6 Groundwater

6.1 Project changes and assessment

The Project changes have not directly resulted in changes to the groundwater assessment. However, the groundwater assessment has been updated to address comments from a number of agencies and councils (Appendix E). The updated assessment and associated groundwater modelling is based on the Project described in the EA and the changes described in this report (Chapter 3).

6.2 Response to submissions

6.2.1 Adequacy of impact assessment

Submissions

C-2, I-45

Issue

These submissions comment that the EA is incomplete in relation to water and that the council has not been able to gather further information on the potential impact of water availability and water licensing.

Response

As described above, the groundwater assessment report has been updated and is provided in Appendix E.

6.2.2 Groundwater modelling

Submission

NA-7

Issue

The DPI comments that a superseded post-mining landform was used in the groundwater model and that the model should be re-run, including a sensitivity analysis of the final water level in the void. Additionally, the DPI requests a worst-case pit inflow scenario with clarification of the certainty of the void acting as a local sink.

Response

The numerical groundwater model was re-run using the final landform and all post-mining results reported in Appendix E relate to this final landform design.

The uncertainty analysis in Appendix E (Section 5.3 of Appendix H 'Groundwater model technical report') provides an analysis of the worst-case pit in-flow scenarios. These were incorporated into surface water modelling of the final void water levels and show that the pit lake will remain a net sink in all modelled scenarios (Section 5.3.3 of Appendix F 'Surface water assessment').

6.2.3 Threat to other industries

Submissions

G-2, G-10, G-11, G-13, G-15, I-4, I-8, I-12, I-13, I-15, I-21, I-22, I-23, I-32, I-34, I-37, I-38, I-39, I-46, I-55, I-61, I-62, I-64, I-65, I-66, I-68, I-74, I-75, I-76, I-79, I-80, I-84, I-85, I-86, I-95, I-96, I-98, I-100, I-109, I-110, I-111, I-113, I-114, I-116, I-118, I-119, I-121, I-135, I-136, I-139, I-140, I-142, I-148, I-152, I-153, I-157, I-158, I-163, I-164, I-172, I-179, I-185, I-187

Issue

These submissions comment that the Project will create unfair competition for water to the region's established tourism and agricultural industries.

Response

The maximum surface and groundwater licences required for the Project total 6,034 ML/a (3,311 ML/a from the Macquarie and Cudgegong Regulated River Water Source, 799 ML/a from the Lower Talbragar River Water Source and 1,924 ML from the Gunnedah-Oxley Basin MDB Groundwater Source), an increase of 18% from the total presented in the EA. Most of these water licences have been purchased, with a further 900 ML/a aquifer access licence required. The amount of additional water the Project requires is about 15% of the water purchased to date (6,114 ML/a) and is unlikely to distort the water market. As stated in Section 9.5.5 of the EA, CHC will investigate the sale of any unused water from the water access licences to agricultural enterprises. The impact of using water that could otherwise be used for agriculture is discussed in Section 8.2.3.

6.2.4 Groundwater licensing

Submissions

NA-8, G-11, I-9, I-63

Issue

These submissions comment that not all necessary groundwater licences have been acquired. The CMA commented that the required groundwater licences may not be available for purchase before 2031.

Response

The majority of the aquifer access licences required to account for groundwater use (1,924 ML/a or 'unit shares') have been acquired from the water trading market. As of January 2013, CHC holds three aquifer access licences with a combined entitlement of 1,024 ML/a for the Gunnedah-Oxley Basin Groundwater Source. The remaining 900 ML/a is still required. The pending finalisation of a 150 ML/a purchase reduces the requirement to 750 ML/a from about 16,000 ML/a across about 113 licence holders in the basin. In addition, there is a large volume of unassigned water in the basin, about 178,000 ML (Section 2.3.1 of Appendix E).

6.2.5 Salinity

Submissions

NA-1, I-45

Issue

Two submissions comment that shallow groundwater aquifers and associated biological ecosystems will be contaminated with salt from the Talbragar and Cudgegong Rivers. The EPA requested an investigation of the potential for hypersaline water conditions to develop in the final void and the potential effect on groundwater quality in adjoining aquifers. The EPA requests the potential for ecotoxicological and amenity impacts from anoxic conditions in final void water be examined as part of mine closure planning.

Response

The final void will contain a saline lake (Section 5.3.3 of Appendix F). Groundwater will not flow from the void towards the creek and the lake will not 'overtop' causing surface water flows. Therefore the void lake will not degrade water quality in the adjacent Sandy Creek. Groundwater and surface water monitoring (see Section 8.1 of Appendix E and Section 7 of Appendix F) during operations will provide detailed data to refine these predictions. This will be used to update the final void water modelling as part of preparing the detailed mine closure plan as described in the EA (Section 3.20.2).

6.2.6 Impact to groundwater systems

Submissions

G-5, I-18, I-49, I-91, I-106, I-112, I-117, I-137, I-138, I-145, I-149, I-151, I-156, I-168, I-173

Issue

These submissions comment that the water available to existing private water bores, alluvial aquifers and groundwater sources may be reduced as a result of the Project. It was commented that the Project could damage groundwater supplies and impact the aquatic ecology of Laheys Creek, Sandy Creek and the Talbragar River.

Response

Groundwater modelling predicts that 13 groundwater bores will experience drawdown greater than 2 m during operations. Ten of these are owned by CHC, and the maximum drawdown in the three private bores are 2.2 m, 2.4 m and 5.1 m. As stated in the EA (Section 7.5.5), CHC has committed to rectifying significant impacts to these bores at the company's cost.

The depressurisation likely to occur in the Permo-Triassic units to the west of mining areas A and B is likely to induce leakage from the alluvium and cause a decline in groundwater seepage in semi-permanent pools in the creeks. This may reduce the availability of groundwater to ecosystems potentially relying on shallow groundwater and four semi-permanent pools within the creeks and river (see Section 6.2.8). However, the pools will receive increased surface water flows during median and wet years, which may offset the loss of groundwater inflow. In addition, rainfall and flood recharge is likely to sustain the local alluvium aquifers for several months following rainfall and flood recharge events. Monitoring alluvial and Permo-Triassic outcrop monitoring bores will be used to identify if impacts are occurring and to determine appropriate mitigation measures. This could include releasing water from the mine site that meets water quality objectives.

6.2.7 Contamination of groundwater by tailings

Submissions

NA-1, NA-7, NA-13

Issue

The DPI comments the proposed method of tailings storage will lead to a moisture content that may result in seepage into underlying groundwater. The DPI states that tailings leachate assessment has highlighted potential exceedances in water quality parameter trigger values; however, the assessment of the associated impact is inadequate. DPI also notes it is recognised the tailings storages will not be lined with any natural or artificial barrier and the proposed method of tailings production will lead to a moisture content that may result in seepage into underlying groundwater.

The EPA states that where the authority's permeability requirements for contaminated water storages are met, any contaminants contained in contaminated water storages still have potential to permeate below clay linings, albeit over a long time. Hence an assessment also needs to be provided, including:

- an assessment of the long-term fate of contaminants in contaminated water storages;
- an assessment of potential impacts on groundwater quality in the longer term, against ANZECC/ARMCANZ (2000) criteria for any beneficial uses likely to be impacted as well as the preservation of aquatic ecosystems; and
- longer-term arrangements for managing, monitoring and responding to any such impacts beyond the operational life of the proposed mine.

The DP&I requests further assessment on the management of wastes and PAF material within the pit shell below recovered groundwater levels, particularly the ability to dispose of directly or relocate wastes deep within pit shell rather than within emplacement areas higher in the mine landform, with increased potential for migration and oxidation. The DP&I also requests further information on the management of tailings and reject materials within the pit shell and/or emplacements and the potential impacts on groundwater.

Response

The proposed tailings management plan has been substantially revised. It is now proposed to line the tailings emplacements as described, along with seepage collection, in Section 3.3 and Appendix B 'Tailings storage facilities management plan'.

The predicted leachate quality (see Section 6.3 of the EA), the geology, the depth to groundwater and the groundwater quality (Section 7.3.4 of the EA) will be considered to determine the best possible liner design to ensure groundwater protection in accordance with ANZECC/ARMCANZ (2000) guidelines. The EA (Section 7.5.4) found that leachate from tailings from the Whaka and Flyblower seams had slightly higher pH (maximum pH 7.9) than the ANZECC/ARMCANZ (2000) guideline for south-eastern Australian upland streams (pH 6.5–7.5) and the pH in the Triassic aquifers (pH 5.83–7.67). The pH in leachate from tailings from the Ulan Upper and Ulan Lower seams was lower that the ANZECC/ARMCANZ (2000) guideline. Metal concentrations (with the exception of nickel and zinc from Trinkey coal seam tailings) were all below ANZECC/ARMCANZ (2000) guidelines or were within the range measured in the underlying Triassic and Permian aquifers. Therefore, there will be minimal impacts as a result of any tailings leachate that permeates to these aquifers.

As stated in the EA (Section 6.3), it is likely the actual volume of PAF, PAF-LC or UC PAF waste rock will be close to 9% of the total volume of waste material. Additional test work is under way to further understand the geochemical characteristics of mine materials, with results expected in March 2013 (see Section 5.2.1). As there will be more than one tailings emplacement operating at any one time, any PAF tailings will be placed below the water table or sufficiently deep within an emplacement so that once drained and capped, oxygen will not reach the tailings causing acid and/or metalliferous leachate generation.

6.2.8 Groundwater monitoring

Submission

NA-7

Issue

The DPI requests that a comprehensive groundwater monitoring network be established, including at Naran Springs, to ensure an ongoing review of predicted impacts and to inform contingency planning if required. Naran Springs are the closest high priority groundwater dependent ecosystem listed in the Water Sharing Plan for the Murray Darling Basin Groundwater Sources. The springs are 1.5 km west of the 1 m modelled drawdown contour.

Response

A comprehensive groundwater monitoring network has already been established and additional details of the expanded groundwater monitoring network and monitoring program are provided in Section 8 of Appendix E.

Naran Springs is thought to be similar to the other springs identified in the study area and associated with outliers of Jurassic sedimentary rocks. The aquifers in these rocks and Naran Springs are unlikely to be impacted. However, it is proposed to install monitoring bores at Naran Springs. One bore will be screened into the base of the Jurassic rock and one screen will be into the underlying Permian Ulan Coal Seam.

6.2.9 Groundwater dependent ecosystems

Submissions

NA-2, NA-13, G-5, G-11, G-16, I-45, I-145

Issue

These submissions comment that surface flows to Laheys Creek, Sandy Creek and the Talbragar River will be reduced as a result of the loss of catchment in the mine footprint and will result in loss of base flows due to groundwater drawdown during and after mining. One submission comments that there has not been adequate consideration of the impact of loss of water availability to terrestrial fauna species during drought, particularly the effect on deep pools as drought refugia (refuges) in ephemeral streams, threatened freshwater catfish (*Tandus tandus*), the degradation of riparian vegetation and other groundwater-dependent ecosystems.

Response

The updated surface water assessment (Section 5.2.2 of Appendix F) considers the impact on 14 semi-permanent pools in Laheys Creek, Sandy Creek and the Talbragar River due to the reduced groundwater inputs; groundwater drawdown; and changed surface water flows from catchment changes during and post-mining. The assessment concluded that drawdown is likely to affect groundwater inflow to one pool in Sandy Creek and one pool in Laheys Creek (Section 5.2.2 of Appendix F). A further two sites in Sandy Creek may also be affected, but the impact at these sites is within the margin of error of the groundwater model. All four pools will receive increased surface water flows during median and wet years, which may offset the loss of groundwater inflow to the pools. The majority of the pools are therefore not predicted to be impacted and will continue to provide refugia during droughts.

Appendix H 'Terrestrial ecology assessment' of the EA (Section 5.5), found that a total of 4.5 ha of terrestrial woodland occurs within the zone where the alluvial groundwater is less than 3 m deep in some areas and therefore within the typical root zone of eucalypts. However, as a range of vegetation types were recorded, no apparent correlation with vegetation type and groundwater availability is apparent. Most of these communities are listed as TECs, as these are associated with the alluvial floodplains. As groundwater is 3–5 m or deeper for the majority of the riparian zone, and therefore likely to be outside the typical rooting depth of the eucalypts present, these systems are likely to rely more on flood events for ecosystem processes than this groundwater. Therefore groundwater use by terrestrial woodland is likely to be opportunistic rather than dependent. This remains current (see Figure 5.17 of Appendix E).

A detailed assessment of the impacts to semi-permanent pools is provided in Section 5.4 of Appendix C 'Downstream flow impact assessment' of Appendix F.

6.2.10 Bore impact threshold

Submission

NA-7

Issue

The DPI requested clarification about the need for additional mitigation measures for bores considering that the Aquifer Interference Policy (DTIRIS 2012) sets a threshold of 2 m decline for both water table and pressure at any supply work. The DPI comments that the EA identifies six works to be affected using a threshold of 2.5 m drawdown.

Response

A drawdown threshold of 2 m has been used in the updated groundwater assessment in accordance with the Aquifer Interference Policy, which defines a maximum drawdown of less than 2 m as 'minimal impact'. As described in Section 6.2.2.1 of Appendix E, 13 privately owned groundwater bores are expected to experience drawdown of more than 2 m during the life of the mine.

Additional monitoring bores (Section 8.1.1 of Appendix E) will be installed to replace monitoring bores removed by mining operations and to help identify:

- potential impacts of the mine's operation on the surrounding groundwater environment; and
- any leakage into underlying aquifers from sedimentation and mine water dams.

6.2.11 Post-mining groundwater recovery

Submission

NA-13

Issues

The DP&I makes the following comments on groundwater recovery post-mining:

- that there is an inadequate assessment of the groundwater recovery levels, including no post-mining reduction contour maps, and inadequate information presented on cumulative storage loss and net reduction in river flows to 2080;
- that post-mining aquifer drawdown contours should be provided for the Permian and Triassic aquifers and for overlying alluvial aquifers; and
- that further explanation is required for the statement that CHC will commit to backfilling the void to a level that will minimise evaporative losses, particularly if this is to a level where evapotranspiration becomes extinct, and the costs and benefits of this process.

Response

The updated groundwater assessment provides predicted cumulative storage losses and river losses to 2085 (Figure 5.2 in Appendix H 'Groundwater model technical report' in Appendix E. Residual groundwater drawdown contour maps are also provided for 20 years (Figure 5.7A and B) and 100 years (Figure 5.8A and B) after the end of mining. The drawdown contours are provided for the Ulan Coal Seams (Permian), where the impacts are predicted to be greatest, and for the water table aquifer, where groundwater dependent ecosystems have been identified.

The updated numerical groundwater model included the final landform and all post-mining results reported relate to this final landform design.

Evapotranspiration has been included in the numerical model with an extinction depth set relative to the ground surface.

6.2.12 Groundwater management and use

Submissions

NA-1

Issue

The EPA comments that groundwater from different strata could be quite variable in quality and considers that some of the proposed uses of groundwater may be a source of potential surface water pollution when used for activities outside the pit catchment areas, such as dust suppression, if not managed closely. The EPA comments this is particularly important given that no treatment of mine pit water is proposed and sediment basins are not designed to treat elevated salinity and metals. The proponent has made a commitment to develop a groundwater management plan with a framework being presented at Appendix J of Appendix D. The framework includes monitoring but little detail about management actions.

Response

The groundwater quality within the strata has been categorised based on extensive groundwater monitoring (Section 4.4.1 of Appendix E). Groundwater entering the mining areas will be managed according to its quality (Appendix E 'Water balance and surface water management system' of Appendix F). For example, saline water will not be used for dust suppression where it may degrade soils or creeks. It is not proposed to directly extract groundwater for mining although some may be used for potable supplies after appropriate treatment.

As listed in Section 21.2 'Commitments Summary', a groundwater management plan will be prepared for the Project. This will address the management and use of groundwater so that any impacts remain within the range predicted within the EA and later assessments. The groundwater sections will be based on the framework provided in Appendix J 'Groundwater management plan framework'.

6.2.13 Beneficial use

Submission

NA-7

Issue

The DPI requests that the potential for changes to beneficial use categories to the different aquifers and connected river systems be assessed and discussed in greater detail. The DPI also requests that seepage from the tailings dams and the waste rock emplacements, potential modifications to recharge and function of the void be investigated.

Response

Mining may result in increased connectivity and then mixing of groundwater between hydrogeological units near the mining areas. However, the change in water quality as a result of increased interaction between the units is not predicted to degrade the measured water quality conditions or beneficial use of groundwater outside the immediate mining area (Section 7.4 of Appendix E).

The groundwater assessment provides an expanded groundwater monitoring network that includes monitoring of potential seepage pathways from the tailings emplacements (Section 8.1.1 of Appendix E).

Enhanced recharge in the waste rock areas emplacement has been incorporated into the numerical groundwater model, based on published studies of recharge and permeability through coal mining spoils (Section 5.1 of Appendix H 'Groundwater model technical report' of Appendix E).

6.3 Conclusions

The updated groundwater assessment considers the changes to the Project and addresses a range of comments from agencies and councils.

The changes to the Project and refinements to the groundwater assessment do not materially change the groundwater impacts described in the EA, that is the Project will cause only localised and temporary impacts to groundwater. As described in the EA, a groundwater management plan will be prepared in consultation with NSW Office of Water (NOW).