



Environmental Assessment
Cadia East Project

EXECUTIVE SUMMARY

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ES1 INTRODUCTION

This executive summary provides an overview of the findings of the Environmental Assessment (EA) prepared for the Cadia East Project (the Project). The Project is situated alongside the existing Cadia Valley Operations, which are located approximately 25 kilometres (km) south-west of Orange, in the Central Tablelands of New South Wales (NSW) (Figure ES-1). Cadia Holdings Pty Limited (CHPL) is the owner and operator of the Cadia Valley Operations. CHPL is a wholly owned subsidiary of Newcrest Mining Limited (Newcrest), Australia's largest gold producer.

The Cadia Valley Operations currently consist of the Cadia Hill Gold Mine (Cadia Hill), the Ridgeway Gold Mine (Ridgeway) and the Blayney Dewatering Facility (Figure ES-1). The Blayney Dewatering Facility is located approximately 25 km to the east of the Cadia Valley Operations in the town of Blayney. Mining of the Cadia Hill open pit is currently scheduled to cease in 2013, and the Ridgeway underground mine is currently scheduled to cease in 2017.

The Cadia Valley Operations have provided significant economic stimulus and employment generation to the region since Cadia Hill was approved in 1996. In 2006/2007 Gillespie Economics Pty Ltd completed a Community Impact Review for CHPL that included a community attitudes survey, and business and stakeholder surveys focussing on perceptions of Cadia Valley Operations' socio-economic contributions to the local region and effects on community infrastructure.

The survey of businesses in Orange, Blayney and Molong found that 71 percent (%) considered that their business directly or indirectly benefits from the Cadia Valley Operations. A total of 93% of businesses surveyed considered that the local economy benefits from the Cadia Valley Operations, with 97% of these considering that the benefit to the local economy from the Cadia Valley Operations is medium to high.

A community attitudes survey also examined the extent to which the local economy benefits from the Cadia Valley Operations. The majority of respondents agreed or strongly agreed that the local economy benefits from the Cadia Valley Operations, and considered that the benefit to the local economy from the Cadia Valley Operations is medium to high.

All stakeholders interviewed at the time considered that the Cadia Valley Operations have had a positive impact on the local economy.

The Cadia Valley Operations were considered to have stimulated existing businesses and also resulted in a number of new businesses setting up to service the mine. The expenditure of employees was also seen as stimulating businesses, particularly retail in the main street of Orange. The Orange City Council (OCC) confirmed increased interest in retail development and improvement within the Orange area due to the Cadia Valley Operations.

If approved, the Project would be the largest underground mining operation in Australia, and the fourth largest underground gold mine in the world. The Project would result in the transition of the current Cadia Valley Operations from a combined large scale open pit and smaller underground operation, to a very large scale underground only mining operation.

The Project would involve a capital outlay of approximately \$2.2 billion. Operation of the Project is estimated to provide an average of approximately 1,889 direct and indirect jobs in the region and would result in a very large net production benefit of approximately \$1,210 million (M).

The Project would extend the mine life of the existing Cadia Valley Operations to 2030 (i.e. 21 year Project life), although it is likely that the mine life could be extended beyond this, subject to successful completion of additional exploration, feasibility studies and CHPL obtaining the necessary operating approvals.

ES1.1 LEGISLATIVE REGIME

This EA has been prepared to accompany the Project Application, in accordance with Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act). The Project was determined to be a "Major Project" to which Part 3A of the EP&A Act applies by the Director-General of the NSW Department of Planning (DoP), as delegate of the NSW Minister for Planning.

Approval for the Project is sought in the form of a Project Approval which would consolidate the existing Development Consents for the approved Cadia Valley Operations.

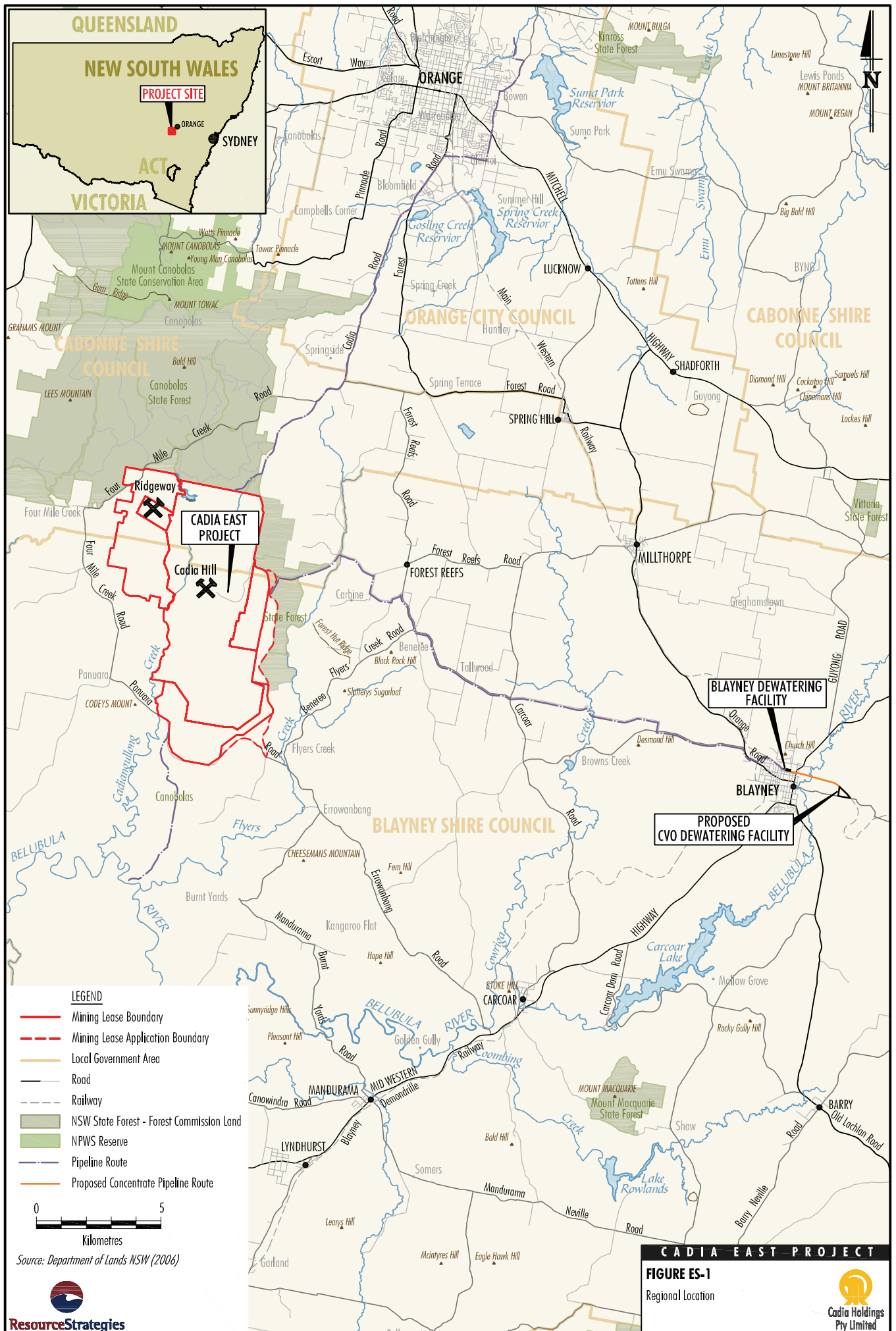


Table ES-1
Environmental Assessment Requirements – Reference Summary

General/Key Issues/Consultation Requirements*	EA Reference
General Requirements	
The Environmental Assessment must include:	
• Executive Summary.	This document
• Description of the Cadia Valley Operations including the existing and approved operations, current regulatory controls, the existing environmental management and monitoring regime and the likely staging of the approved (but undeveloped) operations.	Sections 1, 2, 3 and 4
• Description of the Project including the need for the Project, a detailed resource and landuse assessment, alternatives considered (e.g. justification of the Project on economic, social and environmental grounds), various components and stages of the Project and the likely inter-relationship between the proposed operations and the existing or approved Cadia Valley Operations.	Sections 1, 2, 3 and 4
• Risk assessment of the potential environmental impacts of the Project identifying the key issues for further assessment.	Appendix N
• Assessment of key issues including a description of the existing environment, an assessment of potential impacts (including cumulative impacts) at all stages of the Project and a description of the measures that would be implemented to avoid, minimise, mitigate, rehabilitate/remediate, monitor and offset the potential impacts of the Project, including a detailed contingency plan for managing any potentially significant risks to the environment.	Section 4 and Appendices A to P
• Statement of Commitments.	Section 6
• A conclusion justifying the Project based on economic, social and environmental grounds and consideration of whether the Project is consistent with the objectives of the EP&A Act.	Section 3.7
• Certification by the author of the EA.	Front of EA
Key Issues	
The Environmental Assessment must include an assessment of the following key issues:	
• Soil and Water.	Sections 4.1, 4.2 and 4.3 and Appendices F and G
• Biodiversity.	Sections 4.4 and 4.5 and Appendices A and B
• Heritage.	Sections 4.8 and 4.9 and Appendices K and L
• Noise and Blasting.	Section 4.7 and Appendix D
• Subsidence.	Section 2.5.2
• Air Quality.	Section 4.6 and Appendix E
• Energy.	Section 4.6 and Appendix E
• Traffic and Transport.	Section 4.10 and Appendix I
• Waste.	Section 2.13.1
• Visual.	Section 4.13
• Rehabilitation and Final Landform.	Section 5 and Appendix P
• Socio-Economic.	Sections 4.11 and 4.12 and Appendix H
Consultation Requirements	
• Description of consultation with relevant local, State or Commonwealth Government authorities, service providers, community groups or affected landowners.	Section 3.5 and Appendix N
• Description of the consultation process, and the issues raised during this process.	Section 3.5

* The complete version of the EARs is presented in Attachment 1.

This EA considers the potential environmental impacts of the Project in accordance with the Director-General's Environmental Assessment Requirements (EARs) issued by the DoP on 5 November 2008. Table ES-1 presents a summary of these requirements and the relevant EA section reference that addresses each requirement.

ES1.2 KEY POTENTIAL ENVIRONMENTAL ISSUES

A risk-based approach was undertaken to identify key potential environmental issues of the Project. In accordance with the Project EARs, an Environmental Risk Assessment (ERA) was undertaken. The majority of the key potential environmental issues identified are related to the following potential impacts of the Project:

- creation of a 255 hectare (ha) subsidence zone above the Cadia East underground mine, resulting in the loss of remnant native woodland and fauna habitat;
- post-mining, the Cadia East subsidence zone would slowly fill with water, generating a large waterbody which includes the Cadia Hill open pit final void;
- creation of a local groundwater sink around the Cadia East subsidence zone, including potential impacts on some privately-owned groundwater bores and springs;
- loss of a portion of the groundwater contribution (baseflow) to local creeks; and
- rehabilitation and closure-related issues (e.g. integration of rehabilitated landforms with the existing Cadia Valley Operations and management of the Cadia East subsidence zone).

Key aspects that were identified by the risk assessment team, and the sections of this EA that address them are presented in Table ES-2.

ES1.3 LAND TENURE

CHPL is a major landholder in the vicinity of the Cadia Valley and owns approximately 10,420 ha of land, including the land covered by the mining leases held by CHPL. External to the Cadia Valley are a number of water supply and concentrate pipelines owned by CHPL, the majority of which are within Crown road easements or land controlled by NSW Department of Primary Industries – Forests (Forests NSW).

ES2 PROJECT DESCRIPTION

ES2.1 EXISTING CADIA VALLEY OPERATIONS

A summary of the key components of the existing/approved mining operations is provided in Table ES-3.

ES2.2 PROJECT OVERVIEW

The key Project extensions to the approved Cadia Valley Operations would include (Figure ES-2):

- underground mining of the Cadia East deposit using a panel caving mining method at a rate of up to 27 million tonnes per annum (Mtpa) and the development of an associated 255 ha subsidence zone above the underground mining area;
- development of underground crushing, handling and incline conveyor systems to transfer ore and waste rock mined from the Cadia East orebody to the Cadia Valley Operations ore processing facilities;
- development of supporting infrastructure for the underground mine including multiple ventilation shafts, and personnel and equipment access systems;
- upgrade of the existing Cadia Valley Operations ore processing facilities and associated stockpiles and materials handling equipment to accommodate the harder ore from Cadia East and to enable the total Cadia Valley Operations ore processing rate to increase from 24 Mtpa to approximately 27 Mtpa;
- construction and operation of a molybdenum recovery plant with a capacity of up to 460,000 tonnes per annum and trucking of molybdenum products off-site;
- placement of additional waste rock produced by the Project (approximately 11.4 million tonnes [Mt]) in the existing South Waste Rock Dump;
- raising of the existing Northern Tailings Storage Facility (NTSF) and Southern Tailings Storage Facility (STSF) embankments to accommodate approximately 450 Mt of Cadia East tailings to be produced over the life of the Project;

Table ES-2
Key Aspects Identified in the Environmental Risk Assessment

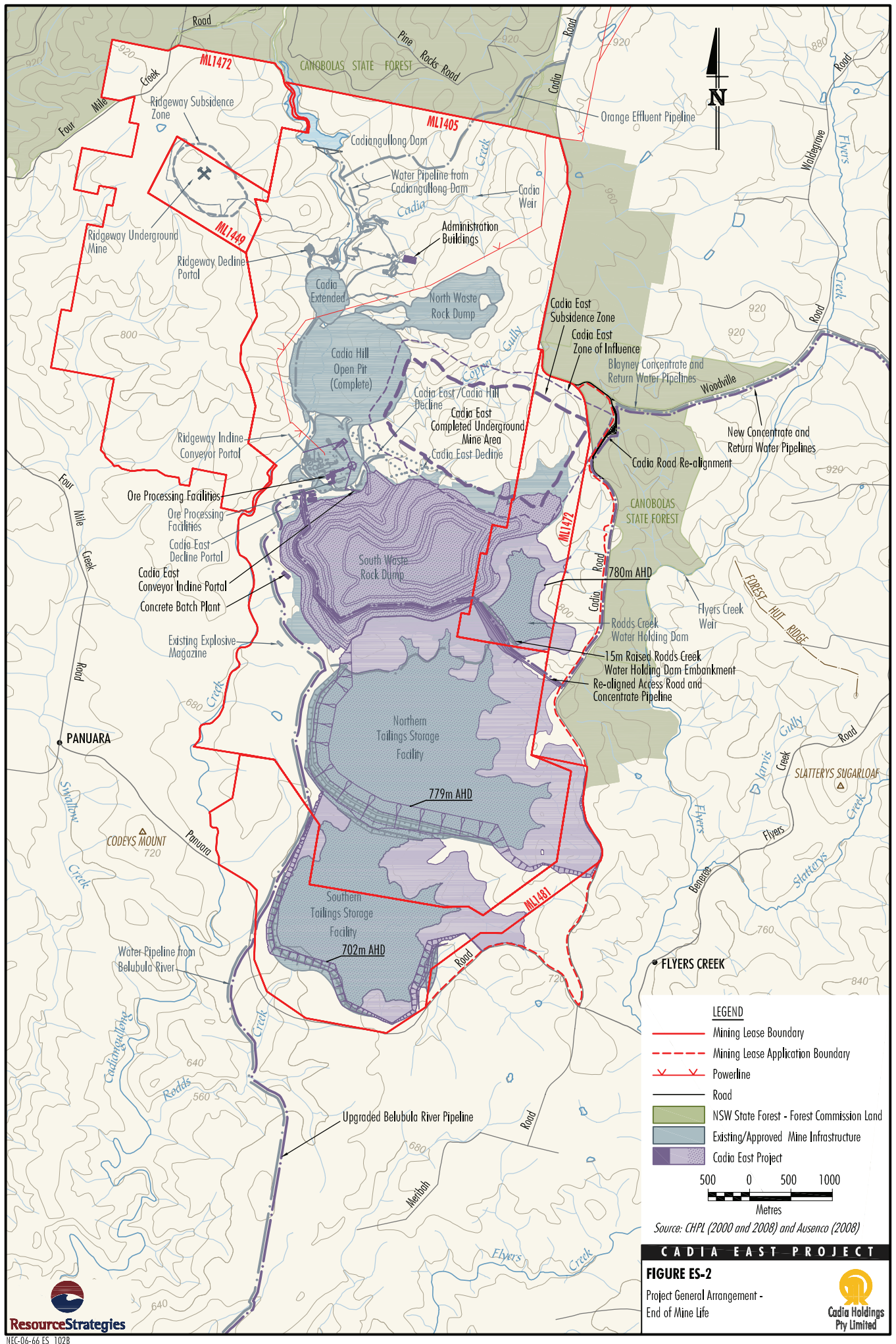
Aspect	Environmental Assessment Section
Potential impacts on existing groundwater users.	Appendix G
Extent of subsidence zone.	Section 2.5.2
Potential operational and long-term stream flow reduction impacts on existing downstream users and the environment.	Appendices A, B and F
Potential loss of native flora and fauna including threatened species and communities.	Appendices A and B
Final landform rehabilitation success and post-closure landuse.	Appendices A, B and P
Potential noise impacts at CVO Dewatering Facility.	Appendix D
Long-term surface water and groundwater modelling predictions (sensitivity).	Appendices F and G

Table ES-3
Summary of Currently Approved Cadia Hill and Ridgeway Operations

Project Component	Cadia Hill ¹	Ridgeway/Ridgeway Deeps ²
Description	Open pit gold/copper mine.	Underground gold/copper mine.
Project Life	Cadia Hill commenced operations in 1998 with an expected mine life of up to 17 years (including the Cadia Extended open pit [Cadia Extended]).	Ridgeway commenced operation in 2003 with an expected mine life of approximately 18 years (including Ridgeway Deeps).
Tenements	Mining Lease (ML) 1405.	ML 1472, ML 1449, ML 1405, ML 1481 and ML 1482.
Mining Method	Open pit mining method producing approximately 18 Mtpa of gold/copper ore.	Underground mining operations (Ridgeway – sublevel caving, Ridgeway Deeps – block caving) producing approximately 6 Mtpa of gold/copper ore.
Waste Rock Management	Deposition of approximately 430 Mt of waste rock in the North and South Waste Rock Dumps and Cadia Extended.	Deposition of approximately 1.68 Mt of waste rock in North and South Waste Rock Dumps.
Ore Processing	Cadia Hill ore processed in the low grade processing plant.	Ridgeway ore processed in the high grade processing plant.
Tailings Storage Facilities	Deposition of approximately 243 Mt of tailings in the NTSF.	Deposition of approximately 96 Mt of tailings in the NTSF and STSF.
Product Handling	Gold/copper concentrate transported from the ore processing facilities via a concentrate pipeline to the Blayney Dewatering Facility where the concentrate is dewatered and then transported by rail to the eastern seaboard.	Product handling system as per Cadia Hill.
Water Supply	Water supply sourced from the Cadiangullong Dam, Flyers Creek Weir, Cadia Creek Weir, Orange Sewage Treatment Plant, Blayney Sewage Treatment Plant, on-site groundwater extraction bores and site runoff.	Existing Cadia Hill water supply supplemented by water sourced from the Belubula River and use of the Rodds Creek Water Holding Dam.

¹ In accordance with Development Consent (DA44/95) (as modified).

² In accordance with Development Consent (DA 134-04-00) (as modified) and Development Consent (DA 257-10-2004) (as modified).



- augmentation and upgrade of the existing Cadia Valley Operations water management/supply system including development of additional pipeline/pumping systems and raising of the Rodds Creek Water Holding Dam;
- obtaining additional mining leases to facilitate the Project extensions of the STSF, NTSF, subsidence zone and Rodds Creek Water Holding Dam (Figure ES-2);
- re-alignment of a 1.1 km section of Cadia Road;
- construction of a new dewatering facility to the east of Blayney (to be known as the CVO Dewatering Facility);
- maintaining the existing Blayney Dewatering Facility to provide standby additional processing capacity during the peak production period from Year 3 to Year 7 and the decommissioning of this facility if it is deemed redundant after this time;
- installation of a new concentrate pipeline and return water pipeline between the Cadia Valley Operations and the CVO Dewatering Facility;
- increased rail transportation of dewatered mineral concentrate from Blayney to the eastern seaboard;
- augmentation, relocation and upgrade of supplementary surface facilities including workshops, administration and site access roads; and
- other associated modifications to existing infrastructure, plant, equipment and activities to allow mining of the Cadia East deposit and integration with the approved Cadia Valley Operations.

ES2.3 MINING RESOURCE

The Cadia Hill, Ridgeway and Cadia East deposits occur as mineralised zones within Ordovician-aged volcano-intrusive complexes of the eastern Lachlan Fold Belt of NSW. The Cadia East deposit occurs immediately east of the Cadia Hill open pit.

The Cadia East deposit is generally defined by an upper disseminated chalcopyrite (copper-rich) section and a deeper quartz vein hosted (gold-rich) section. The majority of the mineralisation is hosted in Ordovician Forest Reefs Volcanics, with some monzonite intrusives at depth. The main sulphide mineral species are chalcopyrite, pyrite, bornite and molybdenite.

The Cadia East deposit has a mining reserve of approximately 828 Mt of ore at a grade of 0.60 grams per tonne (g/t) gold, 0.32 percent (%) copper and 0.014% molybdenum.

ES2.4 MINE OPERATION

The proposed mining method is panel caving, an underground mining method that is optimal for large low-grade orebodies such as Cadia East. The method works by fracturing the orebody in a controlled manner, and removing the fractured ore using underground mobile loaders and ore conveyors. This mining method involves the development of significant underground infrastructure such as declines, inclines, ventilation shafts, and production/undercut levels within and around the orebody.

The Cadia East panel caving operation would be conducted in three lifts (i.e. Lifts 0, 1 and 2). Figure ES-3 shows the relative location of the three mining lifts and subsidence zone at the end of the mine life.

ES2.5 ORE PROCESSING

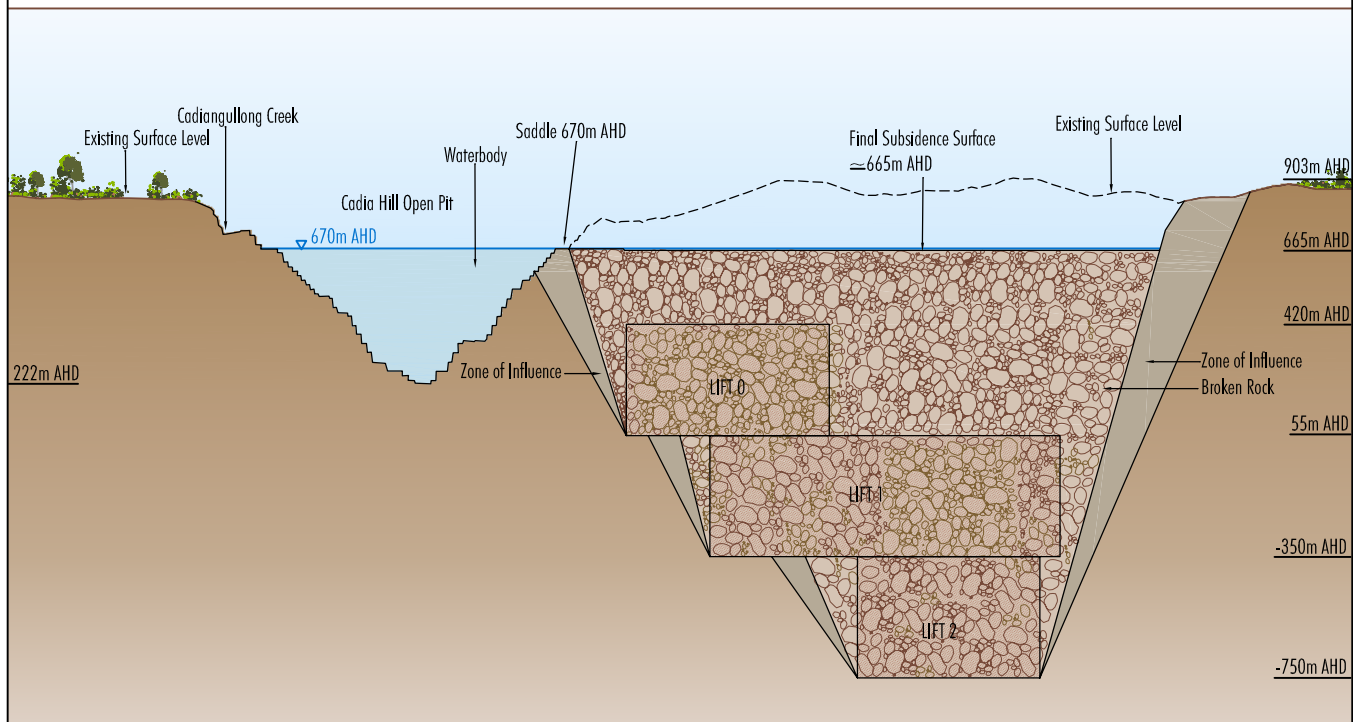
The Cadia East ore is harder than ore from Cadia Hill and/or Ridgeway and as such has slightly different ore processing requirements. The existing Cadia Valley Operations ore processing facilities would be upgraded by either adding new components to the existing facilities or constructing a new processing plant adjacent to the existing facility.

As with the existing ore processing facilities, no cyanide would be used for ore processing.

ES2.6 TAILINGS MANAGEMENT

The Project would produce up to approximately 450 Mt of tailings (dry weight) over the life of the mine. These tailings would be accommodated by progressively raising the embankments of the existing NTSF and STSF by approximately 38 metres (m) and 20 m, respectively, above their existing consented maximum heights.

Raises to the NTSF and STSF would be undertaken by upstream lifts, using similar materials to the existing embankments (i.e. predominantly rockfill with a core of low permeability clay materials).



Source: CHPL (2008)

CADIA EAST PROJECT

FIGURE ES-3
 Conceptual Long Section of the
 Cadia Hill Open Pit and the Cadia East
 Subsidence Zone



ES2.7 WASTE ROCK MANAGEMENT

Relatively small amounts of waste rock material (e.g. approximately 11.4 Mt during the mine life) would be generated by Cadia East. The majority of waste rock would be accommodated in the South Waste Rock Dump (which already contains some 430 Mt of waste rock).

Geochemical testwork indicates that some of the Cadia East waste rock would be non-acid forming (NAF) and some would be potentially acid forming (PAF) (principally the Ordovician volcanics that host the orebody).

PAF waste rock generated by the Project would be selectively handled and placed on the South Waste Rock Dump consistent with the current methodology employed for the existing mining operations. PAF rock is currently encapsulated in cells created by low permeability materials.

NAF waste rock material generated over the life of the Project would be either:

- used as construction fill materials for development of the other Project-related infrastructure (e.g. tailings storage facility embankments); or
- placed in the South Waste Rock Dump.

ES2.8 WATER SUPPLY

The Project would require approximately 6 megalitres per day (ML/day) of additional water compared with the existing operational water demand (i.e. an increase of approximately 12%). The existing Cadia Valley Operations water supply (Table ES-3) would be augmented for the Project by:

- constructing a pipeline on-site to allow the transfer of water between Cadiangullong Dam to Rodds Creek Water Holding Dam (note: the existing release protocol from Cadiangullong Dam would be unchanged and the amount extracted per year would not exceed the licensed 'cap' of 4,200 ML);
- upgrading the existing extraction system from the Belubula River to facilitate a maximum pumping rate of 30 ML/day, thus allowing CHPL to extract more of its licensed annual allocation;

- raising the existing spillway level of Rodds Creek Water Holding Dam by 15 m; and
- use of on-site bores for potable and processing water supply.

A water balance model was developed to assess the performance of the Project water supply scheme for a wide range of climatic conditions over the Project life. The water balance modelling has demonstrated a water supply reliability of between approximately 95% and 99%.

ES3 ENVIRONMENTAL ASSESSMENT

ES3.1 LAND RESOURCES AND GEOLOGY

The dominant landuse in the Orange region is agriculture, principally grazing (sheep and cattle), cropping and orchards. Other agricultural activities include honey production, viticulture and softwood production (predominantly Monterey Pine [*Pinus radiata*]).

The Orange region is located on the western side of the Great Dividing Range. Areas of higher elevation in the region include Mount Canobolas and Mount Towac located to the north of the Cadia Valley. In the Cadia Valley elevations generally range from approximately 600 to 1,000 m Australian Height Datum (AHD).

Geology in the Cadia Valley and surrounds comprises Ordovician volcanics, Silurian sediments and Tertiary basalt. As noted in Section ES2.4, the majority of the Cadia East deposit is hosted within Ordovician volcanics, with parts of the surface geology near the deposit overlain by Silurian sediments and Tertiary basalt.

The dominant regional structural features are a series of north trending reverse faults and related splays. One of these faults is the Warrengong fault, a near vertical structure located approximately 1 km to the east of the Cadia East deposit. It is considered to be an extensive regional structure.

ES3.2 CLIMATE

The Orange region has a temperate climate. Regional temperatures are warmest from November to March and coolest from May to August. Average daily maximum temperatures peak in January (26.4 degrees Celsius [°C] for Orange Agricultural Institute), while average daily minimum temperatures are lowest in July (1.4°C for Orange Agricultural Institute).

The mean annual rainfall recorded at the Orange Agricultural Institute is approximately 922.7 millimetres (mm). Total mean annual evaporation based on Orange Agricultural Institute records is 1,461 mm per year.

The windroses indicate that at the Ridgeway meteorological station, over the period July 2007 to June 2008, the most common winds are from the south-west and north-east.

ES3.3 GROUNDWATER

Existing Environment

An overview of the key characteristics of the main hydrogeological units in the vicinity of the Project is presented below:

- *Tertiary Basalt* - The Tertiary basalt was formed by lava flows from Mount Canobolas and contains what is known as the Orange basalt fractured rock aquifer. Groundwater in this aquifer typically occurs within old weathered zones between successive lava flows. Tertiary basalt is the most used aquifer in the region. Water quality is known to be good at the bores monitored close to the Cadia Valley.
- *Silurian Sediments* – Silurian sediments host a fractured rock aquifer containing water of generally low salinity. Data on the Silurian rock units indicates that conductivity within the Silurian sediments is relatively low, however where fractures are closely spaced hydraulic conductivities can be locally higher.
- *Ordovician Volcanics* - On a regional scale the hydraulic conductivity of the Ordovician volcanics is relatively low. Water quality is generally poor, with high salinity; making the resource unsuitable for potable use and suitable only for limited stock use.

Potential Impacts

Potential impacts on groundwater from the Project primarily relate to:

- Mine dewatering from the Cadia East underground mine during operations causing drawdown of groundwater resources.
- The Cadia East subsidence zone causing a permanent groundwater sink following closure of the mine.

Outcomes of the Studies

The Project is predicted to create a permanent drawdown effect that would extend to the north-east and east. Records held by the NSW Department of Water and Energy and information obtained by CHPL indicates that there are approximately 23 privately owned bores in this area. The majority of these bores are predicted to be affected by a drawdown of approximately 1 to 3 m. A loss of baseflow from nearby Flyers Creek (up to 0.49 ML/day) and Cadia Creek (up to 1.1 ML/day) is also predicted to occur. Springs have been identified in the upper headwaters of Cadia and Flyers Creeks (approximately 4 to 8 km from the subsidence zone), in the area where groundwater levels may be drawn down by 1 to 5 m.

Potential impacts on groundwater were predicted using a numerical groundwater model based on a relatively simplified conceptual geological model. In particular, the modelling excluded geological structures such as faults due to the variable amount of information on faults in the region. The groundwater drawdown and baseflow impacts discussed above are therefore considered to be conservative, as it is likely that at least some of the faults which occur in the region (e.g. the Warrengong fault) would provide natural barriers to groundwater movement and thereby reduce the drawdown effect.

Post-mining, a large waterbody is predicted to gradually form in the Cadia East subsidence zone and Cadia Hill open pit (Figure ES-3). The waterbody is predicted to reach an equilibrium level at approximately 670 m AHD over a period of 330 years. This level is approximately 45 m below the level of Cadiangullong Creek and approximately 200 m lower than the pre-mining groundwater levels. As a result the void and final waterbody would act as a permanent low point or 'groundwater sink'.

As the void would remain a sink for groundwater flow, salts would slowly concentrate in the open void over time. Potential acidic drainage generated from the oxidation of PAF Ordovician volcanic material would reduce the pH and increase dissolved metal concentrations in the water. However, hydraulic gradients would draw local groundwater into the subsidence void, and therefore would prevent the mobilisation of the water out into surrounding aquifers.

Mitigation Measures and Monitoring

In order to prevent Project-induced impacts on the water supply availability of privately owned bores, CHPL has committed to develop and implement a Groundwater Management Plan for the area potentially affected by the drawdown from the Project. The Plan would include:

- a compilation of the available construction and use information on each existing bore and spring in the potentially affected area;
- details of an inspection of each bore and spring by a suitably qualified hydrogeologist (where permission from the owner was granted);
- details of the groundwater monitoring programme (location, parameters, frequency and reporting) to be used by CHPL to monitor and detect impacts on local aquifers; and
- details of monitoring triggers and corresponding measures to mitigate Project-induced impacts on water supply availability. The mitigation measures could include, but are not necessarily limited to lowering of pumps, deepening of bores, or provision of new bores/alternative water supplies.

In addition, a comprehensive regional monitoring programme would be undertaken, including the construction of additional monitoring bores and monitoring of select springs.

ES3.4 SURFACE WATER

Existing Environment

The Project is situated within the Cadiangullong Creek catchment. Cadiangullong Creek flows southward through the Cadia Valley to the Belubula River (Figure ES-1) which is a major tributary of the Lachlan River.

Locally, the Cadia East deposit is overlain by the Copper Gully catchment, which is a former tributary of Cadiangullong Creek. Other tributaries of Cadiangullong Creek affected by the existing Cadia Valley Operations and the proposed Project are Cadia Creek and Rodds Creek. Swallow Creek and Flyers Creek run in a north to south direction and are located to the west and east of Cadiangullong Creek, respectively (Figure ES-2).

Cadiangullong Creek, Copper Gully, Cadia Creek, Rodds Creek and Swallow Creek are ephemeral streams, whilst Flyers Creek is perennial (below the Long Swamp Road crossing).

Potential Impacts

In summary, the potential impacts on surface water primarily relate to:

- reduction of surface water quality due to runoff, seepage, the release of process water from construction or operational areas, or salinity;
- reduced flows in local creeks due to extraction for the Project water supply and loss of groundwater contribution through the formation of a permanent subsidence zone; and
- changes in flows in the Belubula River due to extraction for the Project water supply and loss of baseflow in local creeks (tributaries of the Belubula).

Outcomes of the Studies

- Flyers Creek – loss of a portion of the groundwater contribution to Flyers Creek (i.e. up to 0.49 ML/day) would occur as a result of the Project (both during operations and post-mining). This loss would increase the proportion of time low flows occur in Flyers Creek. However, the stream would remain perennial and flows would remain above the estimated stock water demand (i.e. riparian water rights would not be affected).
- Cadiangullong Creek – loss of a portion of the groundwater contribution to Cadiangullong Creek (i.e. up to 1.2 ML/day) would occur as a result of the Project (both during operations and post-mining). The effect of this loss during operations would be masked by the existing Cadiangullong Dam release protocol.

The use of the proposed transfer pipeline between Cadiangullong Dam and Rodds Creek Water Holding Dam, together with the predicted baseflow losses, would increase the percentage of time that Cadiangullong Creek would cease flowing, and the proportion of time Cadiangullong Dam is effectively empty from approximately 2.8% to 5.8% of the time. A small potential impact on the one non-CHPL owned property downstream of Cadiangullong Dam is predicted to occur when the water level falls below the lowest release point in the dam.

- Belubula River - the Project would impact on flows in the Belubula River through baseflow losses in Flyers and Cadiangullong Creeks (during operations and post-mining) and from changes in extractions from the Belubula River (during operations only). On average, the simulated long-term effect of the Project on Belubula River flows at the extraction point is less than 0.6% of the mean annual flow.

Mitigation Measures and Monitoring

- The existing Cadia Valley Operations surface water monitoring programme would be expanded to include additional flow gauges and pluviometers (rain gauges) on Flyers and Cadia Creeks.
- CHPL would review and revise the existing Contingency Water Supply Plan required under Condition 43 of the Cadia Hill Development Consent (DA 44/95), to accommodate the unlikely event that the loss of baseflow from Flyers Creek is greater than predicted and significant and adverse impacts on riparian users do occur. The Contingency Water Supply Plan would include details of how and under what circumstances CHPL would provide alternative water supply or other agreed measures.
- CHPL would increase its support of the Flyers Creek landcare group and/or assist with the establishment and support a new independent non-profit environmental organisation with the objective of protecting and improving the sustainability of the Flyers Creek catchment area. The organisation would seek to collaborate with the NSW Department of Primary Industries, Lachlan Catchment Management Authority, and other relevant agencies to develop and implement a long-term catchment management plan and implement ongoing water management and agricultural management projects with the involvement of local Flyers Creek landholders.
- In order to minimise the potential impact of the Project on the non-CHPL owned property on Cadiangullong Creek, CHPL would provide alternative stock water (or otherwise agreed alternative measures) to this property during the periods when the water level in Cadiangullong Dam has fallen below the lowest release point on the multi-level off-take and inflows to the dam are occurring (i.e. the dam is re-filling but it has not yet reached a point where flow releases can re-commence). Details would be provided in the Contingency Water Supply Plan.
- The existing Integrated Erosion and Sediment Control Plan would be augmented and updated for the Project.

ES3.5 FLORA

Existing Environment

Project disturbance areas are predominantly a combination of scattered trees in cleared agricultural land and pine plantations, however there are three main areas of native woodland totalling an area of approximately 238 ha.

The largest area of native vegetation within the Project area occurs adjacent to the existing Cadia Hill open pit. It is dominated by Red Stringybark/Long-leaved Box Open Forest (Vegetation Community 3a) and Red Box/Red Stringybark Open Forest (Vegetation Community 3b) (Figure ES-4). Overall, this area of vegetation is considered to be regionally significant for its flora diversity and condition.

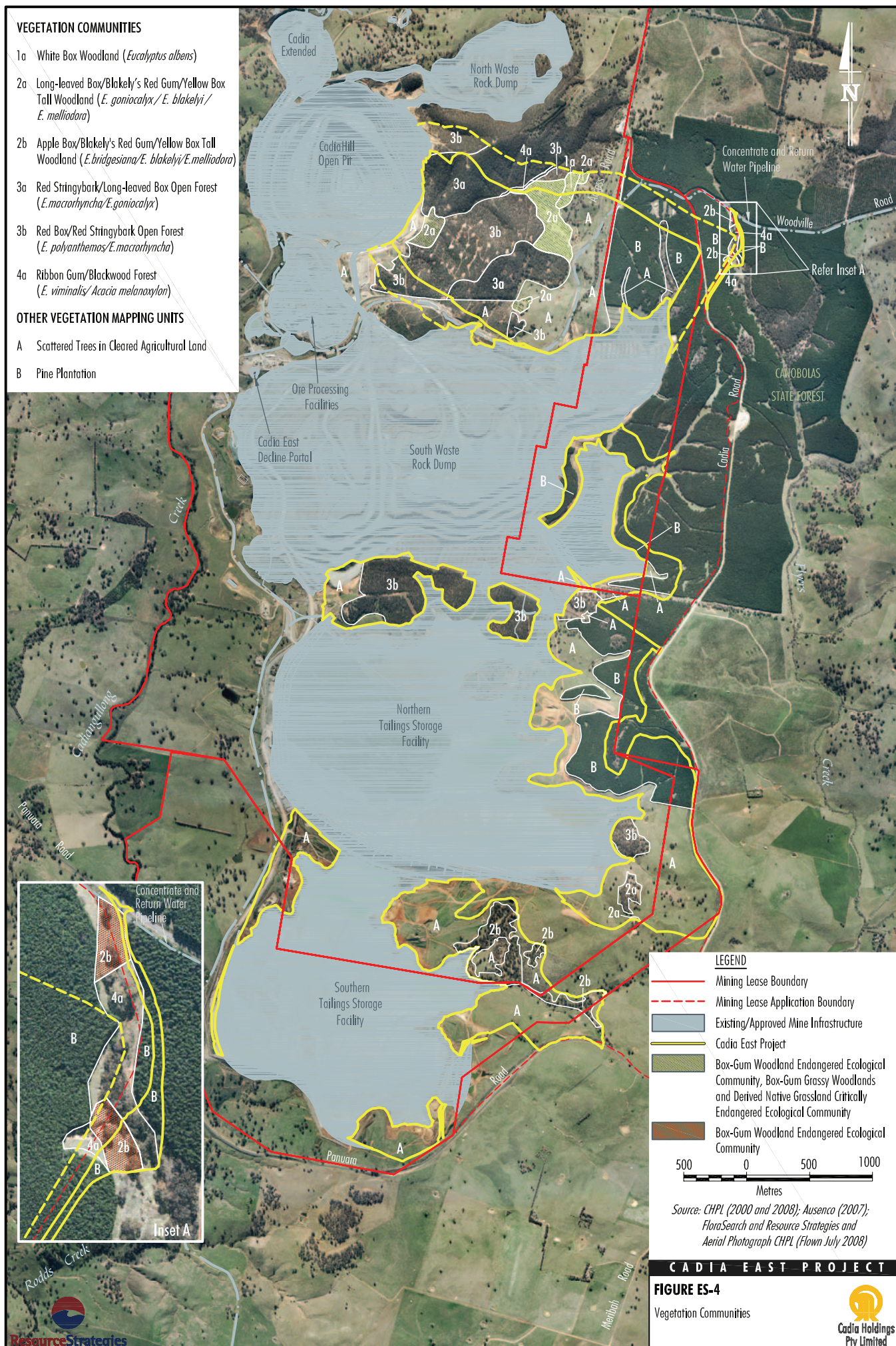
Two threatened ecological communities occur within Project disturbance areas (listed under state and federal legislation). Both of these threatened ecological communities are composed of various proportions of White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*) and are referred to as the Box-Gum Woodland. This woodland is listed as the Box-Gum Woodland Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act, 1995* and the Box-Gum Grassy Woodland and Derived Native Grasslands Critically Endangered Ecological Community (CEEC) under the *Environment Protection and Biodiversity Conservation Act, 1999*.

VEGETATION COMMUNITIES

- 1a White Box Woodland (*Eucalyptus albens*)
- 2a Long-leaved Box/Blakely's Red Gum/Yellow Box Tall Woodland (*E. gonicalyx*/*E. blakelyi*/*E. melliodora*)
- 2b Apple Box/Blakely's Red Gum/Yellow Box Tall Woodland (*E. bridgesiana*/*E. blakelyi*/*E. melliodora*)
- 3a Red Stringybark/Long-leaved Box Open Forest (*E. macrorhyncha*/*E. gonicalyx*)
- 3b Red Box/Red Stringybark Open Forest (*E. polyanthemus*/*E. macrorhyncha*)
- 4a Ribbon Gum/Blackwood Forest (*E. viminalis*/*Acacia melanoxylon*)

OTHER VEGETATION MAPPING UNITS

- A Scattered Trees in Cleared Agricultural Land
- B Pine Plantation



In the Project area, these threatened ecological communities are represented by the following three vegetation communities (Figure ES-4):

- 1a - White Box Woodland;
- 2a - Long-leaved Box/Blakely's Red Gum/Yellow Box Tall Woodland; and
- 2b - Apple Box/Blakely's Red Gum/Yellow Box Tall Woodland.

Potential Impacts

Vegetation disturbance associated with the Project would result in a decrease in the diversity of flora in the local area. The native vegetation communities that would be disturbed by the Project include:

- approximately 85 ha of native vegetation which would be cleared through the expansion of the tailings storage facilities;
- approximately 115 ha of native vegetation which is located within the subsidence area and would be lost as the rock and soil beneath it subsides;
- approximately 38 ha which is located within the surrounding zone of influence which may be modified by surface cracking but the ground itself is not expected to subside; and
- less than 1 ha of native vegetation which would be cleared for the Cadia Road re-alignment.

Approximately 23.5 ha of the threatened Box-Gum Woodland would be lost or modified for the Project (Figure ES-4).

It is considered unlikely that the Project would have a significant impact on the Box-Gum Woodland given the measures to avoid, mitigate and offset potential impacts (see below).

Mitigation and Management

The potential impacts of the Cadia Valley Operations on flora are currently managed via the implementation of existing management measures such as: progressive rehabilitation of disturbance areas; use of vegetation clearance protocols; and fire and weed management measures. These would continue to be implemented for the Project.

In addition to the above, CHPL has entered into an agreement to acquire a large area of remnant bushland and adjoining agricultural land at Black Rock Range, for the Project offset area (Figure ES-5). The offset area is suitably located as it is within the vicinity of the Project, being situated approximately 11 km to the west, and within the same bioregion. The land is currently largely unprotected and parts of it are grazed by sheep and cattle.

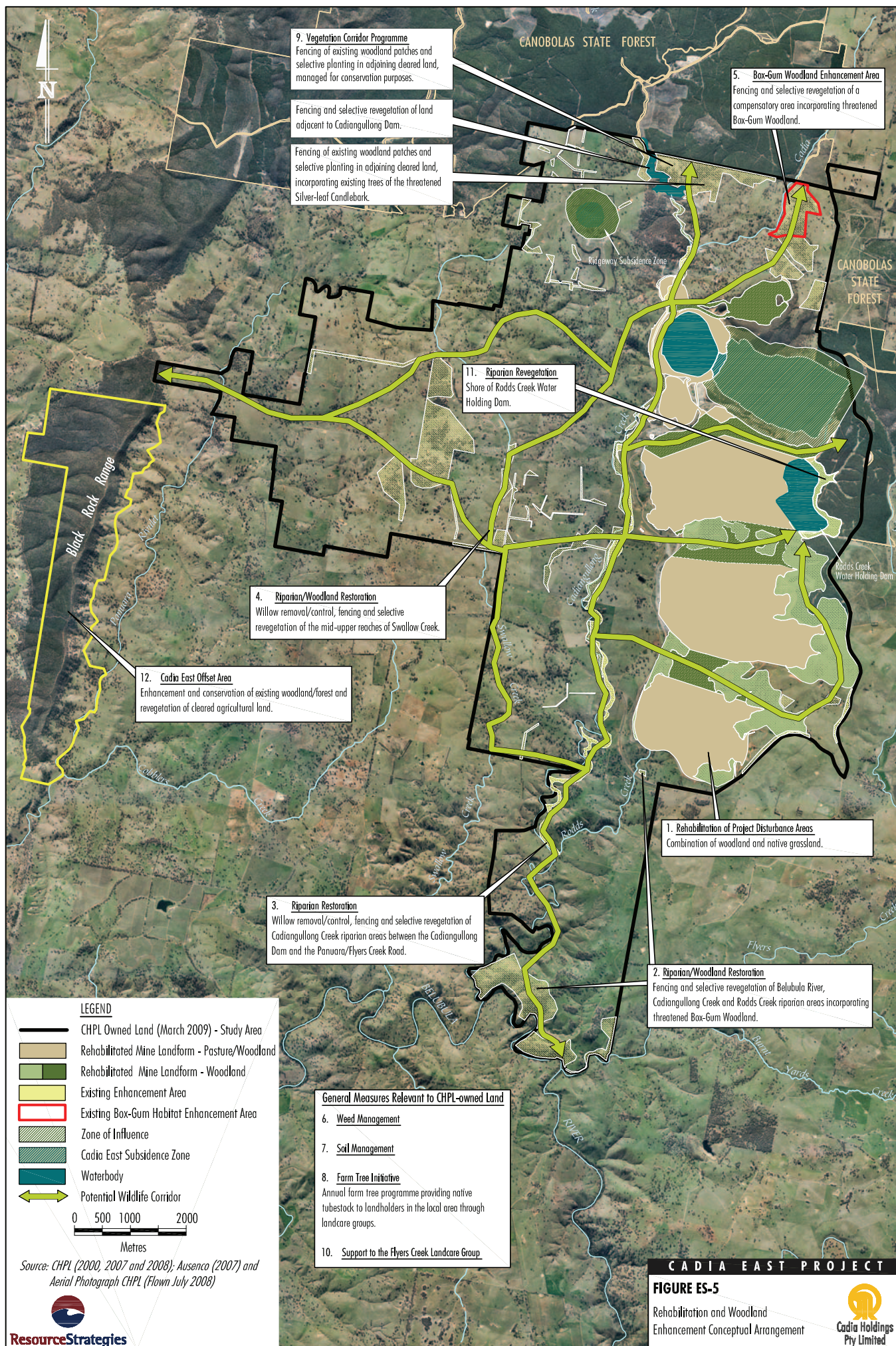
While approximately 238 ha of native vegetation communities would be cleared for the Project (Figure ES-4), it is proposed that significant areas of existing native vegetation communities would be enhanced (some 653 ha – including large quantities of Box-Gum woodland [at least 154 ha]) and areas of cleared agricultural land would be revegetated (some 173 ha) in the offset area (Figure ES-5).

Revegetation and enhancement initiatives that would be adopted for the Project are shown on Figure ES-5.

Conclusions

The following conclusions were made regarding the potential impacts on flora:

- Vegetation clearance associated with the Project would result in a decrease in the diversity of flora in the local area. The enhancement and conservation measures proposed as part of the offset would help maintain (and possibly improve) the flora biodiversity values of a substantial area of vegetation outside of the Project area.
- The Project would not affect any listed threatened populations of flora species.
- The Project would result in the loss of 23.5 ha of the Box-Gum Woodland EEC (of which 23 ha meets the criteria for the Box-Gum Grassy Woodlands and Derived Grasslands CEEC), however, it would not lead to the loss of the communities in the surrounding area. The offset measures, provide for the enhancement and conservation of 210 ha of Box-Gum Woodland EEC and 154 ha of Box-Gum Grassy Woodlands and Derived Grasslands CEEC.



ES3.6 FAUNA

Existing Environment

Project disturbance areas include a number of potential habitat types, including areas of open forest, open woodland, predominantly cleared agricultural land and aquatic habitats of varying habitat quality.

A total of ten threatened fauna species (seven birds and three mammals) have been recorded in or near the Project area and so are considered to have some potential to be affected by the Project. Of these, only the Squirrel Glider, Yellow-bellied Sheathtail-bat and the Eastern Bentwing-bat are considered likely to have viable populations within the Project area.

Potential Impacts

Disturbance associated with the Project would result in the removal of fauna habitats and the displacement and/or loss of native vertebrate individuals. However, the Project is unlikely to lead to the extinction of any threatened fauna species or place any at risk of extinction.

The identification of the Squirrel Glider at the Cadia Valley appears significant as it is more than 50 km from the closest Squirrel Glider record. The removal of the Squirrel Glider's habitat is very likely to result in the displacement of the local population of Squirrel Gliders, and ultimately very likely lead to the loss of the local population. Offset measures are described below.

Mitigation and Management

The Project offset area and revegetation programme would provide for a combination of woodland and native grassland habitats as well as facilitating fauna movement through habitat corridor establishment. These commitments would provide habitat for fauna in the medium to long-term.

A targeted Squirrel Glider monitoring programme would be developed for the Project. The programme would be used to identify specific conservation measures for this population (e.g. translocation and monitoring programme).

Conclusions

The following conclusions were made regarding the potential impacts on fauna:

- Disturbance associated with the proposed Project would result in the removal of fauna habitats and the displacement and/or loss of native vertebrate individuals and meta-populations. However the proposed impact mitigation and offset measures are likely to maintain regional fauna biodiversity in the short-term and to enhance it in the long-term.
- The Project is unlikely to lead to the extinction of any threatened fauna species or ecological community or place any at risk of extinction.
- The Project would not affect any listed threatened populations of fauna species.

ES3.7 AIR QUALITY

Existing Environment

The existing dust deposition and annual particulate matter concentrations surrounding the Cadia Valley generally comply with the relevant dust criteria. The only exceptions are occasional exceedances of the 24 hour criterion for particulate matter less than 10 microns (PM₁₀). These occasional exceedances are consistent with events such as bushfires or dust storms which often cause elevated PM₁₀ concentrations over large areas.

Potential Impacts

The main new sources of air quality emissions associated with the Project are expected to be from the expanded tailings storage facilities, ventilation shafts, general construction activities and wind-blown emissions from the Cadia East subsidence zone.

A cumulative air quality impact assessment was undertaken for the Project (i.e. including consideration of activities associated with the approved Cadia Valley Operations). This assessment indicated that the nearest sensitive receivers to the Project would comply with the relevant air quality criteria and that the overall dust emissions are predicted to reduce over time, reflecting the change from open pit mining at Cadia Hill to underground mining at Cadia East.

Mitigation and Management

The existing dust controls and monitoring network would continue to be implemented for the Project. The real-time PM₁₀ monitor would be used to assist with dust management on-site.

ES3.8 NOISE

Existing Environment

The existing noise emissions from the Cadia Valley Operations generally comply with the existing operational noise criteria. Further afield, the noise environment is typical of a rural setting.

Background noise surveys were conducted in the vicinity of the CVO Dewatering Facility site near Blayney. This noise environment was also characterised as typical of a rural setting, notwithstanding that the dewatering facility is located adjacent to an existing refrigerated warehouse facility (the Blayney Cold Storage and Distribution warehouses).

Potential Impacts

A cumulative noise assessment was undertaken for the Project. This assessment predicts that all sensitive receivers in the Cadia Valley would comply with the operational noise criteria, except for one sensitive receiver to the immediate east of the Cadia Valley during Year 1 at night-time. Similar to air quality, the overall noise emissions from the Project are predicted to reduce over time.

An iterative noise modelling process was also undertaken for the CVO Dewatering Facility. This process initially indicated exceedances of criteria at sensitive receivers near Blayney. As a result, a noise-reducing fence is proposed and train-loading activities would be undertaken during daytime hours only.

The final modelling results for the CVO Dewatering Facility indicate three sensitive receivers would exceed the relevant criteria, including one exceedance of greater than 5 A-weighted decibels (dBA) over the criteria.

Mitigation and Management

The existing noise monitoring network at the Cadia Valley Operations would continue to be implemented for the Project. In addition, monitoring would also be undertaken at the CVO Dewatering Facility to verify modelling results.

For sensitive receivers where monitoring indicates exceedances of the criteria, management strategies would be invoked for those in the 'management zone' (up to 5 dBA above the criteria) and 'affectation zone' (greater than 5 dBA above the criteria). Strategies would include noise mitigation at the receivers and potentially negotiated agreements within the affectation zone.

ES3.9 ABORIGINAL HERITAGE

Existing Environment

The Cadia Valley and the Orange area in general are within the territory of the Wiradjuri-speaking people. Numerous cultural heritage surveys have been undertaken within the Cadia Valley and surrounds. These surveys have recorded only a limited number of artefacts.

Potential Impacts

Although cultural heritage sites are relatively rare in the area, one single lithic item (a quality stone flake) and three archaeological 'areas of interest' have been recorded within Project disturbance areas.

Mitigation and Management

The lithic item is located adjacent to the concentrate and return water pipelines to be installed from the Cadia Valley to Blayney. This item would be salvaged prior to the construction of the pipelines. In addition, archaeological excavations would be undertaken at the 'areas of interest' to determine their archaeological significance (if any) and extent of the site.

ES3.10 EUROPEAN HERITAGE

Existing Environment

The Cadia Valley has a rich history of mining activity dating back to the 1850s. CHPL has been a responsible custodian of historical items at the Cadia Valley Operations, as exhibited by the relocation of the Cadia Cemetery and conservation of the Cadia (Cornish) Engine House and Chimney.

Within the Project disturbance areas, two remnants of historical mining activity are present, namely Little Cadia (a portion of which is within the subsidence zone and zone of influence) and Wire Gully Gold Workings (a portion of which would be inundated by the STSF).

Little Cadia and Wire Gully Gold Workings contain heritage items typical of historical mining activity including remnants of shafts, dams and buildings. Both of these heritage precincts are considered to be of local heritage significance, with some individual items at Little Cadia graded moderate to exceptional.

Potential Impacts

A portion of both Little Cadia and Wire Gully Gold Workings would be impacted by the Project. Of particular significance is a chimney base and wall structure at Little Cadia which would be located within the Cadia East zone of influence. Archaeological excavations of these items have been completed and they are considered to be of moderate to exceptional significance.

Mitigation Measures

Mitigation measures would include salvage of moveable heritage items at both Little Cadia and Wire Gully Gold Workings. In addition, archaeological excavations within the Cadia East zone of influence at Little Cadia (including the chimney base and wall structure) would be backfilled and sandbagged for protection from erosion and degradation.

ES3.11 ROAD TRANSPORT

Existing Environment

The Cadia Valley Operations are a significant existing source of traffic in the region. The principal route used to access the Cadia Valley Operations is from Orange via Forest Road and Cadia Road.

Local roads and key intersections surrounding the Cadia Valley and into Orange are assessed as having a generally good 'Level of Service'.

Potential Impacts

The Project would result in a short-term increase in existing traffic levels during the Project construction period and whilst Cadia Hill and Ridgeway are operating. After this period, traffic levels would return to levels generally consistent with average existing Cadia Valley Operations traffic. The Levels of Service on local roads and intersections would not change as a result of the Project.

The Project would also require the re-alignment of Cadia Road and the construction of a new intersection between Cadia Road and Woodville Road. This intersection would be constructed to maintain the existing level of service.

Mitigation Measures

Although the local road network has sufficient capacity to cater for the Project, CHPL would implement the following mitigation measures:

- all oversized vehicles would have the relevant permits, licences and escorts, as required by the regulatory authorities and the proposed route would be negotiated with the relevant local councils; and
- all oversize vehicles loads would be appropriately secured and covered, where necessary.

ES3.12 COMMUNITY AND ECONOMIC ASPECTS

Existing Environment

The Cadia Valley Operations are acknowledged to be a strong contributor to the regional economy. Results of a survey of local businesses indicate that a total of 93% of businesses surveyed considered that the local economy benefits from the Cadia Valley Operations, with 97% of these considering that the benefit to the local economy from the Cadia Valley Operations is medium to high.

CHPL is also a significant regional employer and employs some 950 people on average, with employment levels currently at around 1,100 with the construction of Ridgeway Deeps.

Potential Impacts

A benefit cost analysis indicates a very large net production benefit of approximately \$1,210 M and states that the Project would generate approximately 1,889 direct and indirect jobs.

The existing community infrastructure and services are expected to be sufficient to cater for the expected increase in population to the area during times of peak employment.

Mitigation Measures

The Mine Closure Plan would be revised in consultation with relevant local authorities and stakeholders and would include measures to manage the potential socio-economic impacts on the regional economy and community of the cessation of the Cadia Valley Operations at the end of the Project.

ES3.13 VISUAL CHARACTER

Existing Environment

The Cadia Valley Operations are currently shielded to a large extent by topographic high points on the east and west sides of the Cadia Valley, and forestry operations to the north and east. Views of the existing operations are available in places, predominantly from the south. CHPL has established visual screens of native trees at strategic locations to screen views from some vantage points.

Potential Impacts

A limited number of new locations would have views of the Cadia Valley Operations as a result of the Project. The main potential visual impacts resulting from the Project would be from the raises of the NTSF and STSF and formation of the Cadia East subsidence zone.

Mitigation Measures

CHPL would increase screens of native trees in some locations, and in response to community feedback.

- vegetation corridor enhancement areas across CHPL-owned land (Figure ES-5).

Rehabilitation concepts for the existing Cadia Valley Operations are described in the existing Mine Closure Plan and are described in the EA as part of an integrated approach to rehabilitation (i.e. including Project landforms). Rehabilitation of key Project-related landforms is described below.

Cadia East Subsidence Zone Final Void (and Cadia Hill Open Pit Void)

The Cadia East subsidence zone and Cadia Hill open pit void would form an integrated final void, with a waterbody forming up to 670 m AHD over a period of approximately 330 years (Section ES3.3). This void would be bunded and fenced to restrict stock and human access. A native woodland screen would be planted around the fence to provide a visual barrier and delineation of the zone to assist in future landuse planning. Where possible the native woodland screen would be used as a link in the vegetation corridor programme.

NTSF and STSF

Post-mining, surface runoff from each tailings storage facility would either be directed into tributaries of Cadiangullong Creek or Rodds Creek. The surface of the tailings storage facility would be revegetated by applying topsoil and direct seeding and/or planting with a mixture of locally occurring trees, shrubs and/or introduced pasture species. Following the completion of tailings deposition, the upstream lift embankments would be stabilised with the application of topsoil and direct seeded and/or planted with endemic tree and shrub species.

ES4 REHABILITATION

CHPL's overall rehabilitation goal for the Cadia Valley Operations is to generate enduring land value, including both ecological value (e.g. biological diversity and other environmental values) and agricultural value (i.e. the ability to produce agricultural goods).

At the completion of mining, the key final landforms at the Cadia Valley Operations (including the Project) would include the following:

- South Waste Rock Dump, North Waste Rock Dump, and waste rock backfilled in Cadia Extended;
- NTSF and STSF;
- subsidence zones created by Ridgeway and Cadia East;
- Cadia Hill open pit void;
- mine infrastructure areas (e.g. ore processing facilities, workshops, etc.);
- retainment of the Rodds Creek Water Holding Dam and Cadiangullong Dam; and

South Waste Rock Dump

The South Waste Rock Dump would be reprofiled to blend in with the natural topography of the area, with an overall outer batter slope of 1:4 comprising 1:3 outer slopes and 15 to 20 m wide, step-back, reverse graded berms. A series of rock lined drainage systems and detention ponds would be constructed to channel runoff safely to constructed receival areas. Progressive rehabilitation of the outer batters would be undertaken once the batters are finalised. Revegetation of some areas on the dump have commenced, with progressive rehabilitation to be undertaken on a campaign basis throughout the Project as new areas become available for rehabilitation.

Riparian and Vegetation Corridor Enhancement on CHPL-Owned Land

As discussed in Section ES3.5 and shown on Figure ES-5, enhancement of vegetation would be undertaken on CHPL-owned lands. The general flora and fauna attributes of the Vegetation Corridor Programme would be that it would:

- link significant areas of remnant vegetation, including the proposed offset area at Black Rock Range;
- enhance habitat for native flora and fauna, including threatened species and ecological communities (i.e. Box-Gum Woodland);
- facilitate the movement of genetic material between flora and fauna populations;
- increase the sustainability and biodiversity of CHPL-owned farms and environs; and
- sustain and enhance the agricultural value of the lands.

The concepts presented above would be adjusted over the life of the Cadia Valley Operations in consideration of the outcomes of research trials, community and regulatory consultation, regional infrastructure requirements and industry knowledge.

ES5 MONITORING AND MANAGEMENT

CHPL's existing extensive environmental monitoring and management commitments would be revised for the Project, where necessary. Existing Cadia Valley Operations management plans include:

- Site Management Plan;
- Land Management Plan;
- Water Management Plan;
- Flora and Fauna Management Plan;
- Mine Closure Plan;
- Noise Management Plan;
- Dust Management Plan;
- Integrated Erosion and Sediment Control Plan;
- Bushfire Management Plan;
- Blasting and Vibration Management Plan;
- Lighting Management Plan;
- Contingency Water Supply Plan;
- Cadia Interpretation Plan; and
- Waste Management Plan.

In addition, CHPL would prepare and implement the following new plans for the Project:

- Groundwater Management Plan; and
- CVO Dewatering Facility Environmental Management Plan.

Environmental monitoring of the Project would include:

- meteorology;
- groundwater;
- surface water;
- flora;
- fauna;
- monitoring of the Black Rock Range offset area;
- erosion and sediment control;
- air quality;
- noise;
- blasting;
- visual (i.e. monitoring and maintenance of vegetation screens); and
- rehabilitation.

Figure ES-6 summarises environmental monitoring to be undertaken for the Project.

