

ASSESSMENT REPORT

Cadia East Gold/Copper Project

Cadia Hill Pit Tailings Deposition Modification (06_0295 – MOD 11)

EXECUTIVE SUMMARY

Cadia Valley Operations is an operational mining complex in the Central Tablelands of NSW (see **Figure 1**). The mining complex includes the active Cadia East underground mine, the Cadia Hill open cut mine (which ceased operations in 2012), the Ridgeway underground mine (which was placed on care and maintenance in 2016) and the Blayney Dewatering Facility (located approximately 25 kilometres [km] east of the mine).

On 9 March 2018, part of the embankment of the northern tailings storage facility failed which led to a limited breakthrough of tailings into the southern tailings storage facility. The tailings material is currently fully contained with no discharge to the environment and suitable contingency measures are in place to manage ongoing residual risks, including construction of a containment bund and increased real-time radar monitoring. Due to ongoing investigations into the cause of the failure, the mine is currently operating at approximately 30% capacity, with limited tailings deposition in the southern tailings storage facility.

To allow it to return to full production, Cadia Holdings Pty Ltd (Cadia) is seeking to modify its project approval to deposit 30 million tonnes (Mt) of tailings into the Cadia Hill open cut pit over an 18 month period.

The Department referred the application to key government agencies for comment and made it publicly available on its website from 16 April 2018. The Department received advice from eight government agencies, including Orange, Cabonne and Blayney Shire Councils, none of which object to the proposed modification.

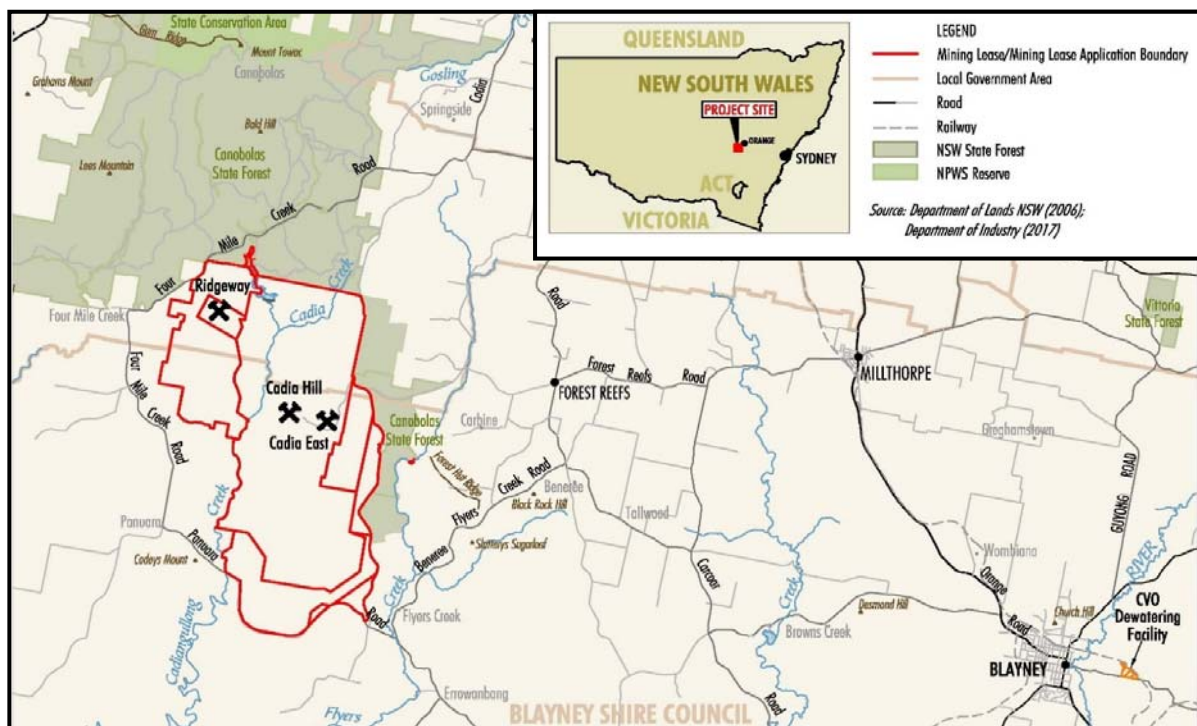


Figure 1: Regional Location

The Department is satisfied the modification would result in minimal environmental risk to groundwater or surface waters. Additional groundwater monitoring would be undertaken as part of the ongoing long-term water management strategy that includes ongoing verification and validation of the groundwater model.

Further, the tailings deposition and associated infrastructure is within existing disturbed areas and the controlled drainage area of the mining complex.

Importantly, the modification would enable the full benefits of the project to be realised, including ongoing employment of up to 880 employees, without any significant environmental impacts beyond those assessed and approved for the original project, while the cause of the embankment failure is investigated and the embankment is repaired.

Consequently, the Department considers the modification is in the public interest and should be approved, subject to conditions.

1 BACKGROUND

Cadia owns and operates the Cadia Valley mining complex, located approximately 25 km southwest of Orange. The complex is located within the Cabonne and Blayney local government areas. The active Cadia East underground mine produces a copper concentrate and gold bullion.

The mining complex operates under the Cadia East project approval (PA 06_0295), granted by the Minister for Planning on 6 January 2010.

The project approval has been modified 10 times, and allows Cadia to undertake the following activities until 30 June 2031:

- extract ore from the Cadia and Ridgeway mines;
- process up to 32 Mt of ore a year; and
- transfer processed ore via a pipeline to the Blayney Dewatering Facility, where it is dewatered and transported via rail to Port Kembla for export.

The processing of the copper and gold ore produces a tailings waste stream of 30 Mt a year. The project approval allows the disposal of tailings into two tailings storage facilities, the Northern Tailings Storage Facility (NTSF) and the Southern Tailings Storage Facility (STSF).

The mining complex is a major employer in the regional area and at full production employs an average of 880 workers.

2 PROPOSED MODIFICATION

On 9 March 2018, part of the embankment of the northern tailings storage facility failed which led to a limited breakthrough of tailings into the southern tailings storage facility. The tailings material is currently fully contained with no discharge to the environment and suitable contingency measures are in place to manage ongoing residual risks, including construction of a containment bund and increased real-time radar monitoring.

Due to ongoing investigations into the cause of the failure, the mine is currently operating at approximately 30% capacity, with limited tailings deposition in the southern tailings storage facility.

Due to the embankment failure, operations at the mining complex were suspended, with investigations commencing as to the cause of the failure, implementation of contingency measures and investigations into repairs to the embankment wall. It is anticipated that these investigations and reinstatement of the embankment to allow deposition into the NTSF would take about 18 months.

On 29 March 2018, tailings deposition recommenced in the STSF, allowing limited operations. The STSF can take about 10 Mt or 30% of the annual tailings stream.

To allow it to return to full production, Cadia is seeking to modify its project approval to:

- deposit 30 Mt of tailings into the Cadia Hill open cut pit over an 18 month period;
- construct and operate pipelines for the transfer of tailings to the open cut pit and return decant water to the water management system; and

- construct and operate supporting infrastructure, such as pump stations and access tracks.

The proposed modification activities are all within previously disturbed areas. The proposed Cadia Hill open cut tailings emplacement area and existing tailings facilities are shown in **Figure 2**.

The Cadia Hill open cut pit is around 500 metres (m) deep (Australian Height Datum (AHD) 220 m) with the proposed consolidated tailings emplacement to fill to a 200 m depth or around 10% capacity of the pit to a final elevation at AHD 420 m.

Full details of the proposed modification are included in Cadia's Statement of Environmental Effects (SEE) (see **Appendix C**).

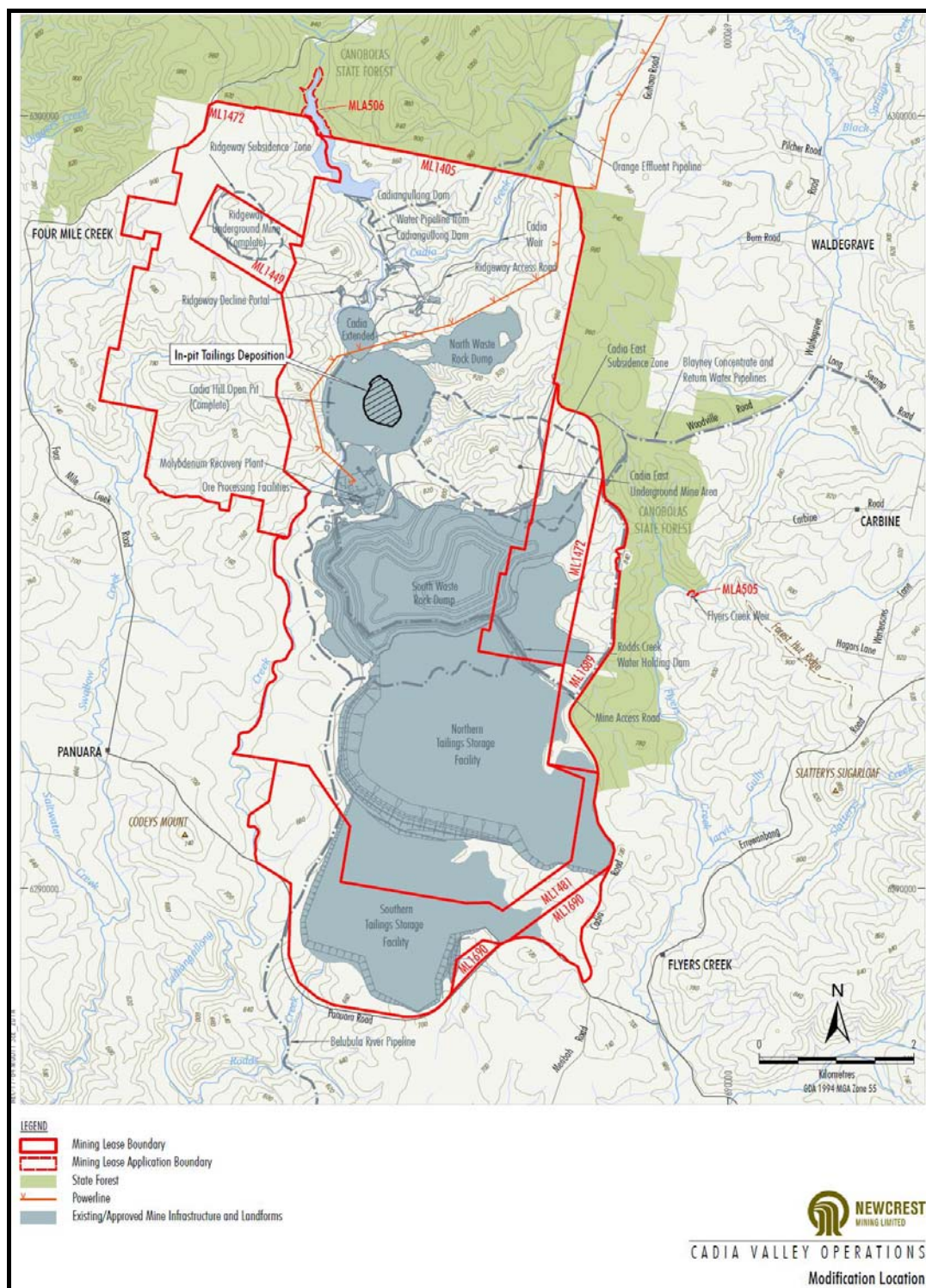


Figure 2: Proposed Tailings Emplacement Area

3 STATUTORY CONTEXT

The Cadia East Project was originally approved under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Under clause 6 of Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, the Cadia East Project was transitioned to State Significant Development (SSD) by order, which took effect by publication in the NSW Government Gazette on 13 April 2018.

A modification application under Section 4.55 (1A) for a modification involving minimal environmental impact was submitted to the Department on 13 April 2018.

Based on its assessment, the Department considers that the application can be characterised as a modification involving minimal environmental impact as the proposal:

- would not significantly increase the environmental impacts of the project as approved;
- is substantially the same development as originally approved in 2010; and
- would not change the approved mining, processing and transport methods, extraction rate, or surface disturbance areas.

Consequently, the Department considers that the proposed modification is within the scope of Section 4.55 (1A) of the EP&A Act.

The Minister for Planning is the approval authority for the modification application. However, under the Minister's delegation dated 11 October 2017, the Executive Director, Resource Assessments and Business Systems, may determine the application.

4 CONSULTATION

The Department referred the application to key government agencies for comment and made it publicly available on its website from 16 April 2018. Cadia also undertook its own consultation with neighbouring landholders and made information publicly available on its website. No public comments were received by the Department.

The Department received advice from eight government agencies, none of which object to the proposed modification. A summary of the advice is provided below. Full copies of the advice are provided in **Appendix D**. Cadia's response is provided in **Appendix E**.

The Department notes the modification is supported by Orange, Cabonne and Blayney Shire Councils, acknowledging the importance of the mining complex to the regional economy, including ongoing employment of the existing workforce (see **Appendix D**).

The **Environment Protection Authority** (EPA) supports the modification and agrees the modification would have negligible environmental impact due to the low inherent permeability of the surrounding rock and that the tailings would be contained within the pit. The EPA advised it would review the groundwater monitoring network to determine if additional bores should be included in its Environment Protection Licence (EPL).

The **Department of Industry – Water** (DoI Water) recommended that additional deep groundwater monitoring bores be installed in the groundwater near the base of the pit to confirm the predicted hydraulic gradient would remain towards the pit, including collection of deeper groundwater quality data during and after the emplacement of tailings. This issue has been considered further in Section 5.1.

The **Division of Resources and Geoscience** (DRG) advised that the emplacement of tailings is unlikely to sterilise economically viable ore reserves and did not object to the emplacement of tailings in the pit. The Resources Regulator (within DRG) advised it had no specific issues relating to mine safety or rehabilitation.

The **Dam Safety Committee** (DSC) had no objection to the emplacement of tailings into the Cadia Hill pit and advised that Cadia would need to submit a formal application to the DSC for its determination that it would be a non-prescribed dam, noting that the open cut pit is a void below natural ground level.

The **Office of Environment and Heritage** (OEH) noted that threatened bats are currently roosting in a mine adit within the Cadia Hill pit. Measures are currently being implemented under the Threatened Species Management Protocol under the existing conditions of approval to remove these bats from the adit before tailings are placed in that part of the pit.

5 ASSESSMENT

In assessing the merits of the modification application, the Department has considered the:

- previous Environmental Assessments (EAs) for the project;
- modification application and existing conditions of approval;
- agency comments on the application;
- Cadia's response to agency advice; and
- requirements of the EP&A Act.

5.1 Water Resources

The key issue for the proposed modification relates to whether the emplacement of tailings in the Cadia Hill open cut void would result in impacts on groundwater and surface water resources, beyond those already approved for the mine.

The SEE includes a groundwater impact assessment undertaken by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) and a surface water assessment, including a final void water balance, undertaken by Hydro Engineering & Consulting (HEC). These assessments were also peer reviewed by Dr Noel Merrick.

The assessment was informed by groundwater modelling that has been re-calibrated twice since the original 2009 Cadia East EA, with the current groundwater model developed in 2016 in consultation with DoI Water and the Department. The model was re-calibrated using recent monitoring data and included changes to the model code (MODFLOW-USG is now used) and improvements to the conceptual groundwater model to reflect current knowledge of the groundwater system. The project approval requires a program for the ongoing verification and validation of the model.

For an impact to occur to water resources, leachate from the tailings emplaced in the open cut would need a migration pathway to groundwater or surface water assets – including groundwater dependent ecosystems and surface and groundwater users.

There are several reasons why the emplacement of tailings into the Cadia open cut is predicted to have a negligible impact on water resources.

Formation of a permanent groundwater sink

The Cadia open cut and the adjoining Cadia East subsidence zone were predicted in the 2009 EA to form a contiguous groundwater sink. The revised final void water balance completed by HEC for the modification also confirms that the open cut and subsidence zone would remain a long-term groundwater sink.

This occurs because groundwater from the surrounding rock flows into the open cut, the underground mining panels and the voids/fractures formed from subsidence of the land over the cave mining area. Once mining is completed, groundwater levels are predicted to recover until a new equilibrium is reached and a pit lake would form, with a direct hydraulic connection between the open cut pit and subsidence void (see **Figure 3**).

With the formation of a pit lake, there would be a permanent loss of groundwater from the system due to evaporation from the pit lake surface, with groundwater from the surrounding rock continuing to flow into the void due to the hydraulic gradient.

This means the area is predicted to remain a groundwater and surface water sink such that any leachate released from the tailings would not migrate to adjoining groundwater or surface water resources.

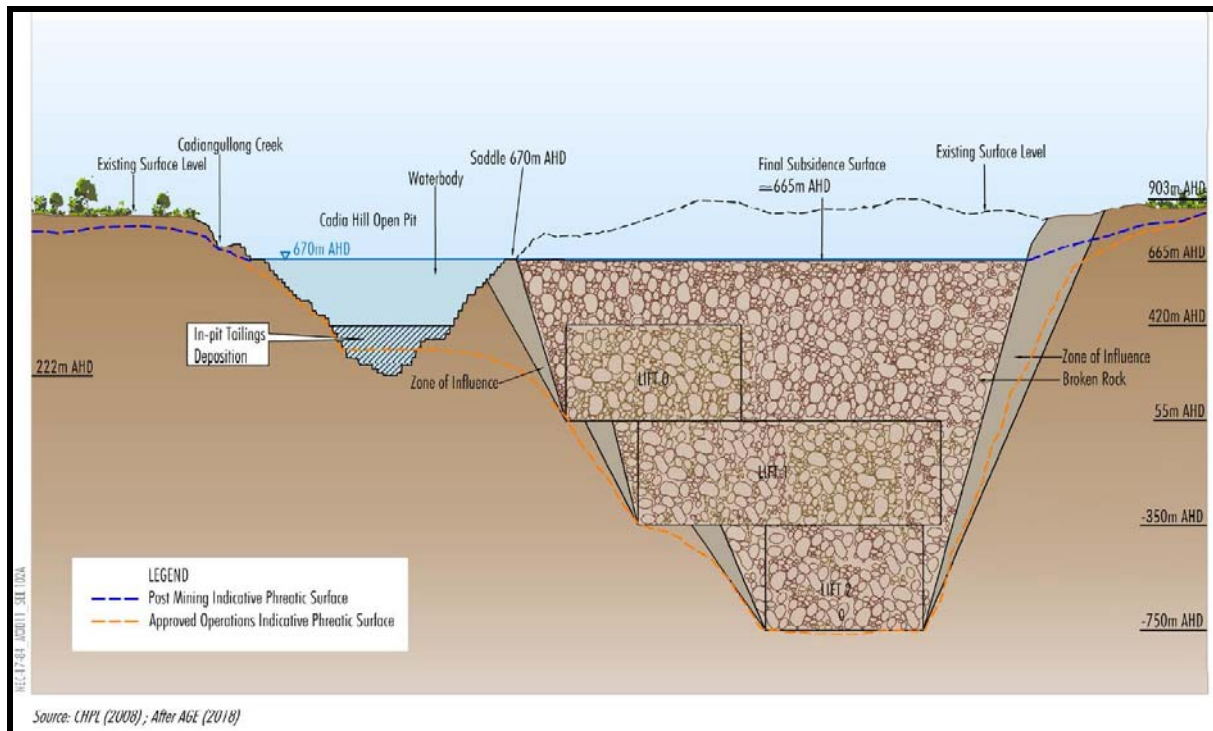


Figure 3: Groundwater levels during operations and post mining recovery

The predicted equilibrium level of 670m AHD for the pit/subsidence lake would also be 51 m below the spill point at 721 AHD into the adjoining surface water system, with the base level of Cadiangullong Creek at 708 m near the pit, 38 m above the pit lake equilibrium level.

Dr Merrick concludes that “the evidence for ongoing behaviour of the Cadia Hill pit as a groundwater sink is compelling” and he concurs with AGE’s conclusion that “the risk to the groundwater regime from tailings emplacement is considered negligible.”

Permeability of the Cadia Hill pit shell

The tailings will be deposited deep into the Cadia pit shell which is entirely within the Ordovician volcanic basement rock. This rock has a very low permeability, with the recent groundwater modelling assuming a permeability in the range 5×10^{-12} to 6×10^{-11} meters per second (m/sec). This permeability is orders of magnitude below the EPA’s current standard for tailings facilities, which requires a permeability of 1×10^{-9} m/sec.

This very low permeability is supported by the low groundwater inflow observed seeping into the pit and the high pore water pressure measured close to the pit wall. This is shown in **Figure 3** above where the groundwater or phreatic surface during mining operations is maintained near the void wall. It is estimated from groundwater modelling that there is currently around 0.7 megalitres (ML) of seepage into the pit daily.

Regardless of the low permeability of the rock, which means that seepage rates are very low, given that the open cut and adjoining subsidence area remain a groundwater sink, the permeability of the tailings emplacement area within the pit is not a material issue. Dr Merrick relevantly concludes:

“The usual requirement of 10^{-9} m/sec as the permeability of a liner/ container, for prevention of leakage/ seepage, is irrelevant when the fluid feature is a gaining system (a sink)”

The Department also notes that there are several fault lines that intersect the open cut. Faults can act as higher permeability conduits. However again, as the open cut will be a permanent groundwater sink, it is predicted that there would be no groundwater movement outwards into the surrounding rock through faults.

The Department also notes that the Cadia Hill decline entry, approved in 2010 (Modification 1) would need to be sealed as the proposed tailings deposition level to 420 AHD would be above this entry. This entry can be sealed off as part of rehabilitation requirements under the existing Cadia East approval.

Cadia has consulted with the Resources Regulator and confirmed that the proposed decommissioning of the decline is not a reportable event requiring notification to the Resources Regulator. It is estimated that the tailings would reach the Cadia Hill decline within 2 months of commencing tailings disposal.

Tailings leachate quality

The SEE also included updated results of leachate testing of the tailings. The monitoring shows that the tailings material is mainly Non-Acid Forming (NAF) with monitoring undertaken of leachate seepage. The Department also notes that leachate from the northern tailings dam is predicted to migrate into the Cadia East underground workings.

The 2009 EA identified that the water quality in the final lake void would progressively deteriorate because of the pit lake forming and salts concentrating over time and through acid generation from sulphide materials remaining in-situ within the Cadia East caving void area. HEC considered this further in its review for this modification concluding that:

“the combination of acidic drainage generated from the oxidation of potentially acid forming Ordovician volcanic material within the Cadia East cave zone and the long term evapo-concentration of salts would be the key drivers of the final void water quality of the approved Project” and that “both of these drivers of final void water quality would be unchanged by the proposed Modification.”

The Department also notes that the approved Water Management Plan already includes provision for tailings leachate to be pumped to the Cadia open cut pit as a management measure during excess wet weather periods to protect the tailings and Upper Rodd Creek dam embankments during flood events.

Conclusion

Based on the above, both the Department and the EPA are satisfied that the proposed emplacement of tailings within the Cadia open cut would have no additional impact on water resources beyond that predicted by the existing groundwater model, and would not adversely impact groundwater or surface water quality.

The Department also notes that the existing conditions of approval require Cadia to undertake a comprehensive groundwater monitoring program. The Department notes Dr Merrick's recommendation that the groundwater bore network around the Cadia Hill open cut pit be reviewed. The EPA also requested review of the groundwater monitoring network.

Dol Water raised concerns that there was no deep groundwater monitoring being undertaken to support the predictions that the open cut would continue to operate as a groundwater sink and that no leachate from the tailings would move out of the pit into deeper groundwater, particularly through higher permeability fracture zones. It requested that a deeper groundwater monitoring bore(s) be installed closer to the base of the pit to measure pressure and groundwater quality.

In its response, Cadia has committed to initially installing a deep borehole incorporating at the edge of the pit or partway down the pit wall with multiple piezometers to measure pressure through the groundwater formation. In addition, a separate deep standpipe would be installed to measure water quality below the current pit lake level. Depending upon the monitoring results, these initial bores would inform the need to further expand the groundwater monitoring network.

The Department supports EPA and Dol Water's advice and recommends that the groundwater monitoring network be reviewed and additional bores be installed, in consultation with these agencies as part of the required updates to the approved Water Management Plan. To formalise this requirement, an additional requirement to Schedule 3 Condition 34 (Groundwater Monitoring Program) has been recommended, requiring a program to monitor the hydraulic gradient and groundwater quality around the base of the Cadia open cut pit.

5.2 Mine Safety and Hazards

There are risks to water resources and soils from spills and leaks associated with the transfer of tailings from the ore processing facility to the Cadia Hill and the return of decant water from the open cut pit back to the process water pond at the processing facility.

The pipeline route is within the controlled drainage area of the mine and any spills would report to the site runoff pond located below the process water pond. In addition, the existing risk management measures

outlined in the approved Water Management Plan would continue to apply, including leak detection systems reporting to the central control room and regular inspections of the pipeline.

In regard to mine safety, the emplacement of tailings to AHD 420 would make no material change to safety hazards in the underground workings due to the low permeability of the Ordovician rock in the open cut pit and distance to the Cadia East underground workings.

As noted above, the Cadia decline is located below the tailings deposition level. This decline does not connect into the Cadia East workings as originally proposed. However, it is being sealed to ensure there is no direct connection from tailings deposition and future subsidence areas in the Cadia East underground workings. As noted in Section 4, the Resource Regulator has advised it has no specific issues with mine safety because of the modification.

5.3 Final Landform

The final landform of the Cadia Hill pit area would not change due to the modification. A pit lake would develop over the emplaced tailings with the stabilised water level predicted to be at AHD 665 m, about 245 m above the emplaced tailings. Under these circumstances, it is proposed that the tailings material would not be capped with soil and/or higher permeability capping materials.

Given the conclusions of the water assessments that the modification would cause no material change to the water quality impacts from the approved project, the Department is satisfied that the proposed modification is consistent with the approved final landform. As noted in Section 4, the Resources Regulator advised it had no comments in regard to rehabilitation.

5.4 Other issues

Table 1 below summarises the Department's consideration of other issues related to the modification.

Table 1: Assessment of Other Issues

Issue	Consideration	Recommendation
<i>Noise and Air Quality</i>	• Tailings deposition is undertaken deep in-pit in a central location of the mine. • There would be no significant incremental increase in air or noise impacts. • The approval conditions impose strict noise and air conditions including noise and air limits, air quality operating conditions and air and noise monitoring requirements.	• Comply with existing noise and air conditions.
<i>Biodiversity</i>	• No additional clearing is required for the modification. • A dead-end adit located within the Cadia Hill open cut has been opportunistically inhabited by the threatened (vulnerable) Eastern Bentwing-bat. The entry to the adit is below the tailings emplacement level requiring the entry to be sealed. • Adits can be sealed under the existing project approval as identified in the approved Rehabilitation Strategy, the Land and Biodiversity Management Plan (L&BMP) and Mine Operations Plan. • As part of its L&BMP, a <i>Threatened Species Management Protocol</i> (TSMP) has been developed. • Cadia has consulted with OEH and the Department to develop a management strategy to mitigate impacts on the bats due to its operations. • The Department and OEH have agreed to the implementation of the strategy, which would involve the relocation of the bats prior to any tailings deposition, thereby avoiding any potential impacts.	• Comply with existing biodiversity conditions. • Implement the approved management strategy as part of the TSMP to minimise impacts on the bats.
<i>Heritage</i>	• Not applicable – no heritage items would be disturbed.	• Comply with existing heritage conditions.
<i>Traffic and Transport</i>	• Not applicable – no additional traffic as a result of the modification.	• Comply with existing traffic conditions.
<i>Social and Economic</i>	• The proposed modification would allow a return to full production and associated social and economic	• Comply with existing conditions

Issue	Consideration	Recommendation
	benefits including direct employment of an average of 880 employees, direct revenues from operations, investments in public infrastructure and services, business opportunities for local suppliers and a range of indirect economic benefits. Cadia estimates that without the modification, the workforce would be reduced by 50%.	
Resource Utilisation	• DRG has confirmed that the emplacement of tailings within the Cadia Hill open cut would not sterilise economically viable ore resources.	• Noted.

6 RECOMMENDED CONDITIONS

The Department has drafted a Notice of Modification (see **Appendix A**) for the proposed modification, as well as a consolidated version of the project approval as modified (see **Appendix B**).

Cadia has reviewed the proposed conditions and has raised no concerns.

7 CONCLUSION

The Department has assessed the merits of the modification in accordance with the relevant requirements of the EP&A Act.

The Department considers that the proposed modification to place tailings in the Cadia Hill pit can be undertaken with no significant environmental impacts on biodiversity, heritage or the amenity of surrounding residences.

The Department is satisfied there would be minimal environmental risk to groundwater, noting that additional groundwater monitoring would be undertaken as part of the ongoing long-term water management strategy that includes ongoing verification and validation of the groundwater model.

Importantly, the modification would enable the full benefits of the project to be realised including continuing employment of up to 880 employees without any significant environmental impacts beyond those assessed and approved for the original project. Consequently, the Department considers the modification is in the public interest and should be approved, subject to conditions.

Consequently, the Department believes the proposed modification is in the public interest and should be approved, subject to conditions.

8 RECOMMENDATION

It is recommended that the Executive Director, Resource Assessments and Business Systems, as delegate of the Minister for Planning:

- **consider** the findings and recommendations of this report;
- **determine** that the request (06_0295 MOD 11) falls within the scope of Section 4.55(1A) of the EP&A Act;
- **modify** the approval (06_0295); and
- **sign** the attached modification of approval (**Appendix A**).

 18/4/18

Phillipa Duncan
Team Leader
Resource Assessments

 18/4/18

Stephen O'Donoghue
A/ Director
Resource and Energy Assessments

9 DECISION

The recommendation is Approved / Not approved by:

 20/4/18

David Kitto
Executive Director
Resource Assessments and Business Systems
as delegate of the Minister for Planning

APPENDIX A: NOTICE OF MODIFICATION

APPENDIX B: CONSOLIDATED APPROVAL

APPENDIX C: MODIFICATION APPLICATION

Refer to: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=9278

APPENDIX D: SUBMISSIONS

Refer to: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=9278

APPENDIX E: RESPONSE TO SUBMISSIONS

Refer to: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=9278