficiency);
- average vehicle travel speed on haul roads of 40 km/hr;
- routine maintenance of haul roads to ensure low silt content within road surface material;
- drop height minimisation;
- cease/modify operations during excessively dry and windy conditions; and
- progressive rehabilitation of emplacements.

69 The water balance will be monitored such that during "dry climate" years chemical dust suppressants will be used as required to reduce water use.

## 3.2 Suggested Conditions of Approval

The following suggestions are matters that warrant inclusion in appropriately worded conditions of project approval. These suggestions assume that any project approval would include the requirement for a Site Water Management Plan to be prepared (to the satisfaction of the Director General and in consultation with OEH, EPA and NOW).

1) The Proponent shall prepare and implement a **Construction Site Water Management Plan** (SWMP), to the satisfaction of the Director-General. The construction SWMP must be approved by the Director-General prior to the start of construction. This plan must:

a) be prepared in consultation with EPA and NOW by suitably qualified expert/s whose appointment/s have been approved by the Director-General; and

b) include an Erosion and Sediment Control Plan for:

- all permanent facilities within the footprint of the mine including the mine infrastructure area, the mine water storage dams, the raw water dam and the out-of-pit tailings emplacement;
- construction of the pump station on the Cudgegong River and the pipeline between the pump station and the raw water dam;
- construction of the rail line between the site and the Dunedoo – Gulgong Railway at Tallawang;

c) be approved by the Director-General prior to commencement of construction of mine facilities or any services associated with the mine.

2) The Proponent shall prepare and implement an **Operational Site Water Management Plan**, to the satisfaction of the Director-General. The **Operational SWMP** must be approved by the Director-General prior to the prior to the start of the initial box cut. This plan must:

(a) be prepared in consultation with OEH and NOW by suitably qualified expert/s whose appointment/s have been approved by the Director-General; and

(b) include:

- a Site Water Balance;
- an Erosion and Sediment Control Plan;
- a Surface Water Management and Monitoring Plan;
- a Final Landform Concept Plan;
- a Ground Water Monitoring Program; and
- a Surface and Ground Water Response Plan.

(c) include details of the design of major storages, including out-of-pit and in-pit tailings storages to demonstrate that the designs comply with the requirements of the NSW Dam Safety Committee in relation to structural design and hydraulic design; and EPA in terms of containment.

3) The **Erosion and Sediment Control Plan** for the construction phase must:

(a) be consistent with the requirements of the following volumes of the series *Managing Urban Stormwater: Soils and Construction:*

- *Volume 1* (Landcom, 2004)*;*
- *Volume 2A – Installation of Services* (DECC, 2008) – as relevant to pipeline construction;
- *Volume 2C – Unsealed Roads (DECC, 2008)* - as relevant to railway construction;
- *Volume 2E – Mines and Quarries* (DECC, 2008) - as relevant to permanent facilities within the footprint;

(d) identify activities that could cause soil erosion and generate sediment;

(e) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;

(f) describe the location, function, and capacity of erosion and sediment control structures;

(g) identify the water quality limits for discharge from sediment dams and describe the measures to monitor water quality prior to discharge and, if necessary, utilise flocculants to achieve the required limit for suspended solids;

(h) identify any sediment control structures that are to remain following completion of construction; and

(i) describe what measures would be implemented to maintain the structures over time.

4) The **Site Water Balance** must:

(a) include details of:

- sources of water;
- reliability of water supply;

- water use on site;
- operating rules and emergency procedures for water management on site;
- off-site water transfers;
- reporting procedures; and

(b) describe measures to minimise water use by the project.

(c) include further refinement of the water balance modelling presented in the *PPR* and *Revised PPR*. The water balance modelling should be based on specific details of the water management facilities (dam size, pump capacity, etc) have been determined for the final mine plan. Specifically, the water balance model should be used to:

- confirm the operating rules for transfer of water between various storages (including transfer of decant and rainfall onto the out-of-pit tailings dam);
- confirm the operating rules for transfer of water from the overburden sediment dams to the mine water system and details of the facilities required to implement the proposed management regime;
- confirm the freeboard allowance in all mine water dams and tailings dams in order to minimise the risk of uncontrolled discharge to the environment;
- provide justification for the design and operation of the Infrastructure Sedimentation Dams (SD1, SD2, SD3);
- assess the requirements for management and emergency actions in the event of breakdown (e.g. pump failure, pipeline leakage).

(d) for all stages of overburden placement, rehabilitation and following completion of mining, justify assumptions regarding the portioning of incident rainfall between surface runoff, soil moisture (available for evapotranspiration) and deep drainage to the in-pit groundwater.

(e) ensure that assumptions relating to groundwater baseflow losses and groundwater contribution to refuge pools are consistent between the surface water and groundwater models.

5) The **Final Landform Concept Plan** must:

(a) provide sufficient elevation detail to define the overall topography of the proposed final landform;

(b) minimise the contributing catchment area draining towards the final void;

(c) identify the location and form of the main drainage lines within the landform and the locations of discharge to the natural creeks;

(d) identify the location of any flow control or drop structures;

(e) identify the location of any sediment dams that are intended to remain once mining is complete;

(f) include design criteria to be adopted for all drainage lines and flow control structures including the design storm, bed gradient, typical cross sections, scour protection, etc.;

(g) identify scour protection measures for all permanent mine structures (eg overburden) that have the potential to be affected by extreme floods (eg 2,000 year ARI) in Laheys Creek, Sandy Creek and Blackheath Creek;

(h) include an indicative schedule for the progressive construction and rehabilitation of all permanent drainage facilities as mining progresses.

6) The **Erosion and Sediment Control Plan** for the operational phase must:

(a) be consistent with the requirements of the following volumes of the series *Managing Urban Stormwater: Soils and Construction:*

- *Volume 1* (Landcom, 2004)*;*
- *Volume 2E – Mines and Quarries* (DECC, 2008) - as relevant to permanent facilities within the footprint;

(j) identify activities that could cause soil erosion and generate sediment;

(k) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;

(l) describe the location, function, and capacity of erosion and sediment control structures;

(m) identify the water quality limits for discharge from sediment dams and describe the measures to monitor water quality prior to discharge and, if necessary:

- utilise flocculants to achieve the required limit for suspended solids; or
- transfer water to the mine water management system in the event that salinity and/or suspended sediment concentrations exceed the required limit for discharge;

(n) identify any sediment control structures that are to remain following completion of mining; and

(o) describe what measures would be implemented to maintain the structures over time.

7) The **Surface Water Management and Monitoring Plan** must include:

(a) detailed baseline data on surface water flows and quality in creeks and semi-permanent pools that could potentially be affected by the project;

(b) a monitoring program to determine the overall water balance of the refuge pools and identify the degree of dependence on groundwater for each pool;

(c) surface water and stream health assessment criteria based on a minimum of two years routine monthly monitoring;

(d) measures to ensure maintenance of separation of different quality water within the mine;

(e) rules for the operation of the mine water management system including monitoring frequency and emergency response actions in the event of breakdown (e.g. pump failure, pipeline leakage), and compliance with the requirements of the NSW Dam Safety Committee;

(f) a monitoring regime designed to determine all key water sources, uses and losses in sufficient detail to permit benchmarking of the Site Water Balance (and periodic updating [say Mine Years 2, 5, 10, 15] to reflect actual operational experience);

(g) water quality trigger values for investigation of exceedances based on the procedures set out in:

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000); and
- *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DECC, 2006);

(h) water quality criteria for discharge of runoff collected in sediment dams;

(i) a program to monitor surface water flows, quality and impacts on water and the environment (upstream and downstream of the project in Sandy Creek and Laheys Creek);

(j) a program to assess stream health conditions in Sandy Creek and Laheys Creek;

(k) a program to monitor water levels and quality in semi-permanent refuge pools in Sandy Creek and Laheys Creek;

(l) measures to sustain the water levels, water quality and temperature requirements for maintenance of the aquatic ecology in the refuge pools.

(m) a program to monitor channel stability in Sandy Creek and Laheys Creek, particularly in the vicinity of locations where mine related structures encroach onto the floodplain (as defined by the extent of the 100 year ARI flood);

(n) reporting procedures; and

(o) a protocol for the investigation, notification, and mitigation of identified exceedances of the surface water and stream health assessment criteria.

8) The **Ground Water Monitoring Program** must:

(*See review of groundwater aspects of the Cobbora Coal Project prepared by Kalf & Associates*.)

9) The **Surface and Ground Water Response Plan** must include:

(a) a protocol for the investigation, notification and mitigation of any exceedances of the surface water, stream health and groundwater impact assessment criteria

(b) measures to mitigate and/or compensate potentially affected landowners with privately owned groundwater bores within the predicted drawdown impact zone identified in the *Revised PPR*, including provision of alternative long term supply of water to the affected landowner that is equivalent to the loss attributed to the project;

(c) measures to mitigate and/or offset any adverse impacts on groundwater dependent ecosystems or riparian vegetation, particularly identified refuge pools.

(d) measures to address any adverse impacts resulting from uncontrolled discharge from mine water dams, tailings storages or sediment dams;

(e) procedures that would be followed if any unforeseen impacts are detected during the project.

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