Appendix G

Surface Water Impact Assessment

REPORT

Cowal Gold Operations
Underground Mine Project
Hydrological Assessment

Prepared for: Evolution Mining (Cowal) Pty Limited

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b	Draft Report	CAW	TSM	TSM	7/9/2020
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d	Rev 2	CAW	TSM / EMM	TSM	18/9/2020
e	Final	CAW	TSM / EMM	TSM	24/9/2020

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EXECUTIVE SUMMARY

Evolution proposes to extend mining operations at the Cowal Gold Operations (CGO) through development of an underground mine (herein referred to as the Underground Development Project). Evolution are seeking approval under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for two separate though inter-related applications:

- Environmental Impact Statement (EIS) – a State Significant Development (SSD) application under Section 4.38 of the EP&A Act for the underground mine component of the Underground Development; and
- Modification 16 – a request for modification (Modification 16) to the existing CGO development consent (DA 14/98) under Section 4.55 of the EP&A Act for the ancillary surface changes associated with the Underground Development.

The main water-related activities associated with the Underground Development Project would comprise:

- Development of an underground mining operation beneath Lake Cowal and associated water demand and dewatering requirements;
- Production of up to 27 million tonnes (Mt) of primary ore and associated water requirements for processing; and
- Development of a tailings paste fill plant and associated water requirements for processing.

Water demand associated with the Underground Development Project is anticipated to be met through the currently approved water supply sources and infrastructure. The maximum water demand to accommodate processing of primary and oxide ore from the proposed underground mine and open cut operations is estimated at 25 ML/d in 2024. This compares with an average process plant demand of 22 ML/d in 2019 for the current CGO.

Site water balance model results indicate that the demand from external sources, based on the median rainfall sequence, would average 2,744 ML/year with up to 2,850 ML/year to be sourced from the Lachlan River based on the 90th percentile model results. If supply from the Bland Creek Paleochannel Borefield was reduced to an average of 4 ML/d over the life of the Underground Development Project, equivalent to the predicted sustainable yield, up to 3,160 ML/year would be required from the Lachlan River based on the 90th percentile model results. Based on DPIE-Water trading records, there has been adequate allocation assignment water available on the market from this source in previous years to meet this predicted demand requirement.

The site water balance results indicate that the existing water management storages and infrastructure are sufficient to accommodate the water demand and dewatering requirements associated with the proposed Underground Development Project. Based on the expected primary and oxide ore processing rates from both the underground and open cut operations, the water demand and available supply for operations is such that the approved water storage D10 may not be required.

The main water-related activities associated with Modification 16 would include:

- Extension of the life of mine and associated water management requirements;
- Management of tailings associated with the underground and open cut mining operations through deposition in the tailing storage facilities (TSFs) and Integrated Waste Landform (IWL);
- Management of runoff from approximately 5.74 Mt of additional underground mine waste rock; and

- Augmentation of on-site water storages from time to time depending on water supply and on-site requirements.

To facilitate management of tailings associated with the underground mine and open cut operations, the final rehabilitated height of the IWL is proposed to be increased from 245 m AHD to 246 m AHD. The proposed increase would be contained within the currently approved disturbance area and runoff and seepage from the IWL would continue to be managed within the approved Up-Catchment Diversion System (UCDS) and Internal Catchment Drainage System (ICDS).

Runoff from the ore stockpile areas and additional waste rock associated with the underground mine operations would continue to be captured and contained within the approved disturbance area. Because the proposed underground development waste rock is geochemically similar to the waste rock from the current open cut operations, the management strategies currently employed for the waste rock emplacements are not expected to require modification in order to accommodate the additional waste rock.

Due to the potential enrichment of arsenic, cadmium, copper, lead, selenium and zinc in the run-of-mine ore and low grade ore, it is recommended that these metals and total alkalinity continue to be included in the site water quality monitoring programme. It is proposed that the site water quality monitoring programme is revised to also include monitoring of silver.

Augmentation of on-site water storages would be undertaken within the existing catchment area/disturbance area of each storage. No overflows were predicted in water balance model simulations from either of the contained water storages (D1 and D4) that could overflow to Lake Cowal in any of the model simulations. The proposed surface changes associated with the Underground Development Project and Modification 16 are to be contained within the current approved disturbance area. As such, no impact on inflows to Lake Cowal or the water quality of Lake Cowal are expected to occur as a result of the Underground Development Project or Modification 16.

Final void water balance model predictions indicate that the final void would reach a peak equilibrium water level more than 60 m below the spill level (i.e. the final void would be contained). Equilibrium water levels would be reached slowly over a period of more than 1,600 years. Groundwater outflow from the final void was not simulated to occur – i.e. the final void would remain a groundwater sink.

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

Evolution Mining (Cowal) Pty Limited (Evolution) is the owner and operator of the Cowal Gold Operations (CGO) located approximately 38 kilometres (km) north-east of West Wyalong in New South Wales (NSW) (Figure 1). The CGO is an open cut mine which has been operational since 2005. Mining operations at the CGO are currently approved to 31 December 2032 and are carried out in accordance with Development Consent DA 14/98 (as modified).

Evolution are seeking approval under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for two separate though inter-related applications:

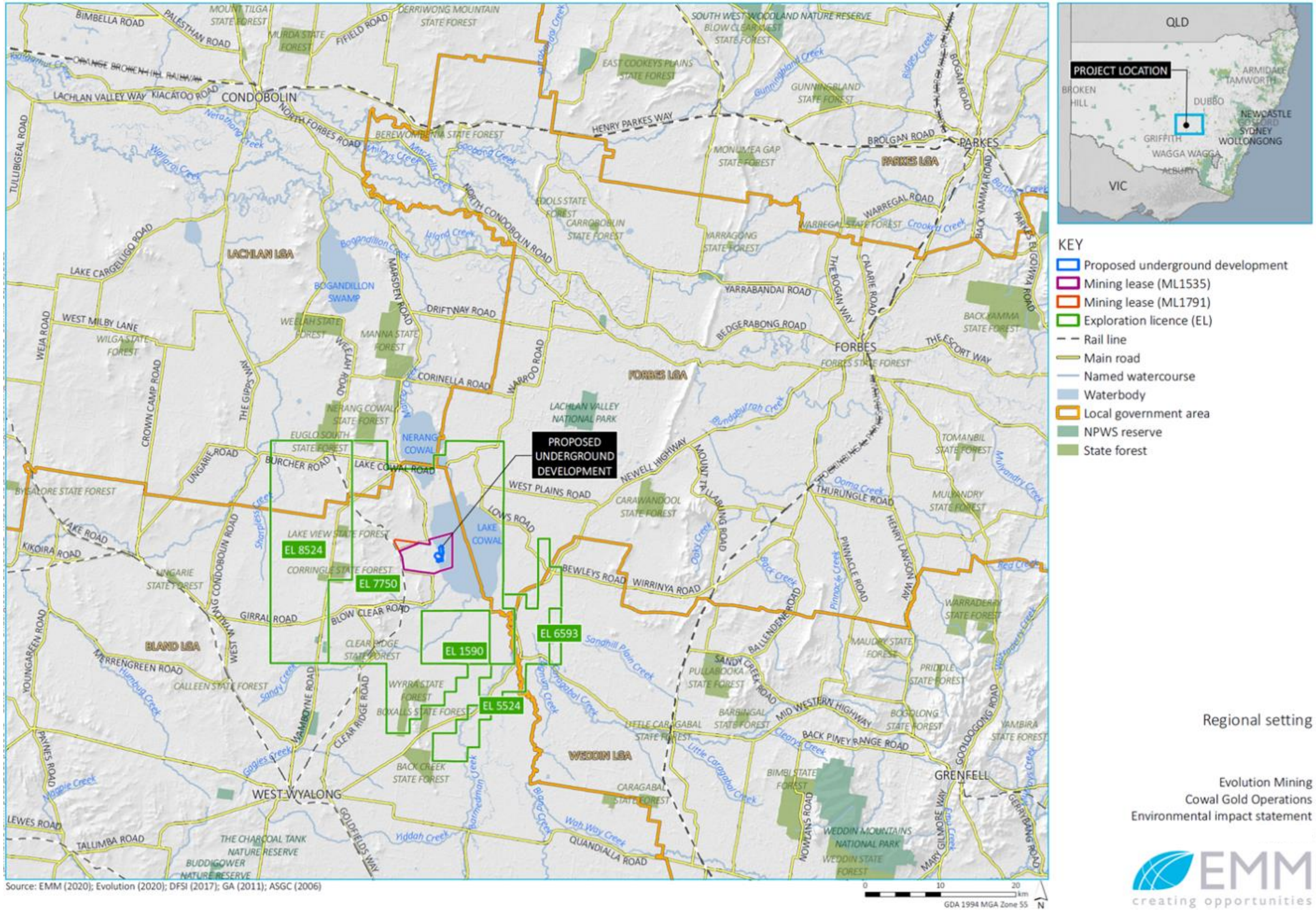
- Environmental Impact Statement (EIS) – a State Significant Development (SSD) application under Section 4.38 of the EP&A Act for the underground mine component of the Underground Development; and
- Modification 16 – a request for modification (Modification 16) to the existing CGO development consent (DA 14/98) under Section 4.55 of the EP&A Act for the ancillary surface changes associated with the Underground Development.

Evolution proposes to extend mining operations at the CGO through development of an underground mine (herein referred to as the Underground Development Project). The Underground Development Project would comprise the development of an underground mine using stope mining practices, in addition to the continued operation of the existing open cut mine. The proposed underground development area, key approved surface elements and Modification 16 surface elements are shown in Figure 2. The key components of the Underground Development Project are to comprise:

- Development of an underground mining operation beneath Lake Cowal through underground stope mining methods;
- A box-cut entry to the underground workings;
- Production of up to 27 million tonnes (Mt) of ore at a rate of 1.8 Mt per annum (Mtpa);
- Production of approximately 5.74 Mt of waste rock;
- Development of an underground mining fleet and associated workforce;
- Development of a paste fill plant, delivery of paste fill via a borehole and backfilling of underground stopes with the paste; and
- Development of ancillary underground infrastructure to support the underground operation, including dewatering infrastructure, ventilation system, electrical reticulation.

Modification 16 would comprise surface changes associated with the Underground Development Project, with key changes to comprise:

- Extension of the mine life to the end of 2040;
- A height of 1 metre (m) from 245 m Australian Height Datum (AHD) to 246 m AHD to the final rehabilitated height of the Integrated Waste Landform (IWL);
- Augmentation of dam D5A within the existing catchment area of the dam; and
- Development of additional surface infrastructure and augmentation of existing infrastructure as required.

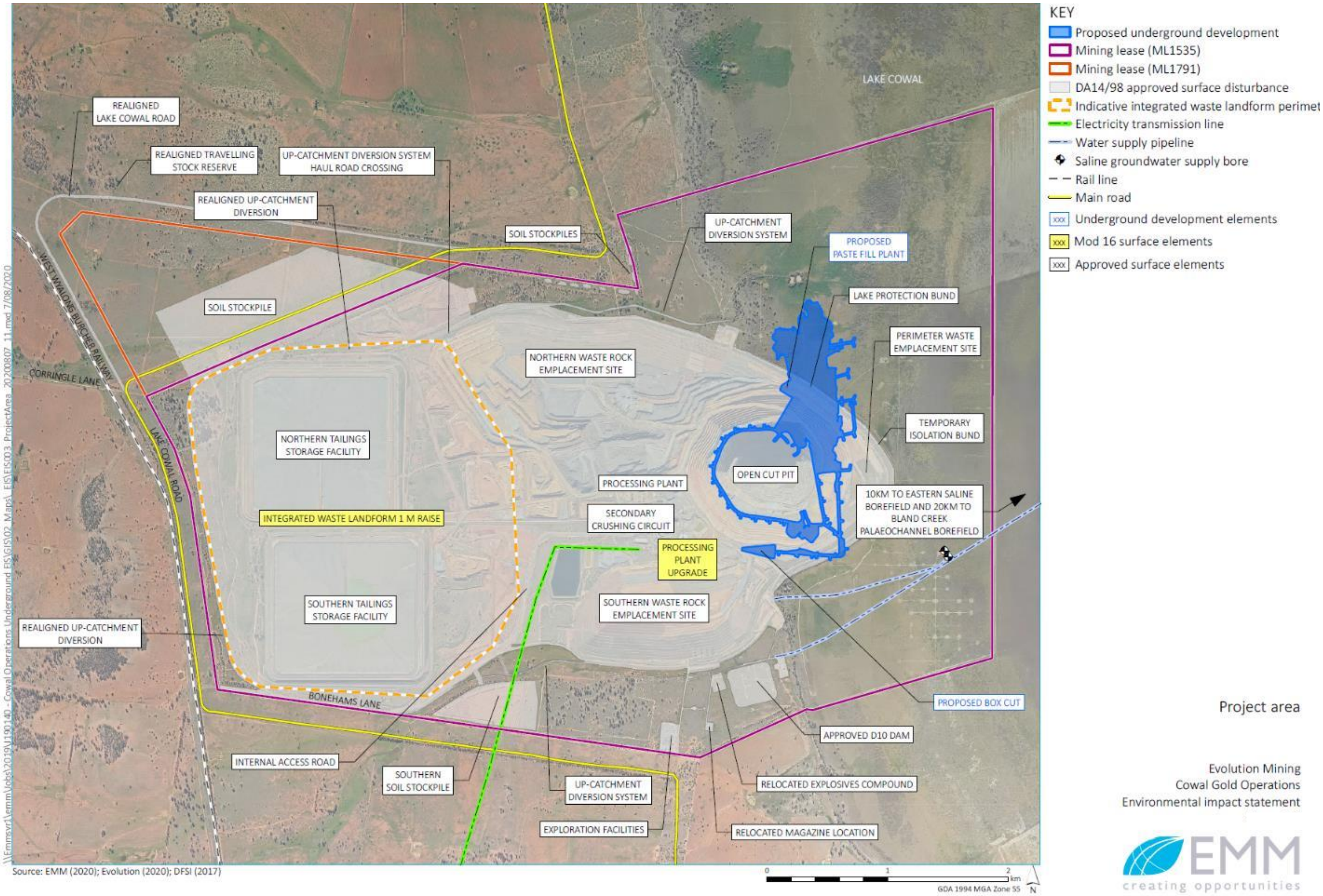


Source: EMM (2020); Evolution (2020); DFSI (2017); GA (2011); ASGC (2006)

Regional setting

Evolution Mining
Cowal Gold Operations
Environmental impact statement

Figure 1 Regional Location



Source: EMM (2020); Evolution (2020); DFSI (2017)

Figure 2 **Project Area**

The main water-related activities associated with the Underground Development Project and Modification 16 would include:

- Extension of the life of mine and associated water management requirements;
- Water demand associated with the Underground Development which is anticipated to be met through the currently approved water supply sources and infrastructure; and
- Management of tailings through deposition in the tailing storage facilities (TSFs), IWL and through paste backfill.

A Hydrological Assessment (this report) has been prepared by Hydro Engineering & Consulting Pty Ltd (HEC) to assess potential water-related impacts associated with the Underground Development Project. The Hydrological Assessment has been developed in support the EIS and Modification 16 for the Underground Development Project and draws on results of groundwater modelling contained in the reports by Coffey Services Australia Pty Ltd (Coffey) (2020a and 2020b) (Appendix E of the EIS).

1.2 STUDY REQUIREMENTS AND SCOPE

This assessment has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the Project dated 26 August 2020. Table 1 provides a summary of the SEARs (including those provided by relevant agencies) related to surface water along with a reference to the relevant section of the report which addresses the requirement.

Table 1 Summary of SEARs and Relevant Sections – Surface Water

Document	Requirements	Report Section
SEARs – General	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. In particular, the EIS must include: ... • An assessment of the likely impacts of the development on the environment, focussing on the specific issues identified below, including:	
	○ A description of the existing environment likely to be affected by the development, using sufficient baseline data;	Section 2.1
	○ An assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice;	Section 8.0
	○ A description of the measures that would be implemented to avoid, mitigate and/or offset the likely impacts of the development, and an assessment of: - Whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; - The likely effectiveness of these measures, including performance measures where relevant; and - Whether contingency plans would be necessary to manage any residual risks;	Section 8.0 and Section 9.0
	○ A description of the measures that would be implemented to monitor and report on the environmental performance of the development if it is approved; and	Section 9.0

Table 1 (Cont.) Summary of SEARs and Relevant Sections – Surface Water

Document	Requirements	Report Section
SEARs – General	A consolidated summary of all the proposed environmental management and monitoring measures, identifying all commitments made in the EIS.	Section 9.0
SEARs – Specific Issues (Water)	An assessment of the likely impacts of the development on the quantity and quality of regional surface water and groundwater resources.	Section 8.0 Groundwater resources are discussed in Coffey (2020a and 2020b)
	An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users.	Section 8.0
	Identification of the proposed water supply for the development.	Section 4.2
	A detailed site water balance, including a description of site water demands, water disposal methods (including the location, volume, and frequency of any water discharges and management of discharge water quality), water supply arrangements, water supply and transfer infrastructure and water storage structures.	Section 6.0
	A detailed description of the proposed water management system (including sewerage), beneficial water re-use and proposed measures to monitor and mitigate surface water and groundwater impacts.	Section 3.0, Section 4.0 and Section 9.0 Groundwater monitoring is discussed in Coffey (2020a and 2020b)
Environment Protection Agency (EPA) - Attachment 2 & 3 (Water)	The goals of the project should include the following: • No pollution of waters (including surface and groundwater), except to the extent authorised by the EPA (i.e. in accordance with an Environment Protection Licence); • Polluted water (including effluent, process waters, wash down waters, polluted stormwater or sewage) is captured on the site and collected, treated and beneficially reused, where this is safe and practicable to do so; • It is acceptable in terms of the achievement or protection of the River Flow Objectives and Water Quality Objectives. The assessment should document the measures that will achieve the above goals. Details of the site drainage and any natural or artificial waters within or adjacent to the development must be identified and where applicable measures proposed to mitigate potential impacts of the development on these waters. The assessment should provide details of any water management systems for the site to ensure surface and groundwaters are protected from contaminants.	Section 3.0, Section 4.0, Section 5.0, Section 8.0 and Section 9.0

1.3 RELEVANT PLANNING INSTRUMENTS, POLICIES, GUIDELINES AND PLANS

The objects of the NSW *Water Management Act 2000* which is the principal statute governing management of water resources in NSW, were considered during the assessment. *The Water Management Amendment Act 2014* was passed in 2014 and the provisions commenced on 1 January 2015. The objects of the *Water Management Act 2000* include:

> *…to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:*
>
> (a) *to apply the principles of ecologically sustainable development, and*
>
> (b) *to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and*
>
> *(c) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:*
>
> > *(i) benefits to the environment, and*
> >
> > *(ii) benefits to urban communities, agriculture, fisheries, industry and recreation, and*
> >
> > *(iii) benefits to culture and heritage, and*
> >
> > *(iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water,*
>
> *(d) to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources,*
>
> *(e) to provide for the orderly, efficient and equitable sharing of water from water sources,*
>
> *(f) to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna,*
>
> *(g) to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users,*
>
> *(h) to encourage best practice in the management and use of water.*

The relevant planning instruments, policies, guidelines and plans used as a basis for assessing impacts in this report are listed in Table 2.

Table 2 Summary of Planning Instruments, Policies, Guidelines and Plans

1	Water Sharing Plan for the Lachlan Regulated River Water Source 2016	Extraction of water from Lachlan River via the Jemalong Irrigation Channel for use at the CGO has been assessed in accordance with the requirements of the *Water Sharing Plan for the Lachlan Regulated River Water Source 2016*.
2	Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012	Extraction of water from the Western Bland Creek Water Source associated with the CGO has been assessed in accordance with the requirements of the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012.*
3	NSW State Rivers and Estuary Policy (NOW)	Potential impacts to Lake Cowal have been assessed with consideration to the NSW State Rivers and Estuary Policy.
4	NSW Government Water Quality and River Flow Objectives (EPA)	The NSW water quality objectives are consistent with the agreed national framework for assessing water quality set out in the Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000a) as listed below.
5	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC, 2006)	The Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000a) has been applied in accordance with this guideline, including consideration of the NSW Government Water Quality and River Flow Objectives (NSW Government, 2016).
6	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000a)	The surface water quality monitoring results for the existing CGO and surrounding areas have been compared to these guidelines where appropriate.
7	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000b)	Surface water quality monitoring would continue to be conducted in accordance with these guidelines.
8	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)	The ANZG (2018) revision of the Water Quality Guidelines is being progressively updated and is to supersede the ANZECC/ARMCANZ (2000a) Guidelines. The surface water quality monitoring results for the existing CGO and surrounding areas have been compared to these guidelines. Updated default guideline values are yet to be published under the 2018 Guidelines for all constituents and, as such, default values have been adopted from the ANZECC & ARMCANZ (2000) Guideline as recommended in ANZG (2018) where appropriate.
9	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC, 2004b)	Surface water quality monitoring would continue to be conducted in accordance with these guidelines.
10	Managing Urban Stormwater: Soils & Construction (Landcom, 2004) and associated Volume 2E: Mines and Quarries (DECC, 2008)	Existing and planned erosion and sediment controls would be designed in accordance with Landcom (2004) and DECC (2008) to control suspended solids in runoff.

ANZECC/ARMCANZ = Australian and New Zealand Environment and Conservation Council/ Agriculture and Resource Management Council of Australia and New Zealand

ANZG = Australian and New Zealand Environment Guidelines

DEC = NSW Department of Environment and Conservation

EPA = NSW Environment Protection Authority

NOW = NSW Office of Water

Table 2 (Cont.) Summary of Planning Instruments, Policies, Guidelines and Plans

11	Managing Urban Stormwater: Treatment Techniques (EPA, 1997)	Would be considered and applied as relevant to drainage design/management around mine infrastructure area.
12	Managing Urban Stormwater: Source Control (EPA, 1998)	Would be considered and applied as relevant to drainage design/management in mine infrastructure areas.
13	Technical Guidelines: Bunding & Spill Management (now Storing and Handling Liquids: Environmental Protection - Participants Manual [DECC, 2009]; Environmental Compliance Report: Liquid Chemical Storage, Handling and Spill Management - Part B Review of Best Practice and Regulation [DEC, 2005])	Would be used in design of containment systems for hazardous chemicals and would be incorporated into standard operating procedures for spill response.
14	A Rehabilitation Manual for Australian Streams (CRCCH and LWRRDC, 2000)	This guideline would be considered upon approval of the Underground Mine Project.
15	NSW Guidelines for Controlled Activities (NOW)	Not considered relevant to this assessment as minimal surface disturbance is proposed outside of the already approved surface disturbance areas.
16	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ANZECC/ARMCANZ, 1997)	The existing sewerage systems at CGO (with upgrades as required) would continue to be operated in accordance with the *Environmental Guidelines: Use of Effluent by Irrigation* (DEC, 2004a).
17	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Use of Reclaimed Water (ANZECC/ARMCANZ, 2000c)	The existing sewerage systems at CGO would continue to be operated in accordance with the *Environmental Guidelines: Use of Effluent by Irrigation* (DEC, 2004a) which makes reference to ANZECC/ARMCANZ (2000c).
18	Floodplain Development Manual (DIPNR, 2005)	Not considered relevant to this assessment as there are no properties other than those owned by the proponent that could be affected by mine infrastructure in any floodplain.
19	Floodplain Risk Management Guide (OEH, 2019)	Not considered relevant to this assessment as the Underground Mine Project is outside areas which could be affected by current sea level rise predictions and there are no properties outside those owned by the proponent that could be affected by mine infrastructure in any floodplain.
20	Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004a)	The surface water quality monitoring results from the existing CGO and surrounding areas have been compared to guidelines set in ANZECC/ARMCANZ (2000a) for use of water as irrigation water where relevant.
21	Guidelines for Practical Consideration of Climate Change (DECC, 2007)	Considered in the interpretation of post-mine impacts.

CRCCH and LWRRDC = Cooperative Research Centre for Catchment Hydrology and Land and Water Resources Research and Development Corporation.

DECC = NSW Department of Environment and Climate Change

DIPNR = NSW Department of Infrastructure, Planning and Natural Resources

OEH = Office of Environment and Heritage

The groundwater-related components of the assessment are provided separately in the Hydrogeological Assessment prepared by Coffey (2020a and 2020b) (Appendix E of the EIS). These include a discussion on the *NSW Aquifer Interference Policy 2012* and its implications for the Underground Mine Project.

Under the *Water Management Act 2000*, the *Water Sharing Plan for the Lachlan Regulated River Water Source 2003* commenced on 1 July 2004 and was replaced on 1 July 2016. The *Water Sharing Plan for the Lachlan Regulated River Water Source 2016* covers licensed surface water accessed from the Lachlan River.

The external make-up of water supply at CGO is provided to the site via the mine borefield pipeline which draws water from the eastern saline borefield, the Bland Creek Palaeochannel Borefield and water extracted from the Lachlan River via the Jemalong Irrigation Channel. Water is currently extracted from the Lachlan River using regulated flow licences purchased by Evolution on the open market under the *Water Sharing Plan for the Lachlan Regulated River Water Source 2016.* Between approximately 4,000 and 274,000 megalitres (ML) of allocation assignment has been traded annually since records began in the 2004/2005 water year to the 2019/2020 water year[1].

Under the *Water Management Act 2000*, the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* commenced on 14 September 2012. The *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* applies to all unregulated water sources in the Lachlan catchment which occurs naturally on the surface of the ground, and in rivers, lakes and wetlands.

Within the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012,* CGO is located within the Western Bland Creek Water Source, which has a total surface water entitlement of 2,270 megalitres per year (ML/year) divided between 32 surface water licences[1].

1.4 SUMMARY OF RELEVANT FINDINGS OF PREVIOUS ENVIRONMENTAL APPROVALS DOCUMENTATION

Cowal Gold Project Environmental Impact Statement (EIS) (North Limited, 1998).

- Surface water on the mine site was to be permanently isolated from Lake Cowal by the Up-Catchment Diversion System (UCDS), directing runoff from areas unaffected by mining around the perimeter of the site, and an Internal Catchment Drainage System (ICDS), capturing all site runoff and seepage for re-use in the processing plant. In the longer term the ICDS would direct site runoff to the final void which would become a permanent sink for groundwater and surface runoff.
- The long term final void water balance was such that the final void was predicted to not spill under any conceivable climate conditions.
- The operational water balance prediction was for a moderately negative site water balance. External water supply would be required from the Bland Creek Palaeochannel Borefield.
- Mine waste rock material was predicted to have the potential to generate moderately saline seepage, particularly during the active mining phase. During the active mining phase, all runoff and seepage from the waste rock emplacements would be contained within the ICDS.
- The tailings storages were designed to be able to contain runoff from a 0.1 percent (%) annual exceedance probability (AEP) rainfall event. Any overflow or seepage would be contained within the ICDS, ultimately reporting to the open pit.

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[1] https://waterregister.waternsw.com.au/ accessed 4 August 2020.

- In the longer term, it was predicted there would be little potential for movement of surface water or groundwater from the waste rock emplacements or of seepage from the tailings storages.

Use of suitable soils and vegetation in rehabilitation of waste rock emplacements and the tailings storages was predicted to result in low salt fluxes in surface waters consistent with regional runoff water quality.

Cowal Gold Mine Extension Modification Hydrological Assessment (Gilbert & Associates, 2013) – Modification 11.

- There was no change proposed to the UCDS, directing runoff from areas unaffected by mining around the perimeter of the site, with the ICDS continuing to capture all site runoff and seepage for re-use in the processing plant.
- In order to effectively manage water within the ICDS and maintain water supply, some minor changes were proposed, including some re-direction of internal drainage from constructed mine landforms and construction of an additional raw water storage – D10.
- Augmentation of the external water supply pipeline (across Lake Cowal) was proposed increasing its capacity from 11 ML/day to 14 ML/day. This would also involve construction of another pump station which would be located outside the bounds of the Lake Cowal inundation limits and away from drainage paths. Any potential impacts of the pump station construction would be mitigated by appropriate design.
- Water balance modelling indicated that there were no external water supply shortfalls simulated, with the median peak annual water supply requirement from licensed Lachlan River extraction peaking at 2,924 ML. No overflows were predicted in the water balance model from either of the contained water storages (D1 and D4) that could overflow to Lake Cowal.
- Final void water balance modelling indicated that final void equilibrium water levels would be lower than those predicted in North Limited (1998) and would be approximately 80 m below spill level.
- It was concluded that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification.

Cowal Gold Operations Mine Life Modification Hydrological Assessment (HEC, 2016) – Modification 13.

- There was no change proposed to the UCDS, directing runoff from areas unaffected by mining around the perimeter of the site, with the ICDS continuing to capture all site runoff and seepage for re-use in the processing plant.
- In order to effectively manage water within the ICDS and maintain water supply, some minor changes were proposed, including some re-direction of internal drainage from constructed mine landforms.
- The two TSFs were to be progressively raised for the remainder of the mine life, with the area between the two TSFs also used for storage of tailings.
- Two campaigns of oxide ore were to be processed – in 2020 and from 2030 to 2032. Due to the nature of the oxide ore, during these times the demand for process plant makeup water would increase.
- Water balance modelling indicated there were no external water supply shortfalls simulated, with the median peak annual water supply requirement from licensed Lachlan River extraction peaking at 2,853 ML. No overflows were predicted in the water balance model from either of the contained water storages (D1 and D4) that could overflow to Lake Cowal.

- Final void water balance modelling indicated that final void equilibrium water levels would be lower than those predicted in North Limited (1998) and would be more than approximately 80 m below spill level.
- It was concluded that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification.

Cowal Gold Operations Processing Rate Modification Hydrological Assessment (HEC, 2018) – Modification 14.

- The ore processing rate was proposed to be increased from 7.5 Mtpa to up to 9.8 Mtpa through secondary crushing and other upgrades, with concurrent processing of oxide and primary ore.
- Increased annual extraction of water from the CGO’s external water supply sources and duplication of the existing water supply pipeline across Lake Cowal were proposed to facilitate the increased water demand at the processing plant.
- The two TSFs were to be combined to form one larger TSF which would also accommodate mine waste rock (referred to as the IWL).
- Relocation of water management infrastructure (i.e. UCDS and approved location for contained water storage D10) and other ancillary infrastructure (e.g. internal roads and soil and ore stockpiles) elsewhere within Mining Lease (ML) 1535 and within Mining Lease Application (MLA) 1 was proposed.
- Water balance modelling indicated that non-negligible (>20 ML) supply shortfalls were simulated in 13% of the 128 climatic sequences simulated and were predicted to occur either towards the end of the early stage of the IWL (2023 to 2024) or towards the end of the planned predominately oxide ore processing period (2031).
- Based on the modelling results for the median rainfall sequence, the demand from external sources (the eastern saline borefield, the Bland Creek Palaeochannel borefield and licensed extraction from Lachlan River water entitlements) averaged 4,247 ML/year, with the median annual water supply requirement from licensed Lachlan River extraction peaking at 2,853 ML.
- No overflows were predicted in the water balance model from either of the contained water storages (D1 and D4) that could overflow to Lake Cowal, contingent upon pumped dewatering of these storages in between rainfall events.
- It was concluded that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification.

2.0 HYDROMETEOROLOGICAL SETTING

2.1 REGIONAL HYDROLOGY

The CGO is located on the western side of Lake Cowal (refer Figure 3) and extends into the natural extent of Lake Cowal. Lake Cowal is an ephemeral, freshwater lake that forms part of the Wilbertroy-Cowal Wetlands which are located on the Jemalong Plain. Lake Cowal is in the lower reaches of the Bland Creek catchment. It also receives periodic inflows from the Lachlan River during periods of high flow[2] when flood waters enter Lake Cowal via two main breakout channels from the north-east. Breakout from the Lachlan River to Lake Cowal occurred in late 2010, in the first half of 2012 and again in 2016, but had not occurred prior to this since 1998. According to site monitoring data, Lake Cowal was dry from July 2018 to August 2020 (inclusive).

Lake Cowal is a large oval shaped lake which, when full, occupies an area of some 105 square kilometres (km^2), holds some 150 gigalitres of water and has a depth of approximately 4 m when full. It overflows to Nerang Cowal, a smaller lake to the north. When flows are sufficient, the lakes ultimately overflow and drain into the Lachlan River via Bogandillon Creek. The Lachlan River is the major regional surface drainage, forming part of the Murray-Darling Basin. Flows in the Lachlan River near Lake Cowal are regulated by releases from Wyangala Dam.

The area surrounding the CGO site is drained by ephemeral drainage lines which flow to Lake Cowal. Bland Creek and all other tributaries of Lake Cowal are also ephemeral. Bland Creek drains a catchment of approximately 9,500 km^2 which ultimately reports to Lake Cowal at the northern end of the creek. Flow records from a gauging station[3] on Bland Creek indicate that runoff is low, averaging about 5% of rainfall.

2.2 METEOROLOGY

The region experiences a semi-arid climate which is dominated by cool, higher rainfall conditions in winter and hot and relatively dry conditions in summer. Table 3 summarises regional monthly and annual rainfall totals from Bureau of Meteorology (BoM) stations (Wyalong, Ungarie and Burcher Post Offices [PO]), as well as rainfall recorded at CGO since 2002.

Long-term regional rainfall averages[4] 455 millimetres (mm) per annum. Average annual rainfall recorded at the CGO from 2002 to May 2020 averaged 415 mm, which compares with an annual average of 432 mm recorded at Wyalong PO and 463 mm at Burcher PO for the same period.

Table 4 summarises regional monthly and annual pan evaporation totals from the nearest BoM pan evaporation stations. The nearest BoM pan evaporation station is located at the Condobolin Agricultural Research Station, approximately 65 km north of CGO. Annual pan evaporation averages 1,972 mm at this station.

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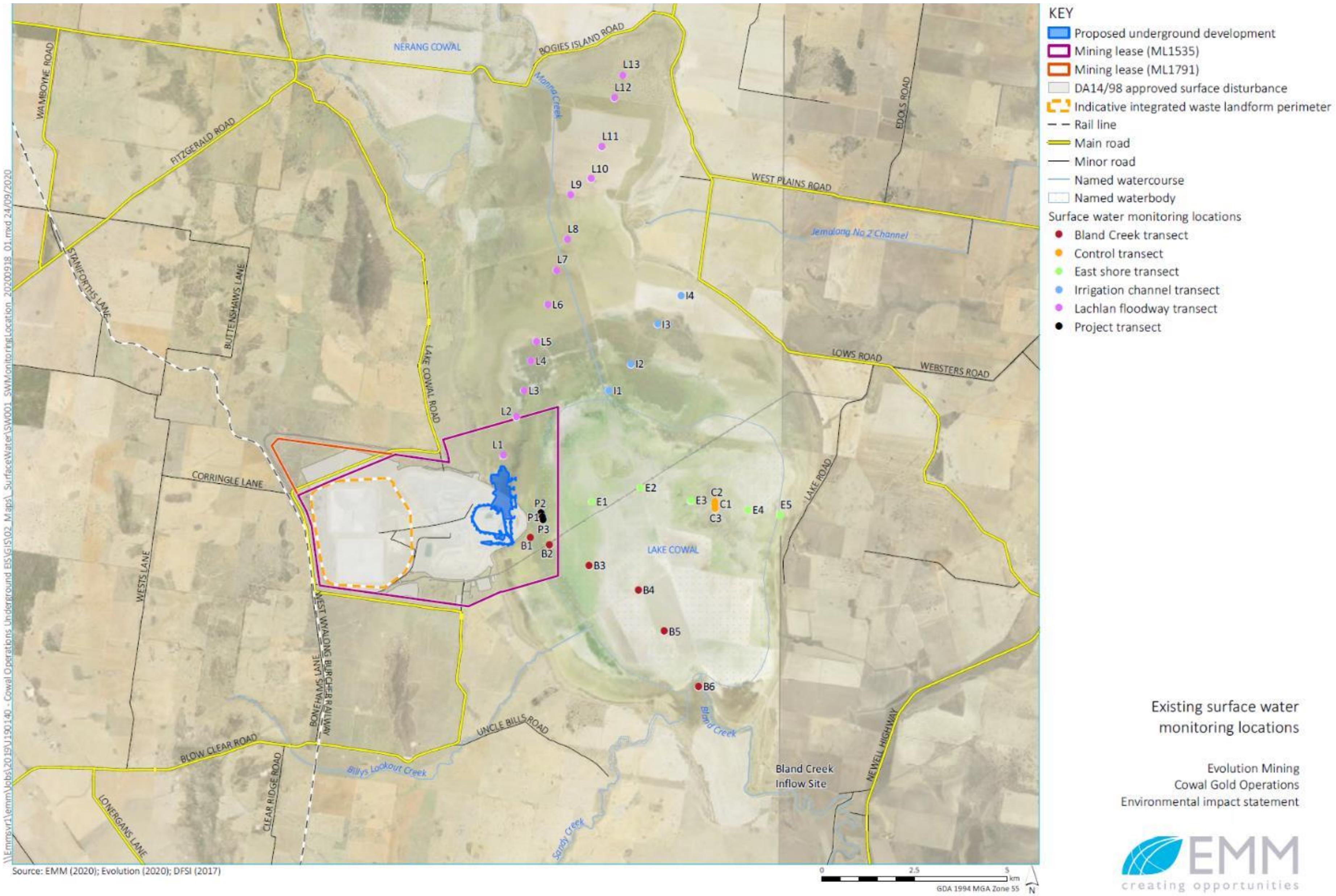
[2] Inflows from the Lachlan River occur when flows at Jemalong Weir exceed 15,000 to 20,000 ML/day – North Limited (1998)

[3] GS 412171 (Bland Creek at Marsden), which operated from 1998 to 2004

[4] From SILO Point Data - https://www.longpaddock.qld.gov.au/silo/point-data/ for location 33º 39'S 147º 24'E



Source: EMM (2020); Evolution (2020); DFSI (2017)

Figure 3 **Existing Environmental Monitoring Locations**

Table 3 Rainfall Data Summary

	Wyalong PO (073054*)		Ungarie PO** (050040*)		Burcher PO (050010*)		CGO	
	Jun-1895 – May-2020		Oct-1895 – Jun-2020		Jun-1937 – May-2020		Jan-2002 – May-2020[†]	
	Mean Total (mm)	Mean No. Raindays	Mean Total (mm)	Mean No. Raindays	Mean Total (mm)	Mean No. Raindays	Mean Total (mm)	Mean No. Raindays
Jan	41.5	4.9	41.5	3.7	41.9	4.1	26.8	5.8
Feb	38.6	4.6	38.8	3.7	42.9	4.0	52.0	6.3
Mar	37.2	4.7	38.5	3.7	41.0	4.0	37.6	5.4
Apr	34.3	4.8	33.0	3.8	34.0	4.1	22.1	4.3
May	38.9	6.6	37.9	5.4	37.0	5.8	23.2	6.0
Jun	43.4	8.7	42.8	6.6	36.3	6.5	45.2	10.8
Jul	42.2	9.7	38.0	7.0	38.3	7.4	37.2	10.2
Aug	38.3	8.9	35.2	6.8	37.0	6.4	28.1	8.1
Sep	35.6	7.2	33.4	5.6	34.5	5.3	31.8	6.3
Oct	44.3	6.8	40.2	5.4	45.0	5.5	29.0	6.3
Nov	36.4	5.6	36.5	4.2	37.1	4.7	33.5	6.3
Dec	44.6	5.4	43.3	4.2	42.6	4.1	48.6	7.1
Annual	475.3	77.9	459.3	60.0	467.6	61.9	415.0	82.6

* BoM Station Number.

** Data contains numerous gaps in recent years and early in the 20th century.

[†] Manual gauge to December 2006, automatic weather station thereafter.

Note: Statistically, the sum of monthly means does not necessarily equal the annual mean.

Table 4 Evaporation Data Summary

	Pan evaporation Condobolin Agricultural Research Station (050052*)	Pan evaporation Condobolin Soil Conservation (050102*)	Pan evaporation Cowra Research Station (063023*)
	1973 – 2017	1971 – 1985	1965 – 2011
	Mean Total (mm)	Mean Total (mm)	Mean Total (mm)
Jan	313.1	235.6	229.4
Feb	248.6	200.6	180.8
Mar	207.7	161.2	148.8
Apr	126.0	102.0	90.0
May	74.4	58.9	49.6
Jun	48.0	36.0	30.0
Jul	49.6	43.4	34.1
Aug	77.5	68.2	49.6
Sep	117.0	96.0	78.0
Oct	182.9	142.6	120.9
Nov	234.0	189.0	162.0
Dec	297.6	235.6	217.0
Annual	1,972	1,571	1,388

* BoM Station Number.

Note: Statistically, the sum of monthly means does not necessarily equal the annual mean.

2.3 WATER QUALITY

2.3.1 Lake Cowal

Baseline water quality reported in the Cowal Gold Project EIS (North Limited,1998) was based on results of an intensive sampling programme conducted between 1991 and 1995 and included 34 monitoring locations along four transects across Lake Cowal. This has been supplemented by monitoring campaigns undertaken (when the lake re-filled) from November 2010 through to July 2014 and from August 2016 to July 2018[5]. Sampling of lake inflow from Sandy Creek and Bland Creek was also undertaken from November 2010 through to July 2014 and from August 2016 to January 2017 when sufficient flow permitted. Table 5 summarises the surface water monitoring programme for Lake Cowal as detailed in the CGO Water Management Plan (Evolution, 2018).

Table 5 Lake Cowal Surface Water Monitoring Programme

CGO Component	Site	Monitoring Frequency	Parameter/Analyte
Lake Cowal Chemical Monitoring	P1, P3, L1, C1	Weekly and following rainfall events of 20 mm or greater in a 24 hour period (when lake water is present and the lake water level is at or above 204.5 m AHD)	Suspended Solids, EC, pH
	Lake Cowal transect sampling sites: • Lachlan Floodway • transect – L1, L2, L5, L8, L9, L11 and L13 • Irrigation Channel • transect – I1, I3 and I4 • East Shore transect – E1, E3 and E5 • Bland Creek transect – B1, B2, B4 and B6 • CGO transect – P1 to P3 • Control sites transect – C1 to C3	Monthly (when lake water is present and the lake water level is at or above 204.5 m AHD)	EC, pH, turbidity, dissolved oxygen, temperature, lake water level
		Quarterly (when lake water is present and the lake water level is at or above 204.5 m AHD)	Suspended Solids, Alkalinity, cations and anions Total Fe, Ca, Mg, K, sodium, chloride, sulphate, total phosphate, ortho phosphate, ammonium, nitrogen as nitrate and nitrite Total As, Cd, Cu, Mo, Ni, Pb, Sb, Se and Zn Dissolved As, Cd, Cu, Mo, Ni, Pb, Sb, Se and Zn
Lake Cowal Inflow Sites	Lake inflow sites: Lachlan Floodway, Irrigation Channel, Bland Creek and Sandy Creek inflow sites	Monthly (when lake water is present and the lake water level is at or above 204.5 m AHD)	EC, pH, turbidity, dissolved oxygen, temperature
		Quarterly (when lake water is present and the lake water level is at or above 204.5 m AHD)	Suspended Solids, Alkalinity, cations, anions Total Fe, Ca, Mg, K, sodium, chloride, sulphate, total phosphate, ortho phosphate, ammonium, nitrogen as nitrate and nitrite Total As, Cd, Cu, Mo, Ni, Pb, Sb, Se and Zn Dissolved As, Cd, Cu, Mo, Ni, Pb, Sb, Se and Zn

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[5] Evolution advises that between 2014 and August 2016 and from July 2018 lake water levels were too low (or the lake dry) for effective sampling to occur.

The results of monitoring since 2010 have been summarised in Table 6 and Table 7. The water quality assessment has been conducted using monitoring data for Lake Cowal recorded over the period November 2010 to May 2018 when the lake levels were sufficient to enable sampling. Results from the assessment period are compared to relevant default guideline values published in ANZECC/ARMCANZ (2000a) and ANZG (2018)[6] and with values obtained from sampling programs conducted during the baseline period prior to commencement of mining operations (1991 to 1995). Lake water quality monitoring locations are shown in Figure 3.

Average total nitrogen measured at the lake transect sites was 489 micrograms per litre (µg/L), which was higher than the maximum level recorded during the baseline period (257 µg/L) and the ANZECC/ARMCANZ (2000a) default guideline value for freshwater lakes (350 µg/L). It was, however, lower than the average concentration in lake inflows from Bland Creek and Sandy Creek over the monitoring period (807 µg/L).

Average total phosphorous measured at the lake transect sites was 388 µg/L, which was lower than the baseline data (range 970 to 2,640 µg/L) and lower than the average total phosphorous recorded at the lake inflow sites (Bland Creek and Sandy Creek – 468 µg/L). It was however higher than the ANZECC/ARMCANZ (2000a) default guideline value for freshwater lakes (10 µg/L).

Average pH measured at the lake transect sites was 8.0, which was slightly lower than the average recorded over the baseline period (pH 8.48), but slightly higher than the average recorded at the lake inflow sites (pH 7.5). The range of pH levels recorded at the lake transect sites (pH 5.56 to 11.42)[7] was greater than that recorded at the lake inflow sample locations (pH 5.78 to 9.39) and outside the default guideline value range (pH 6.5 to 8.0) published in ANZECC/ARMCANZ (2000a). The range measured at the lake transects during the baseline period was pH 7.72 to 9.8 (which is noted to also be above the upper default guideline value published in ANZECC/ARMCANZ [2000a]).

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[6] The ANZG (2018) revision of the Water Quality Guidelines is being progressively updated and is to supersede the ANZECC/ARMCANZ (2000a) Guidelines. The surface water quality monitoring results for the existing CGO and surrounding areas have been reviewed against ANZG (2018) where updated default guideline values are available. For constituents in which revised default guideline values are yet to be published under the ANZG (2018), default values have been adopted from the ANZECC & ARMCANZ (2000) Guideline as recommended in ANZG (2018).

[7] Two field pH values greater than 10 were recorded in late February 2011. 90% of recorded pH values were less than 8.7.

Table 6 Summary of Lake Cowal Water Quality – Generic Parameters

Parameter (Units as stated)	Default Trigger Values[1]		Lake Cowal Baseline Water Quality (1991-1995)	Baseline Data Inflow Sites Only (1991-1992, Dec 93)	Baseline Data Lake Transects (1991-1995)	Lake Cowal Transect Monitoring (Nov 2010 – July 2018)	Lake Cowal Inflow Sites (Nov 2010 - August 2017)
	Protection of Aquatic Ecosystems	Stock Water Protection Low Risk Trigger Value					
Total N (µg/L)	350 µg/L for SE Australia Freshwater Lakes and Reservoirs	No trigger values given	Not available	660 to 2,610 (1,200**)	61 to 257 (136**)	10 to 5,620 (489**)	10 to 2,700 (807**)
Total P (µg/L)	10 µg/L for SE Australia Freshwater Lakes and Reservoirs	No trigger values given	Not available	29 to 216 (79**)	970 to 2,640 (1,667**)	10 to 1,980 (388**)	120 to 1,860 (468*)
pH (pH units) - field	6.5 to 8.0 pH for SE Aust. Freshwater Lakes and Reservoirs	No trigger values given	8.27 to 8.67	7.6 to 8.2	7.72 to 9.8 (8.48**)	5.56 to 11.42 (8.0**)	5.78 to 9.39 (7.5**)
EC (measured in field)/TDS	EC 20-30 µS/cm for SE Australia Freshwater Lakes and Reservoirs	TDS triggers 2,500 mg/L dairy cattle, 5,000 mg/L sheep	222 to 1,557 µS/cm	382 to 1,260 µS/cm (726**)	160 to 3,130 µS/cm (881**)	2.09 to 1,801 µS/cm (407**)	34 to 871 µS/cm (218**)
Turbidity (NTU – measured in field)/TSS (mg/L)^	1 to 20 NTU Turbidity Triggers for slightly disturbed ecosystems - lakes	No triggers given	22 to 224 mg/L	0.62 to 234 (70.5**) NTU^ 0.54 to 150 (37.9**) mg/L TSS	7 to 566 (111**) NTU^ 13 to 271 (103.4**) mg/L TSS	7.8 to 2,562 (287**) NTU^ 2 to 1,210 (125**) mg/L TSS	13.4 to 2,819 (360**) NTU^ 6 to 640 (102**) mg/L TSS

mg/L: milligrams per litre.
EC: electrical conductivity.
TDS: total dissolved solids.
TSS: total suspended solids.
N: nitrogen.
P: phosphorous.
SE: south-east.
^ Catchments with highly dispersive soils will have high turbidity (ANZECC/ARMCANZ, 2000a).
** Average Value.

[1] Default guideline values were adopted from ANZECC/ARMCANZ (2000a). The NSW Water Quality Objectives do not differ from the ANZECC/ARMCANZ (2000a) Guidelines.

Note: pH, turbidity, and EC data were derived from field samples, all other parameters were derived from laboratory analysis.
Conductivity in lakes and reservoirs is generally low, but will vary depending on catchment geology (ANZECC/ARMCANZ, 2000a).

Table 7 Summary of Lake Cowal Water Quality – Metals

Parameter (Units as stated)	Default Trigger Values[1]					Lake Cowal Baseline Water Quality (1991-1995)	Baseline Data Inflow Sites Only (1991-1992, Dec 93)	Baseline Data Lake Transects (1991-1995)	Lake Cowal Transect Monitoring (Nov 2010 - May 2018)	Lake Cowal Inflow Sites (Nov 2010 - August 2017)
	Protection Levels for Aquatic Ecosystems				Stock Water Protection Level					
	99%	95%	90%	80%	Low Risk Trigger Value					
As (Total) (µg/L)	0.8	13	42	140	500	2.6**	<0.1 to 3.5 (1.2**)	<0.5 to 3.98 (2.6**)	2 to 27 (6.4**)	1 to 26 (4.8**)
Cd (Total) (µg/L)	0.06	0.2	0.4	0.8	10	0.055**	<0.05 to 0.5 (0.1**)	<0.05 to 0.5 (0.06**)	0.1 to 1 (0.11**)	All samples less than or equal to the Level of Detection Limit (0.1)
Cu (Total) (µg/L)	1.0	1.4	1.8	2.5	1,000 µg/L cattle, 400 µg/L sheep	6**	1.6 to 7.5 (3.5**)	2.2 to 15.9 (5.8**)	1 to 32 (8.8**)	2 to 70 (11.1**)
Fe (Total) (µg/L)	No trigger values given				Not sufficiently toxic	-	-	-	50 to 33,600 (11,668**)	900 to 180,000 (18,933**)
Pb (Total) (µg/L)	1	3.4	5.6	9.4	100	2.9**	<0.5 to 7.2 (2.3**)	<0.5 to 6.5 (2.7**)	1 to 15 (5.4**)	1 to 97 (10.6**)
Mn (Total) (µg/L)	1,200	1,900	2,500	3,600	Not sufficiently toxic	-	-	-	55 to 470 (166**)	137 to 296 (217**)
Hg (Total) (µg/L) (inorganic)	0.06	0.6	1.9	5.4	2	>50% of samples less than the Level of Detection Limit (0.1)	<0.1 to 0.4 (0.2**)	<0.1 to 0.4 (0.13**)	All samples less than or equal to the Level of Detection Limit (0.1)	All samples less than or equal to the Level of Detection Limit (0.1)
Zn (Total) (µg/L)	2.4	8	15	31	20,000	12**	<3 to 22 (9.0**)	<3 to 30 (11.7**)	5 to 79 (20.5**)	5 to 234 (31**)
Ni (Total) (µg/L)	8	11	13	17	1,000	-	-	-	2 to 26 (11.1**)	3 to 77 (12.7**)

As: arsenic.
Cd: cadmium.
Cu: copper.
Fe: iron.
Pb: lead.
Mn: manganese.
Hg: mercury.
Zn: zinc.
Ni: nickel.
>: greater than.
<: less than.
** Average Value

[1] Default guideline values were adopted from ANZG (2018) and do not differ from ANZECC/ARMCANZ (2000a) for these constituents. The NSW Water Quality Objectives do not differ from the ANZECC/ARMCANZ (2000a) Guidelines.

Average Electrical Conductivity (EC) (a measure of salinity) in lake water over the assessment period was 407 microSiemens per centimetre (µS/cm). This is lower than the average EC measured at the lake transect sites during the baseline period (881 µS/cm). The average EC measurements for the lake recorded during the assessment period were slightly higher than the average records for the lake inflow sample locations (218 µS/cm) over the assessment period. Both the average lake inflow and lake transect values recorded during the baseline and assessment periods were well above the ANZECC/ARMCANZ (2000a) default guideline value for slightly disturbed ecosystems of freshwater lakes and reservoirs (20 - 30 µS/cm).

The average turbidity level recorded at lake transect sites during the assessment period was 287 nephelometric turbidity units (NTU), compared to 111 NTU recorded during the baseline period. Average turbidity recorded at lake transects was lower than the average recorded at the lake inflow sample locations (360 NTU) during the assessment period. The levels recorded during the baseline and assessment period were well above the ANZECC/ARMCANZ (2000a) default guideline value for protection of slightly disturbed ecosystems of freshwater lakes and reservoirs (1 to 20 NTU).

Laboratory analysis of lake and inflow water quality samples included metals analyses for nine metals (arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel and zinc). Mercury concentrations were at or below laboratory detection level at both lake transect and lake inflow sites during the assessment period. Cadmium concentrations were at or below laboratory detection level at lake inflow sites and one sample returned a concentration above the laboratory detection in the lake transect sites (1 µg/L).

Average arsenic, cadmium and manganese concentrations at the lake transect sites were below the ANZG (2018) default guideline value for protection of slightly to moderately disturbed ecosystems (95% protection level), while the average nickel concentration (11.1 µg/L) slightly exceeded the default guideline value (11 µg/L). The average of all detectable metal concentrations, with the exception of arsenic and cadmium, at the lake transect sites were lower than the respective average concentrations measured at the lake inflow sites. The average lake transect site arsenic (6.4 µg/L), cadmium (0.11 µg/L – one sample above limit of detection), copper (8.8 µg/L), lead (5.4 µg/L) and zinc (20.5 µg/L) concentrations were greater than the corresponding baseline values. The average lake inflow sites arsenic (4.8 µg/L), copper (11.1 µg/L), lead (10.6 µg/L) and zinc (31 µg/L) were greater than the corresponding baseline values.

In summary, notable results are:

- the range of pH was high relative to ANZECC/ARMCANZ (2000a) default guideline values and baseline ranges, however, as discussed further below has been similarly elevated at sites near and distant to the CGO;
- average copper, lead and zinc concentrations were high relative to both the ANZG (2018) default guideline values and baseline concentrations however were lower than inflow site concentrations and as discussed further below have been similarly elevated at sites on the opposite side of Lake Cowal;
- average turbidity was significantly higher than the ANZECC/ARMCANZ (2000a) default guideline value and higher than baseline levels, however as discussed further below turbidity levels have been relatively uniform at sites close to and distant from the CGO; and
- total phosphorous concentrations were significantly higher than the ANZECC/ARMCANZ (2000a) default guideline value for freshwater lakes however as discussed further below concentrations have been similar at sites both close to the CGO and on the other side of Lake Cowal and lower than inflow site records (it is also noted that the average total phosphorous concentration is much lower than the baseline average).

As surface water runoff within the CGO area is fully contained in the ICDS, there is no obvious causal link between the mining operations and water quality in the lake. Given that groundwater, including any seepage from on-site storages, would flow toward the mine pit (Coffey, 2020a), the only plausible links between mining activity at the CGO and lake water quality would be overflow from dams D1 and/or D4 (which are outside the ICDS), mine site dust fall-out onto the lake or runoff/wash-off from the outside batters of the perimeter waste emplacement when the Lake Temporary Isolation Bund is inundated. Both D1 and D4 storages are fitted with pump back systems and Evolution has advised[8] that they have never overflowed to date. Based on assessment of the monitoring data, there is no evidence that the existing CGO has resulted in changes to water quality in Lake Cowal.

Samples taken at transect sites P1, P2 and P3 are physically close to the Lake Temporary Isolation Bund and therefore more likely to reflect mine-related effects, whilst sites E3 and E4 are on the opposite side of the lake – refer Figure 3. A comparison of the monitored results from these sites for pH, copper, lead, zinc, turbidity and total phosphorous is shown in Figure 4 to Figure 9.

2.3.1.1 Comparison of Monitored pH Across Lake Cowal

The pH values were relatively elevated at lake sites close to the CGO (P1, P2, and P3) in February 2011 compared to sites on the opposite side of the lake (refer Figure 4). Elevated pH levels were also recorded near the CGO in February 2012 although similar levels were also measured on the opposite side of the lake at that time. Since the lake refilled in 2016, pH levels have been relatively consistent across the lake except in December 2017 when slightly elevated levels were recorded at lake sites close to the CGO (P1, P2 and P3).

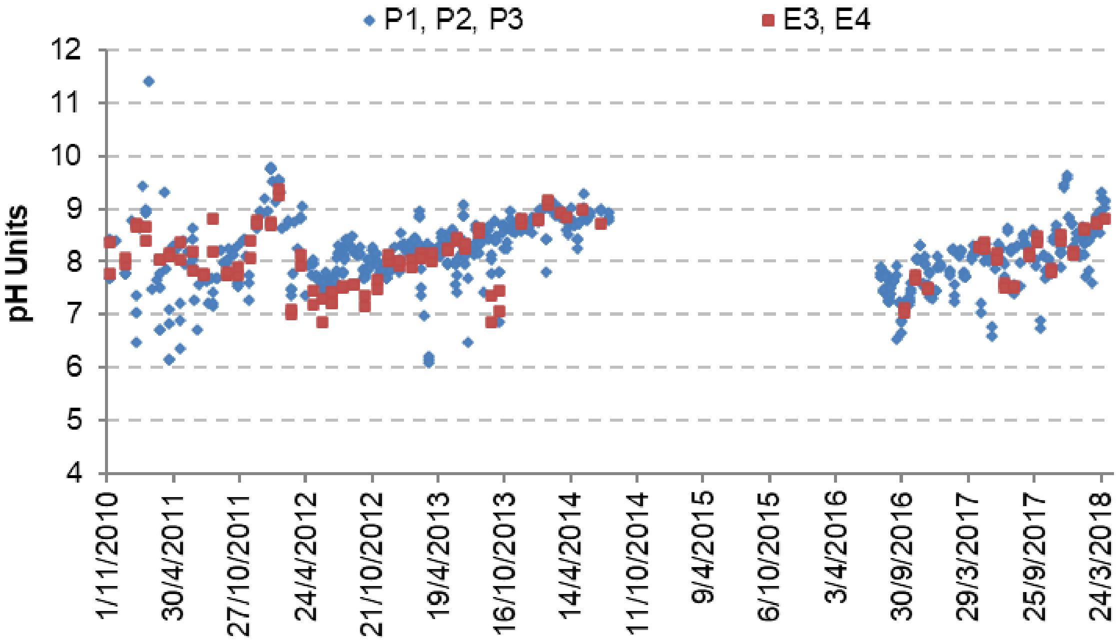

Figure 4 Field Measurement of pH at Selected Sites – Lake Cowal

To further assess whether there was a link between elevated pH levels in February 2011 and December 2017 and proximity of the monitoring sites to the CGO, a comparison was undertaken of pH levels recorded from 2010 to 2018 at all sites considered to be relatively close to the Lake Temporary Isolation Bund (E1, L1, P1, P2, P3, B1 and B2 – refer Figure 3) and all other sites in the lake. As shown in Figure 5, the pH levels were generally similar at sites close to the CGO and at other (more distant) sites. In February 2011, there was a relatively elevated pH value recorded at

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[8] Pers comm., Evolution.

site C1 (pH 11.05) which suggests that pH was similarly elevated at sites close to and distant from the CGO at this time. On two occasions in December 2017, the field pH measurements were slightly elevated at monitoring sites P1 and P3 only, however, the pH measurements did not exceed the maximum pH value (pH 9.8) recorded at lake transect sites during the baseline monitoring period (refer Table 6). The maximum pH recorded at the sites relatively close to the Lake Temporary Isolation Bund on 21 December 2017 was 9.65, which is only slightly higher than the concurrent level at other sites of pH 9.18.

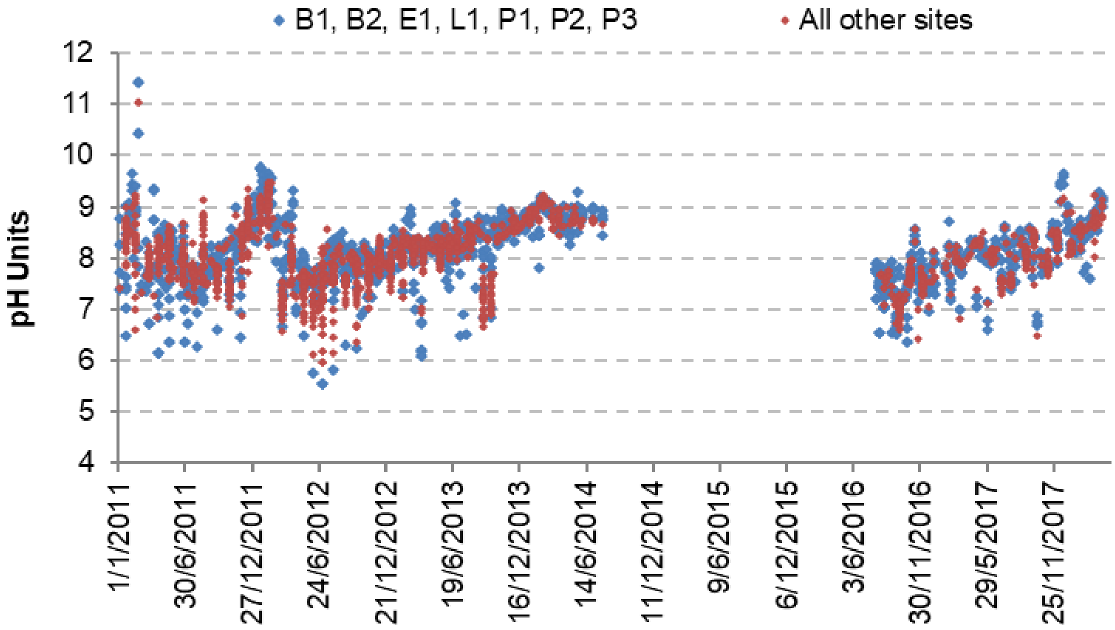

Figure 5 **Field Measurements of pH – Lake Cowal**

2.3.1.2 Comparison of Monitored Copper Concentrations Across Lake Cowal

The monitoring records of copper concentrations at sites close to the CGO and sites on the opposite side of the lake are presented in Figure 6. The monitoring records indicate that copper concentrations have been similar at sites close to the CGO and at sites on the opposite side of the lake, with concentrations generally declining between 2017 and 2018.

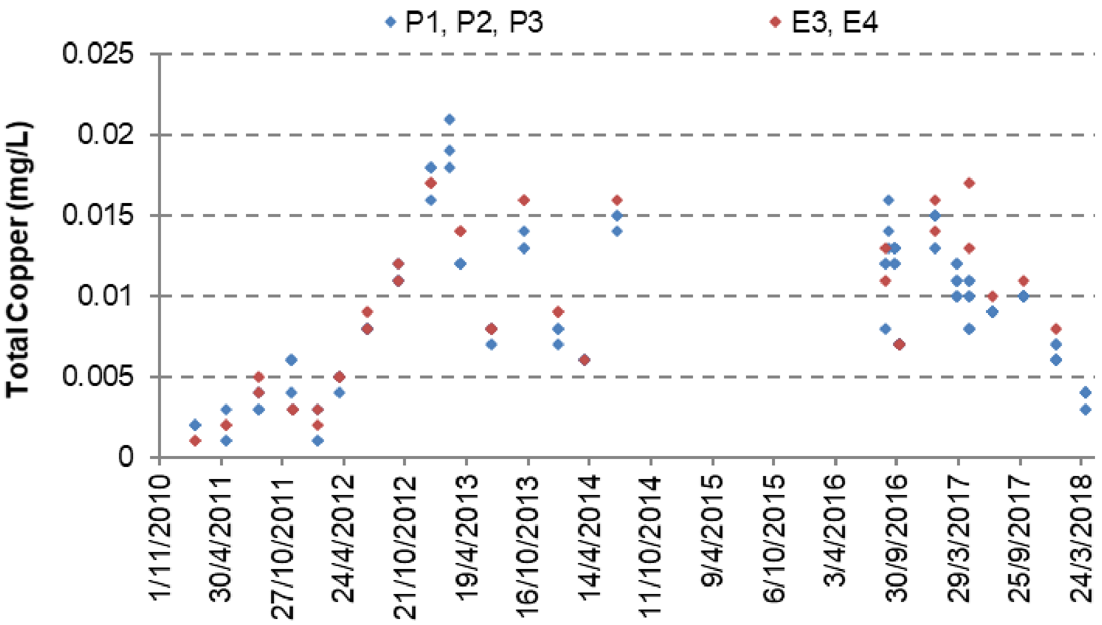

Figure 6 Recorded Copper Concentrations at Selected Sites – Lake Cowal

2.3.1.3 Comparison of Monitored Lead Concentrations Across Lake Cowal

The monitoring records of lead concentrations at sites close to the CGO and sites on the opposite side of the lake are presented in Figure 7. The monitoring records indicate that lead concentrations have been similar at sites close to the CGO and at sites on the opposite side of the lake, with concentrations generally declining between 2017 and 2018.

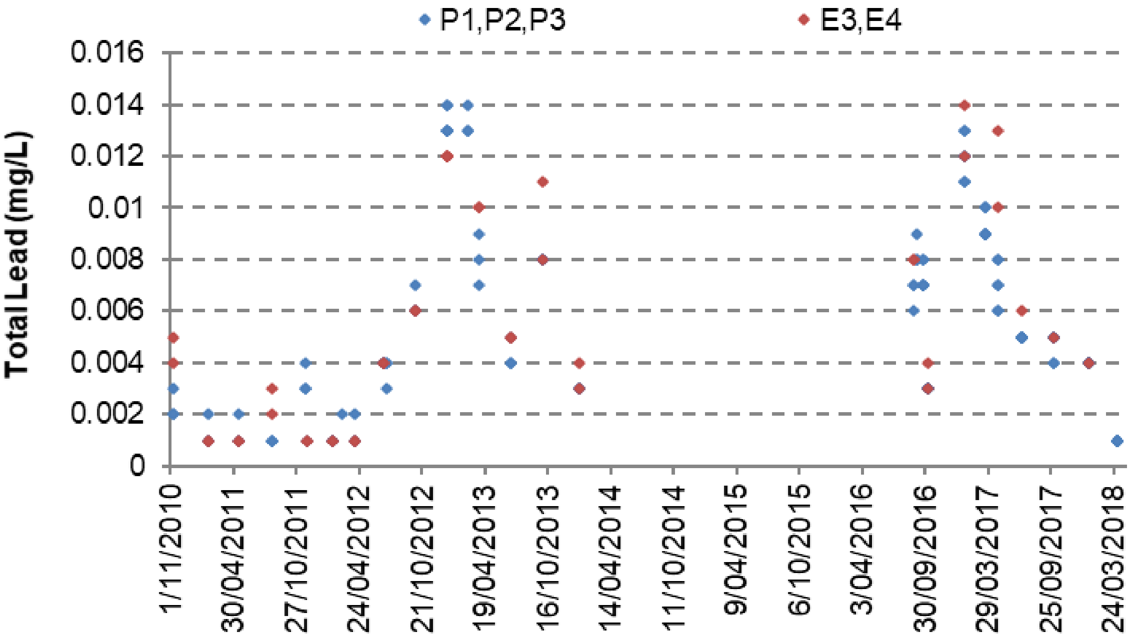

Figure 7 Recorded Lead Concentrations at Selected Sites – Lake Cowal

2.3.1.4 Comparison of Monitored Zinc Concentrations Across Lake Cowal

The monitoring records of zinc concentrations at sites close to the CGO and sites on the opposite side of the lake are presented in Figure 8. The monitoring records indicate that zinc concentrations have also been similar at sites close to the CGO and at sites on the opposite side of the lake and have generally declined between 2017 and 2018.

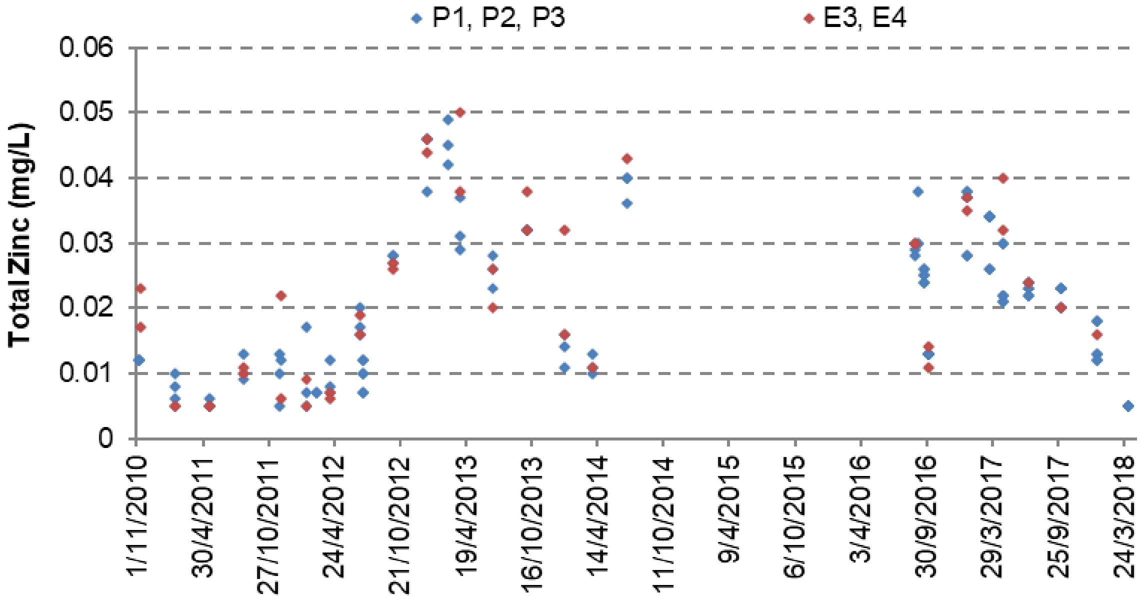

Figure 8 Recorded Zinc Concentrations at Selected Sites – Lake Cowal

2.3.1.5 Comparison of Monitored Turbidity Across Lake Cowal

The assessment of lake turbidity levels indicates a consistent trend of increasing turbidity from March to December 2012 and May to July 2014 at sites both close to the CGO and sites on the other side of the lake – refer Figure 9. It is noted that flood water entered Lake Cowal in March 2012.

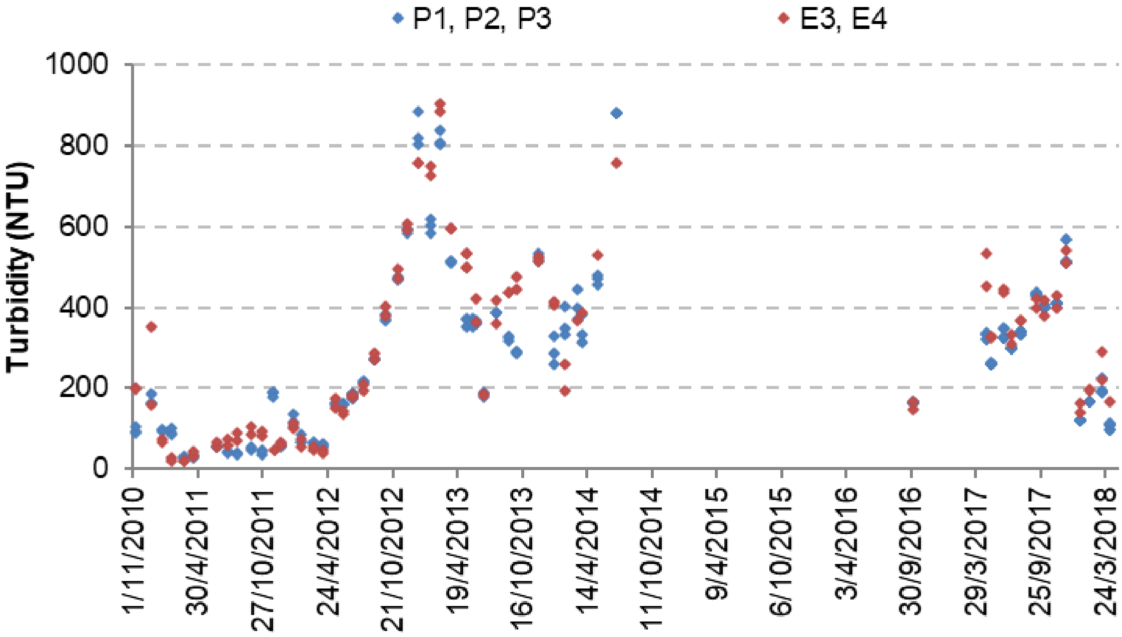

Figure 9 Field Measurements of Turbidity at Selected Sites – Lake Cowal

An assessment of the concurrent trends in lake turbidity and lake water level indicates a period of increasing turbidity followed by a gradual decline. This has occurred uniformly at sites close to and distant from the CGO. The monitoring records indicate that turbidity levels generally declined between 2017 and 2018 at all sites concurrent with a decline in lake water level.

2.3.1.6 Comparison of Monitored Phosphorous Concentrations Across Lake Cowal

Assessment of total phosphorous concentrations indicates that concentrations have been similar at sites both close to the CGO and on the other side of the lake (refer Figure 10).

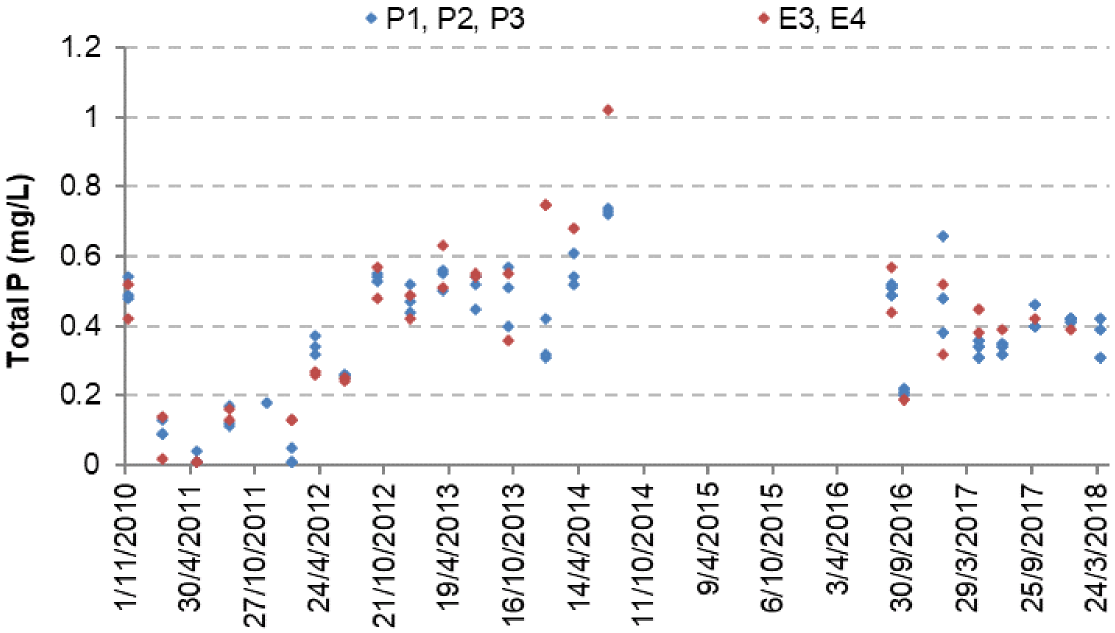

Figure 10 **Recorded Total Phosphorous Concentrations at Selected Lake Sites and Lake Water Level**

2.3.2 *Other Water Quality Monitoring*

As detailed in the CGO Water Management Plan (Evolution, 2018), surface water monitoring is undertaken at specific areas within the Mine Lease area including the contained water storages, Up-catchment Diversion System, Internal Catchment Drainage System, open pit and tailings storage facilities.

The CGO has provided monitored pH, EC and TSS values in the UCDS from 2007 to April 2020. Recorded pH ranged from 4.8 to 11.16, EC between 25.8 and 19,530 µS/cm and TSS from 4 to 2,140 mg/L.

The CGO has also monitored pH, EC and TSS values for site contained water storages and the open pit over a similar period. Ranges of pH in these site storages have been recorded from 4.4 to 10.3, EC between 12 and 142,700 µS/cm and TSS from 1 to 13,700 mg/L. High recorded EC values reflect, at least in part, the use of water supplied from saline groundwater bores and saline groundwater inflow to the open pit.

2.4 HARVESTABLE RIGHT

Landholders in most NSW rural areas are allowed to collect a proportion of the rainfall runoff on their property and store it in one or more dams up to a certain size. This is known as a 'harvestable right'. Maximum harvestable right dam capacity is the total dam capacity allowed under the harvestable right for a given property. It is based on 10% of the average regional rainfall runoff and takes into account local evaporation rates and rainfall periods.

The regulations (made under the *NSW Water Management Amendment Act, 2014*) relating to harvestable right exclude capture of drainage and/or effluent in accordance with best management practice, and dams constructed to control or prevent soil erosion. None of the storages on-site are used to harvest runoff from land and all storages are used to contain contaminated drainage, mine water or effluent in accordance with best management practice or are used to control soil erosion. It is concluded therefore that all of these storages should be excluded from consideration as a component of the harvestable right calculation.

2.5 GROUNDWATER

The groundwater levels and water quality in the CGO region are described separately in the Hydrogeological Assessment prepared by Coffey (2020a and 2020b), as provided in Appendix E of the EIS.

3.0 CURRENT CGO WATER MANAGEMENT AND WATER SUPPLY

3.1 DESCRIPTION

The CGO currently involves open pit mining and on-site ore processing. On-site ore processing involves crushing and grinding followed by combined flotation and carbon-in-leach circuits. Tailings produced from the processing plant are deposited in two TSFs. Mine waste rock is placed in waste rock emplacements located to the north, south and east of the open pit (refer Figure 11).

The CGO water management strategy for the construction and operational phases of the mine development involve the following key principles (North Limited, 1998):

- Minimisation of disturbance areas;
- Containment of potentially contaminated water;
- Recycling of contained water; and
- Progressive stabilisation and revegetation of disturbed areas.

The CGO water management system has been designed such that the approved CGO does not impact on the integrity of Lake Cowal. Mine infrastructure and landforms have been constructed within a contained catchment – the ICDS. The ICDS combines with the UCDS and the lake isolation system to protect Lake Cowal from CGO development activities. The lake isolation system comprises a Temporary Isolation Bund and a permanent isolation bund (i.e. Lake Protection Bund). The Lake Protection Bund comprises a large engineered embankment that provides a permanent barrier between the lake and the open pit. Runoff from areas upslope of the ICDS (i.e. areas undisturbed by mining) is diverted via the UCDS, around the CGO to Lake Cowal.

The main water demand for the approved CGO is for supply to the process plant. Since the commencement of primary ore processing in mid-2007, the CGO processing rate has averaged 7.4 Mtpa and the water demand[9] (total) has averaged 17 ML/day (of which up to approximately 7.6 ML/day on average was supplied by on-site recycling of return water and incident rainfall from the TSF decant ponds). In 2019, the average process plant demand was 22 ML/d. Prior to mid-2007, during the initial oxide ore processing phase[10], the ore processing rate averaged 6.4 Mtpa and the water demand (total) averaged 33.7 ML/day. A higher water demand is required for oxide ore due to the finer, clayey nature of the ore.

Other water demands comprise water for construction requirements and haul road dust suppression. Monitoring data (to mid November 2017) indicates that demand for haul road dust suppression averages 0.62 ML/day.

Water supply for the approved CGO involves re-use of mine process water (tailings water reclaim), capture and re-use of runoff from areas within the ICDS, groundwater seepage to the open pit and groundwater sourced from the saline groundwater supply bores within ML 1535 when Lake Cowal is dry. Other external make-up water supply is provided to the site via the mine borefield pipeline and is drawn from three sources (in order of priority):

1. The eastern saline borefield.
2. The Bland Creek Palaeochannel Borefield.

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[9] Based on data provided by Evolution to end of April 2020.

[10] Based on data provided as part of the Modification 11 Surface Water Assessment for period from August 2006 to April 2007 (refer Gilbert & Associates, 2013).

3. Water extracted from the Lachlan River via the Jemalong Irrigation Channel (Figure 12) using regulated flow licences purchased by or temporarily transferred to Evolution on the open market.

The various CGO water management system components and their linkages (via system transfers) are shown in schematic form in Figure 12.

3.2 CONTAINED WATER STORAGES

The ICDS comprises a series of six internal drainage catchments (each served by a contained water storage for runoff collection) and two water supply storages. Details of the catchment areas and the capacities of the contained water storages are summarised in Table 8. With the exception of D5A, the contained water storages are designed to collect runoff generated from their contributing catchment during a 1% AEP rainfall event of 48 hours duration. Contained water storage D5A and water supply storages D6 and D9 are designed to contain runoff and/or incident rainfall from a 0.1% AEP rainfall event of 48 hours duration. With the exception of storages D1 and D4, all storages would (in the unlikely event) ultimately overflow to the open pit. Storages D1 and D4 are equipped with pumps which facilitate dewatering of these storages such that they can be emptied in between rainfall events, as required. Runoff from the outer batters of the perimeter waste rock emplacement ponds against the Temporary Isolation Bund, which has a capacity for at least a 1% AEP rainfall event of 48 hours duration. Water that ponds in this area would be pumped to D6 (via D1 or D4) between rainfall events as required.

Table 8 Summary of Existing/Approved Internal Catchments and Contained Water Storages

Storage	Catchment/Function	Catchment Area (ha)*	Storage Capacity (ML)**
D1	Runoff from northern perimeter of the northern waste rock emplacement.	92	57.8
D2	Runoff/seepage from run-of mine (ROM) pad, low grade ore stockpile and from the northern waste rock emplacement area.	332	198.2
D3	Runoff from perimeter catchment surrounding the open pit and the perimeter waste rock emplacement areas.	88	38.1
D4	Runoff from the southern perimeter of the southern waste rock emplacement.	64	62.3
D5A	Process plant area runoff collection.	32	78.6
D6	Process water storage. Main source of process plant make-up.	10	19.3
D8B	Runoff from southern waste rock emplacement and area between southern TSF and D9.	216	30.4
D9	Process water storage and storage for raw water.	Incident area	730.7
D10[†]	Process water storage and storage for raw water.	Incident area	1,500

ha = hectares

* Estimated from July 2019 contour plans provided by Evolution.

** Calculated from as-built plans and confirmed by Evolution.

[†] Approved storage D10 is yet to be constructed. The requirement for construction has been assessed in Section 6.0.

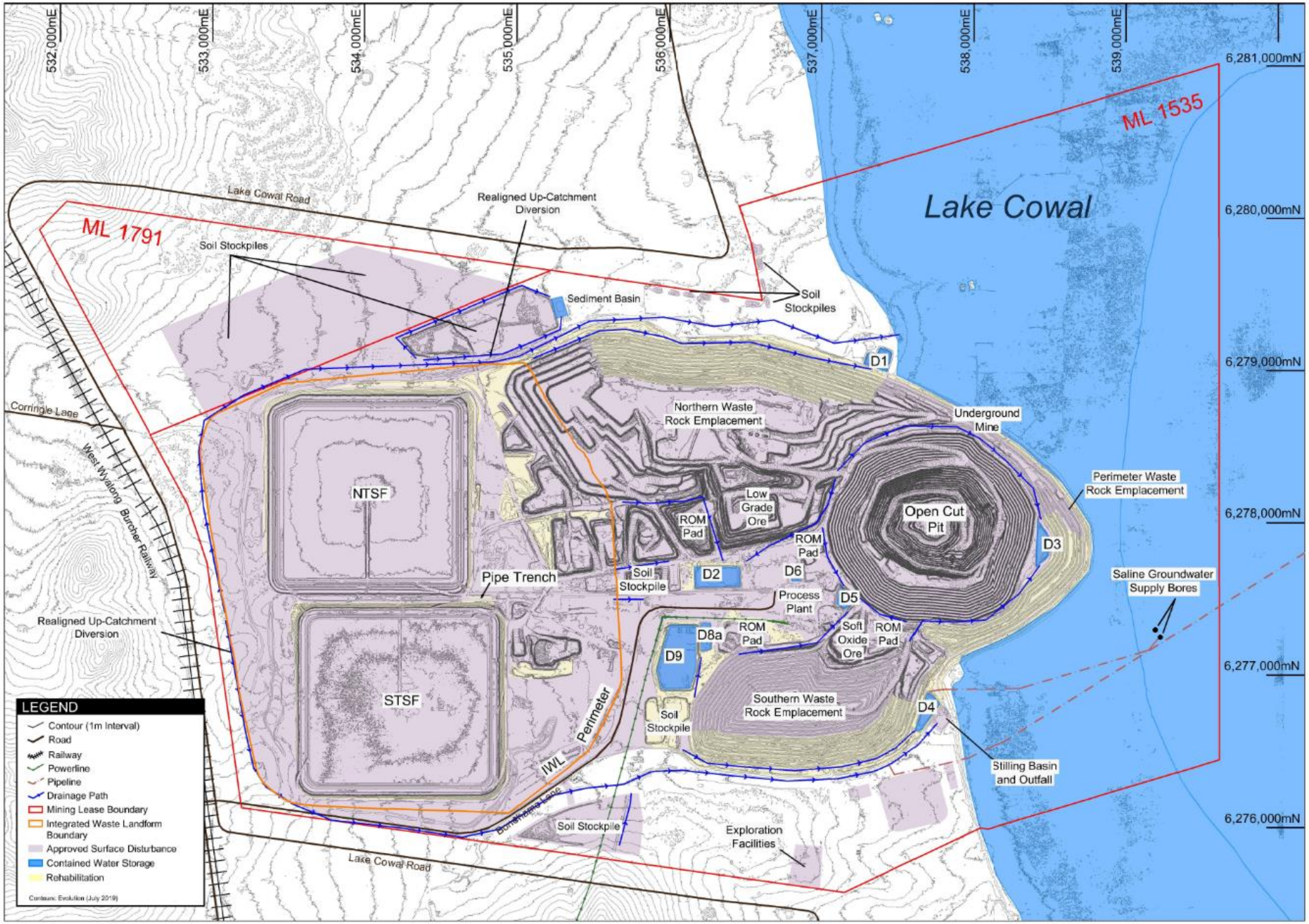

Figure 11 Current CGO General Arrangement

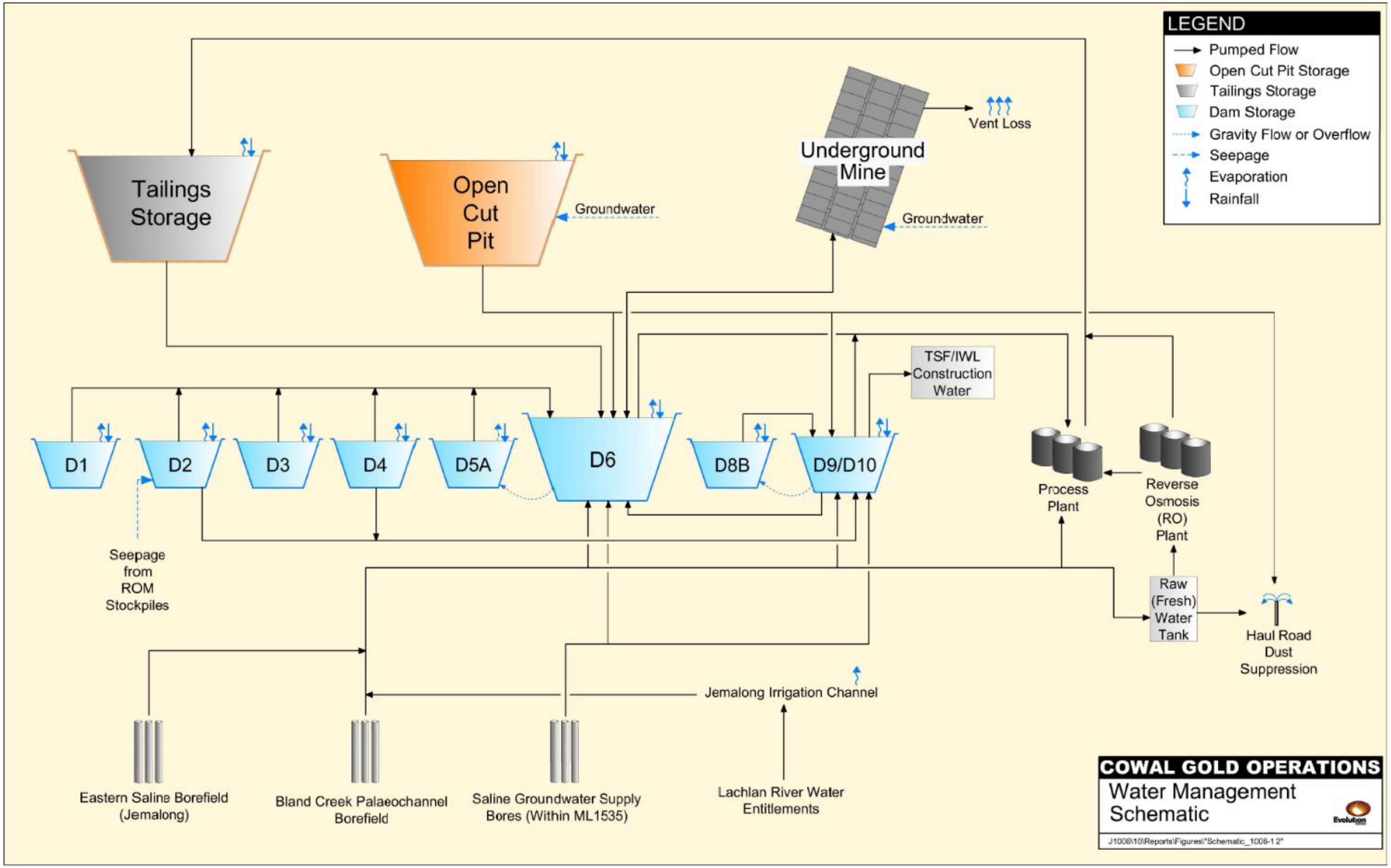

Figure 12 CGO Water Management System Schematic

3.3 PIT DEWATERING

Pit inflows occur via groundwater seepage, incident rainfall and rainfall runoff from areas surrounding the open pit. The catchment area draining to the open pit varies from approximately 150 ha in 2020 up to 135 ha at the end of processing. The open pit would also be the final water containment point in the event of overflow from any of the contained water storages (except D1 and D4 which are emptied by pumping) or in the highly unlikely event of an overflow from the TSFs. Inflows to the open pit accumulate in a sump in the pit floor and are pumped to storage D6.

Groundwater inflow predictions made as part of the Cowal Gold Project EIS (North Limited, 1998) were for quite high groundwater inflow rates. Significantly lower groundwater inflow rates have been encountered in practice as described in Coffey (2018).

3.4 WASTE ROCK EMPLACEMENT WATER MANAGEMENT

Mine waste rock from open cut mining operations is placed in three waste rock emplacement areas: the northern, southern and perimeter waste rock emplacements. The northern and southern waste rock emplacements are integral with the perimeter waste rock emplacement which is a component of the permanent lake isolation system. The outside faces of the northern and southern waste rock emplacements form part of the perimeter catchment limits of the approved CGO. The northern waste rock emplacement is the largest of the emplacement areas.

Runoff from the external face of the northern waste rock emplacement reports to contained water storage D1 which has been constructed below the external (north-eastern) toe of the northern waste rock emplacement area and is dewatered by pumping to storage D6.

Runoff from the external face of the southern waste rock emplacement reports to contained water storage D4 which has been constructed below the external (south-eastern) toe of the southern waste rock emplacement area and is dewatered by pumping to storage D6 or D9.

Runoff from the perimeter waste rock emplacement area reports to the storage which forms between the toe of the perimeter waste rock emplacement and the Temporary Isolation Bund. Water that accumulates in this storage is returned to D6 as required.

3.5 TAILINGS STORAGE FACILITY WATER MANAGEMENT

Tailings material is deposited into the two TSFs (i.e. northern tailings storage facility [NTSF] and southern tailings storage facility [STSF]) as a slurry, normally under sub-aerial conditions. The TSFs comprise confining embankments raised above the surrounding natural surface and, as such, their catchment area comprises only the area inside the confining embankments – estimated to be approximately 128 ha for the NTSF and 129 ha for the STSF[11]. Tailings are discharged to only one TSF at any given time. Once the tailings level has risen to its design level, discharge is switched to the other TSF while the confining embankment of the first TSF is raised.

In general, tailings are deposited through a 450 mm nominal diameter polyethylene pipeline which runs from the process plant to the TSFs and around their perimeter embankments. There are spigots (smaller pipe sections) exiting from the deposition pipeline around the circumference of each TSF, which deposit tailings around the perimeter of the inside of the TSF. Within each spigot is a gate valve which is used to alternate the locations of the deposition, allowing for intermittent drying times of the deposited tailings and for a consistent tailings beach height around the perimeter of the operational TSF. Tailings are discharged around the perimeter of the TSF and solids settle as they flow towards the centre of each TSF. Rainfall runoff and free water liberated during settling and consolidation of the tailings (termed 'bleed' water) accumulate in an internal (central) decant pond

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[11] Estimated from July 2019 contour plan provided by Evolution.

within each TSF. Water within the decant pond (from rainfall) of the inactive TSF may be pumped to the active TSF. Water from the decant pond of the active TSF is pumped to storage D6 for re-use in the process plant. The TSFs have been designed to maintain a minimum freeboard sufficient to store at least the contingency 0.1% AEP rainfall event at all times[12].

3.6 SEWAGE AND ASSOCIATED WASTE MANAGEMENT

The management and treatment of sewage is addressed in the CGO Hazardous Waste and Chemical Management Plan. A site sewage treatment plant is operational with treated sewage and sullage disposed of to the satisfaction of Bland Shire Council and the EPA in accordance with the requirements of the NSW Department of Health (Evolution, 2018).

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[12] 1:1,000 AEP rainfall is calculated using procedures described in Institution of Engineers Australia (1998) by interpolation in between the 1:100 AEP rainfall and the probable maximum precipitation (PMP). The 1:100 AEP rainfall is obtained from the BoM. The PMP is calculated using methods published by BoM (2003).

4.0 FUTURE CGO WATER MANAGEMENT AND WATER SUPPLY

4.1 WATER MANAGEMENT

4.1.1 Modification 14 Approved Future Surface Works

The future development of the CGO surface facilities is shown in two conceptual arrangement plans (Figure 13 and Figure 14) showing the layout of surface facilities, drainage and the plan projection of proposed underground mine development at 2022 and 2032 (noting that there would be no surface disturbance associated with the underground mine development areas shown in Figure 13 and Figure 14). The following describes the future surface works and water management system approved for Modification 14.

Duplication of the existing water supply pipeline across Lake Cowal was approved for Modification 14 with construction completed in early 2020. The duplication of the water supply pipeline enables increased annual extraction of water by CGO from external water supply sources, in accordance with licence limits, thereby meeting the increased water demand at the processing plant.

By 2021, the approved UCDS and ICDS would have been reconstructed outside the planned ultimate extent of the IWL. The two systems would be constructed as parallel excavated drains around the planned perimeter of the IWL, with the inner drain comprising the ICDS and the outer drain the UCDS. Both the UCDS and ICDS would commence (i.e. have their highest invert levels) adjacent to the western perimeter of the IWL, approximately at the point adjacent to the area between the two existing TSFs. From this point, both would drain to either the north and around the northern boundary of the IWL or to the south. The northern limb of the ICDS would link into toe drainage north of the northern waste rock emplacement which discharges to storage D1. Similarly, the northern limb of the reconstructed UCDS would link into the existing UCDS near the north-western corner of the northern waste rock emplacement. The southern limb of the ICDS would discharge into the catchment of storage D8B. The southern limb of the reconstructed UCDS would link into the existing UCDS near the south-western corner of the STSF.

By 2022 (Figure 13), the approved IWL perimeter embankment would be constructed using waste rock material. By 2024 the perimeter embankment of the IWL would have reached its full planned extent. The northern waste rock emplacement would have expanded slightly and the low grade ore stockpile north-east of storage D2 would have been developed further. Rehabilitation would have advanced on the southern waste rock emplacement, around the perimeter of the northern waste rock emplacement and in parts of the IWL embankments.

If required, approved storage D10 (new water storage) would be constructed (refer Section 3.2) to the south-east of the southern waste rock emplacement and outside the UCDS. Storage D10 would be constructed in a similar fashion to existing storage D9 with a cut to fill earthfill confining embankment, with its catchment area comprising only its own surface area. Approved storage D10 was proposed as an additional measure for effectively managing water within the ICDS and maintaining sufficient water supply. As the water supply requirements for the CGO are expected to change based on the proposed Underground Development Project, the requirement for construction of approved storage D10 has been reassessed (refer Section 6.2).

Toward the end of the mine life (Figure 14) the waste rock emplacements would have been completed to their maximum elevation and rehabilitation works would be well advanced (refer also Section 7.0). Runoff from waste rock emplacements (including the batters of the IWL) would continue to be directed to contained water storages.

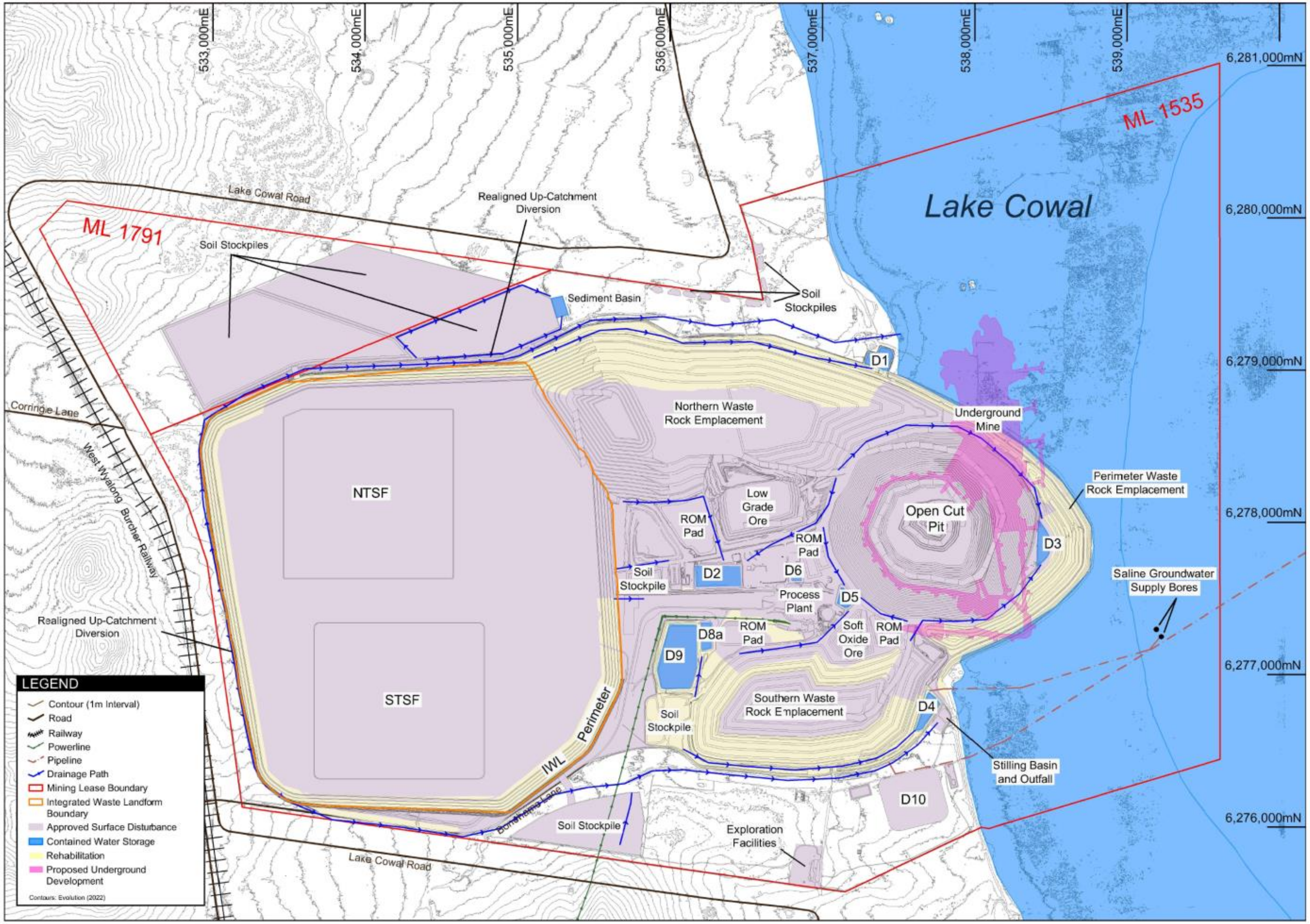

Figure 13 **Conceptual General Arrangement (2022)**

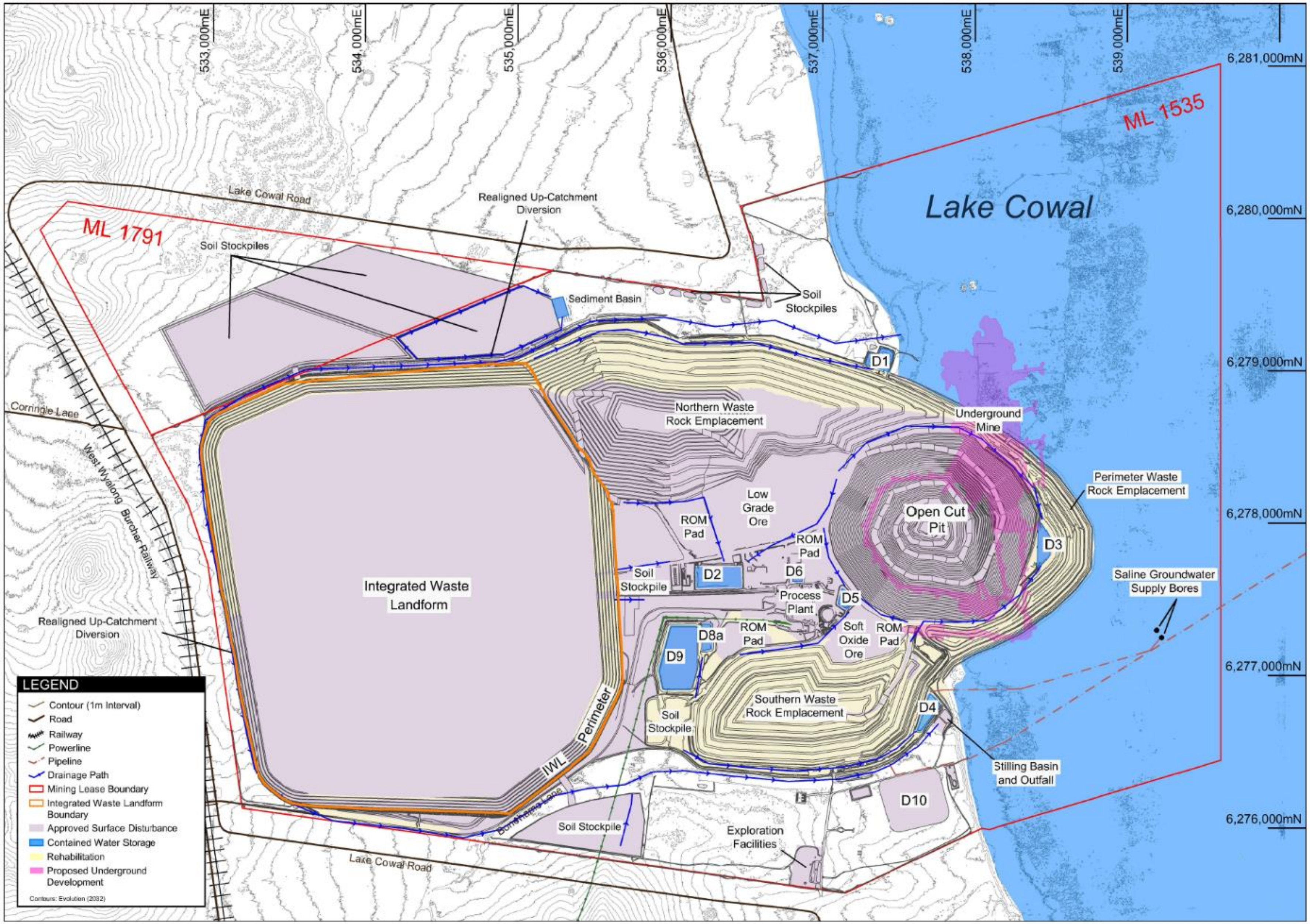

Figure 14 **Conceptual General Arrangement (2032)**

As outlined in Section 3.5, the IWL is proposed to encompass the existing TSFs and provide adequate tailings storage capacity for the planned mine life. The embankment would be constructed in stages and integrate with the northern embankment of the existing NTSF and the southern embankment of the existing STSF. A cut-off trench would be constructed beneath the IWL along its full perimeter to control seepage. Water for use in embankment construction (for fill conditioning and dust suppression) would be sourced from storage D2 or, if there was insufficient water in D2, from D9.

Full peripheral discharge is planned for the IWL in a manner similar to the existing TSFs as described in Section 3.5, with tailings discharge cycled around the IWL perimeter. Initially discharge may only occur from the initial embankment. Ultimately, as the tailings beach forms around the full periphery of the IWL, tailings would infill the areas around and between the existing TSFs and cover the existing NTSF embankment.

A single central decant is planned for water reclaim, located between the existing STSF and NTSF (refer Figure 11), comprising a pontoon mounted decant pump located within a circular (in plan) coarse rockfill decant structure. Water reclaim would continue to be pumped to storage D6. During the initial operation of the IWL temporary pumping may be required from water which accumulates between the edge of the initially forming tailings beach and the central decant; or alternatively trenches or diversion drains may be excavated to facilitate drainage to the central decant prior to the tailings beach establishing from the perimeter embankment to the central decant. Evolution have indicated that it is expected there would be a reduction in the rate of recovery of water from settling and consolidation of tailings within the IWL during approximately the first three years of the operation of the IWL. Such a reduction in the reclaim rate has been included in water balance modelling (refer Section 6.1).

4.1.2 Underground Mine Development

The underground mine development would comprise a sequence of stoping with access tunnel development commencing initially and stoping development commencing in 2022. The underground mine development would cover an area of approximately 1,500 m in length to the north of the eastern edge of the open cut pit and approximately 800 m north of the Lake Protection Bund. A network of access and haulage tunnels would extend approximately 200 m further to the west. The underground mine operations are expected to generate primary ore only.

As part of the proposed underground mine operation, a portion of the process tailings would be thickened to produce a tailings paste. This tailings paste would in turn be used to produce a backfill to support the excavated stopes. The paste is proposed to consist of fresh full stream tailings and a cementitious binder (Outotec, 2019). A portion of tailings would feed into a new paste plant feed tank located at the process plant. Following processing, the paste would be reticulated to the stopes via gravity flow.

Water supply would be required in the production of the tailings paste for flocculant dilution, vacuum pump seal and cloth washing associated with tailings filtration. However, it is anticipated that the majority of this water would be returned to the process plant thickener for recycle and reuse (Outotec, 2019). Water would be required for the underground mine for dust suppression and cooling water requirements. While the majority of this water would report to the underground sumps and be returned to the surface for reuse, a portion would be removed as vent loss and in increased ore moisture.

The quality of groundwater collected by the dewatering system (including groundwater pumped from both the open pit sump and stopes) is expected to be similar to existing groundwater quality and would contribute to water supply for the processing plant (Coffey, 2020a).

4.1.3 Modification 16 Proposed Surface Works

The Modification 16 proposed surface works comprise an increase in the height of the IWL from the currently approved height of 245 m AHD to 246 m AHD to accommodate additional tailings deposition within the currently approved disturbance areas. Ultimately, as the tailings beach forms around the full periphery of the IWL, tailings would infill the areas around and between the existing TSFs and cover both the existing NTSF and STSF embankment. The IWL height is expected to reach 245 m AHD by mid-2029, with tailings covering both the existing NTSF and STSF embankment from that point on.

Additional surface changes comprise augmentation of dam D5A and other on-site water storages as required. The augmentation of dam D5A would be contained within the current catchment area of the dam with only minor changes to the storage capacity and area of the dam expected. Augmentation of other on-site water storages as required would be undertaken within the existing catchment area/disturbance area of each storage.

The Environmental Geochemistry Assessment for the Underground Development Project (GEM, 2020) identified that the proposed underground development waste rock is geochemically similar to the waste rock from the current open pit operations, indicating that the management strategies currently employed for the waste rock emplacements would not need to be modified to accommodate the development waste. As is currently undertaken, runoff from waste rock emplacements (including the batters of the IWL) would continue to be directed to contained water storages.

The stockpiled ROM ore should only be exposed to surface oxidation conditions within the ore stockpiles for short periods, however, it is expected that the low grade ore could be stockpiled and exposed to surface oxidation and leaching processes over long periods which presents a risk to water quality if not appropriately managed (GEM, 2020). Additionally, a small amount of the ROM and low grade ore may be Potentially Acid Forming (PAF) although development of acidic drainage is not expected to be a concern for the ROM ore stockpiles given the expected short time period of exposure and low quantity of PAF material. However, if the PAF material is exposed on the surface of the stockpiles for an extended period of time, low pH conditions may develop, potentially leading to an increase in salinity, metal solubility and release (GEM, 2020).

Runoff from the ore stockpile areas would continue to be captured and contained within the approved disturbance area. Runoff would be directed to contained water storage D2 which has been designed to contain runoff and/or incident rainfall from a 1% AEP rainfall event of 48 hours duration (refer Section 3.2). In the event that overflow occurs from water storage D2, the overflow would be directed to the open cut pit and would not discharge offsite.

4.2 WATER SUPPLY

4.2.1 General

The main water demand for the CGO would continue to be the requirements of the process plant as well as dust suppression (e.g. haul roads), and other potable and non-potable uses. An additional demand requirement would be for underground mine operation (dust suppression and cooling water requirements).

Water demand for the process plant is linked to ore processing rates and the type of ore being processed. Annual proposed processing tonnages are given in Table 9 and summarised as follows:

- the primary ore processing rate would rise from 6 Mtpa in 2021 to 8.4 Mtpa in 2025;
- oxide ore processing would peak at 2.4 Mtpa in 2021;
- a peak combined processing rate of 8.5 Mtpa would occur in 2024;

- from 2032 onwards, processing of open cut oxide ore would cease and from 2035 onwards processing of open cut primary ore would cease; and
- from 2035 to 2038, the underground mine primary ore processing rate would reduce from 1.8 Mtpa to 1.1 Mtpa.

Table 9 Proposed CGO Ore Processing Rates

Calendar Year	Oxide Ore (Mt) – Open Cut	Primary Ore (Mt) – Open Cut	Primary Ore (Mt) – Underground Mine Operations	Total (Mt)
2020	1.7	6.4	0.0	8.1
2021	2.4	6.0	0.0	8.4
2022	1.6	6.4	0.3	8.2
2023	1.2	6.4	0.6	8.2
2024	0.5	6.7	1.4	8.5
2025	0.0	6.6	1.7	8.4
2026	0.6	6.0	1.8	8.4
2027	0.6	6.0	1.8	8.4
2028	0.8	5.7	1.8	8.4
2029	1.7	4.9	1.8	8.4
2030	0.9	5.7	1.8	8.4
2031	0.1	6.5	1.8	8.4
2032	0.0	6.6	1.8	8.4
2033	0.0	5.2	1.8	7.0
2034	0.0	1.9	1.8	3.7
2035	0.0	0.0	1.8	1.8
2036	0.0	0.0	1.8	1.8
2037	0.0	0.0	1.8	1.8
2038	0.0	0.0	1.1	1.1
2039*	0.0	0.0	0.1	0.1

Mt = Million tonnes.

Note: There may be discrepancies in totals due to rounding.

* to August 2039

The average process plant demand (total) at the above processing rates is estimated at 22 ML/day between 2020 and 2031 when both primary and oxide ore are to be processed. The maximum water demand to accommodate processing of primary and oxide ore from the proposed underground mine and open cut operations is estimated at 25 ML/d in 2024. Between 2032 and 2034 when oxide ore processing will have ceased, the average water demand (total) is estimated at 18 ML/day. From 2035 to 2038 (inclusive), the average water demand (total) is estimated at 2.9 ML/day (refer Section 6.0).

Water supply would continue to be sourced primarily from on-site sources, with make-up from external water supply sources. The order of priority of water supply sources would be:

1. Reclaim from the IWL decant pond.
2. Pumping from the open pit and underground mine sumps.
3. Water from contained water storages (transferred to either storage D6 or D9 as indicated on Figure 12).
4. Groundwater from the eastern saline borefield via the mine borefield pipeline.

5. Groundwater from the Bland Creek Palaeochannel borefield via the mine borefield pipelines (consistent with existing licensed limits – refer Section 4.2.4).
6. Groundwater from the saline groundwater bores located with ML 1535 when lake conditions allow.
7. Water accessed from the Lachlan River via the Jemalong Irrigation Channel using regulated flow licences purchased by Evolution on the open market.

In order to maintain a secure water supply for the duration of the CGO, the proposed system would be managed such that storage D9 would be maintained as full as possible (supplied by on-site sources and off-site sources via the duplication of the external water supply pipeline). If additional water storage is required to maintain a secure water supply, Evolution would augment the CGO water supply system through construction of the approved process water storage D10 with a design capacity of 1,500 ML. Storage D10 would effectively act as an enlarged storage D9, with water shared between the storages and used to provide make-up supply to the process plant. The requirement for construction of water storage D10 has been assessed in Section 6.2.

4.2.2 Saline Groundwater Supply Bores

Currently, two saline groundwater supply bores are located within ML 1535 to the south-east of the open pit (Figure 11). Continued operation of the existing saline groundwater supply bores is proposed for the mine life.

Pumping tests (Coffey, 2009) indicate that the groundwater bores could supply up to 1 ML/day of saline water (with an EC of approximately 40,000 μS/cm) for use in the process plant. During periods when Lake Cowal is inundated, the bores would be shut-down and capped and, as such, the bores would only operate during low rainfall periods. At various times during the mine life, sourcing water from the saline groundwater supply bores would reduce demand on the other external water supply sources.

4.2.3 Eastern Saline Borefield

The eastern saline borefield is located approximately 10 km east of the Lake Cowal eastern shoreline (Figure 3). Pump tests (Groundwater Consulting Services Pty Ltd, 2010) indicated that two bores could supply approximately 1.5 ML/day of saline water (with an EC of approximately 12,000 μS/cm). Average extraction since commissioning of the borefield has been approximately[13] 0.45 ML/day. The borefield is currently approved for the life of the mine to supply a maximum of 750 ML/year.

4.2.4 Bland Creek Palaeochannel Borefield

Extraction from the Bland Creek Palaeochannel Borefield (Bores 1 to 4) would continue for the mine life.

Groundwater extraction from the Bland Creek Palaeochannel borefield is limited by daily and annual licensed volumetric limits, as follows:

- maximum daily rate: 15 ML/day; and
- maximum annual extraction: 3,650 ML.

Extraction would be managed to maintain groundwater levels above established Department of Planning, Industry and Environment - Water (DPIE - Water) (formerly DI-Water) trigger levels. Modelling results detailed in Coffey (2020b) indicate that a maximum continuous rate of 4 ML/day can be supplied from the Bland Creek Palaeochannel Borefield while maintaining groundwater levels

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[13] Based on data provided by Evolution to end of April 2020.

above the DPIE - Water trigger levels. However, it is intended that sourcing water from this borefield would continue in a similar manner as occurs currently, by alternating between this source and the Lachlan River to manage groundwater levels as well as providing flexibility with respect to extraction rates and the availability of allocation assignments in the Lachlan River during “good” years.

4.2.5 Lachlan River

The proposed external water supply arrangements for the remaining mine life involve continued purchase of water from the Lachlan River regulated water source. The CGO high security and general security zero allocation water access licences enable water allocation assignments (temporary trade of water). Table 10 lists the annual volume of water extracted from the Lachlan River for use at the CGO in comparison with the total volume of water usage from general security and high security water allocation assignments for the Lachlan River regulated water source.

Table 10 Annual CGO Lachlan River Extraction and Total Usage Volumes

Financial Year	Approximate CGO Extracted Volume (ML)	Total Water Usage (ML)[†]	Percentage of CGO Extraction to Total Water Usage
2007/2008	2,168	14,726	14.7%
2008/2009	1,504	10,172	14.8%
2009/2010	415	2,469	16.8%
2010/2011	0	56,471	0.0%
2011/2012	857	192,428	0.4%
2012/2013	1,488	356,500	0.4%
2013/2014	1,012	212,024	0.5%
2014/2015	2,001	147,697	1.4%
2015/2016	687	168,211	0.4%
2016/2017	0	184,145	0.0%
2017/2018	1,274	117,915	1.1%
2018/2019	2,309	239,175	1.0%
2019/2020	3,179*	91,062[‡]	3.5%*

ML = megalitres

[†] Source: https://waterregister.waternsw.com.au/

* to 30 April 2020.

[‡] the total water usage volume was 109,050 ML for the 2019/2020 period though this has been approximated at 91,062 ML for the 1 July 2019 to 30 April 2020 period for comparison with the CGO extracted volume.

The data presented in Table 10 shows that CGO extracted 3,179 ML from the Lachlan River between 1 July 2019 and 30 April 2020, which equated to approximately 3.5% of the total CGO water usage from the Lachlan River regulated water source. The maximum annual CGO Lachlan River water usage as a percentage of CGO total water use occurred in 2009/10 and equated to 16.8%.

Between approximately 4,000 and 274,000 megalitres (ML) of water allocation assignments have been made annually since records began in the 2004/2005 water year to the 2019/2020 water year[14]. All general security accounts were reset on 8 March 2012 to 136% following the first spill of Wyangala Dam since December 2000. Table 11 summarises the available water determinations (AWDs) made for the Lachlan River Regulated River Water Source from August 2015. From 1 July 2011 to 1 July 2015, the AWDs were zero.

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[14] https://waterregister.waternsw.com.au/ accessed 4 August 2020.

Table 11 Lachlan River Regulated Water Source Available Water Determinations

Date	General Security	High Security
Aug 2015	4%	0%
Sep 2015	16%	0%
Oct 2015	5%	0%
Jul 2016	18%	100%
Jul 2016	25%	0%
Sep 2016	9%	0%
Apr 2017	5%	0%
Jun 2017	2%	0%
Jul 2017	0%	100%
Aug 2017	2%	100%
Jul 2018	0%	100%
Jul 2019	0%	87%
Jul 2020	0%	70%
Aug 2020	0%	30%

Source: https://waterregister.waternsw.com.au/

As of 1 July 2020, available water determinations (AWDs) for general security accounts were zero, with high security licences at 70%. DPIE - Water will continue to closely monitor rainfall and river inflows as well as usage in the valley to determine when subsequent changes to AWDs are made. As at 2 September 2020, Wyangala Dam reservoir was at 57.3% capacity[15].

Future water supply requirements for the CGO (from external water sources and ultimately licensed extraction from the Lachlan River) have been estimated using a water balance model and reviewed against the historical AWDs made for the Lachlan River Regulated Water Source (refer Section 6.0).

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[15] Refer http://realtimedata.water.nsw.gov.au/water.stm

5.0 POST-CLOSURE WATER MANAGEMENT SYSTEM

Consistent with CGO Development Consent (DA 14/98) Condition 2.4(b), rehabilitation of final landforms or disturbed areas would continue to be undertaken progressively as soon as reasonably practicable following disturbance. Mine closure concepts and management measures would continue to be developed in accordance with the Mining Operations Plan (MOP), the Strategic Framework for Mine Closure (Department of Industry, Tourism and Resources, 2000), the Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure (Department of Industry, Innovation and Science, 2016) and in consultation with the Division of Resources and Geosciences and other relevant regulatory authorities.

The post-closure water management strategy described in the Cowal Gold Project EIS (North Limited, 1998) included concepts for runoff minimisation from waste rock emplacements and TSFs, and the provision of stable drainage channels to drain site surface water to the final void. These concepts are to be retained and further developed as described below. A conceptual post-mining general arrangement layout is shown in Figure 15.

5.1 WATER MANAGEMENT STRUCTURES

The permanent water management structures for the CGO would comprise:

- UCDS;
- ICDS (including the permanent catchment divide structures); and
- Lake isolation system (lake protection bund and perimeter waste rock emplacement).

Rehabilitation monitoring of the permanent surface water diversion systems would continue to be undertaken post-closure to determine whether the relevant rehabilitation criteria have been met (Evolution, 2018). Silt fences and flow retention structures would be maintained to reduce the potential for off-site migration of sediments until satisfactory surface stability is achieved.

5.2 WASTE ROCK EMPLACEMENTS

At the completion of mining, the top surface of the northern and southern waste rock emplacement areas would be graded such that any surface runoff would flow toward the final void. A cover layer comprising low salinity sub-soil and topsoil would be laid over the graded top surface of the waste rock emplacements. The cover material and thicknesses would be selected to be consistent with the overall objective of reducing runoff from the emplacement surface by encouraging rainfall infiltration and moisture retention in a relatively thick cover layer where it would be available for surface vegetation.

Deep rooting, high transpiration capacity vegetation species would be utilised as cover vegetation to take-up and use the available moisture in the cover layer. The final surface of the waste rock emplacement areas would be purposely left with a high degree of irregularity to provide surface retention of excess rainfall for longer term infiltration and take-up in the surface cover and plant system. A network of low energy drainage swales would be provided on both waste rock emplacement areas for drainage of any net runoff to the final void. The external faces of the waste rock emplacements would be constructed in a regular series of batters and berms. The berms would be constructed with reverse grades to prevent overflow of berm runoff over the batters. Runoff retention areas and deep vegetated soil cover layers have been proposed as concepts to minimise net runoff.

5.3 TAILINGS STORAGES

Concepts developed for rehabilitation of the external batters and berms of the tailings storages involve a similar approach as those developed for the outer faces of the waste rock emplacements. The concepts developed for the top surface (i.e. tailings) include retention of the final inverted cone shape of the final beach surface which would, by virtue of the planned peripheral tailings discharge regime, slope downward from the embankment perimeters toward the central decant area. The final surface would be covered with a relatively thick layer of low salinity sub-soil and topsoil to support a deep rooting plant cover. A capillary break layer between the final tailings surface and the cover has also been identified as a requirement of the surface rehabilitation to prevent salt rise into the overlying soil cover layer. Planned surface irregularities, mounds and swale-like channels are also proposed for transient retention of surface runoff, to enhance moisture retention within the cover system and to provide a formal pathway for any net runoff under extreme conditions to be diverted to the final void.

5.4 INTEGRATED WASTE LANDFORM

The concepts developed for rehabilitation of the external batters and berms of the tailings storages are directly applicable to the IWL, including shaping, surface covering and surface treatments. Evolution is undertaking on-going waste rock emplacement rehabilitation trials (using a number of different combinations of rock mulch, topsoil and gypsum) as well as rehabilitation trials on the current TSFs. Results of these trials would inform the final design of the waste rock emplacement and IWL rehabilitation. Consistent with the 2014 Independent Monitoring Panel Report recommendations (Bell & Miller, 2014), Evolution would continue to monitor rehabilitation trials with a view to continually refine its approach to achieving large-scale sustainable rehabilitation.

5.5 FINAL VOID

The final open pit would be left as a void and the UCDS and the ICDS would be retained. Surface drainage from the CGO area would be diverted to the final void via a series of low energy swales. Drainage from areas upslope of the CGO area would flow to Lake Cowal via the UCDS and pre-mine creek lines. The implications of the Underground Development Project on the final void water balance are described in Section 7.0.

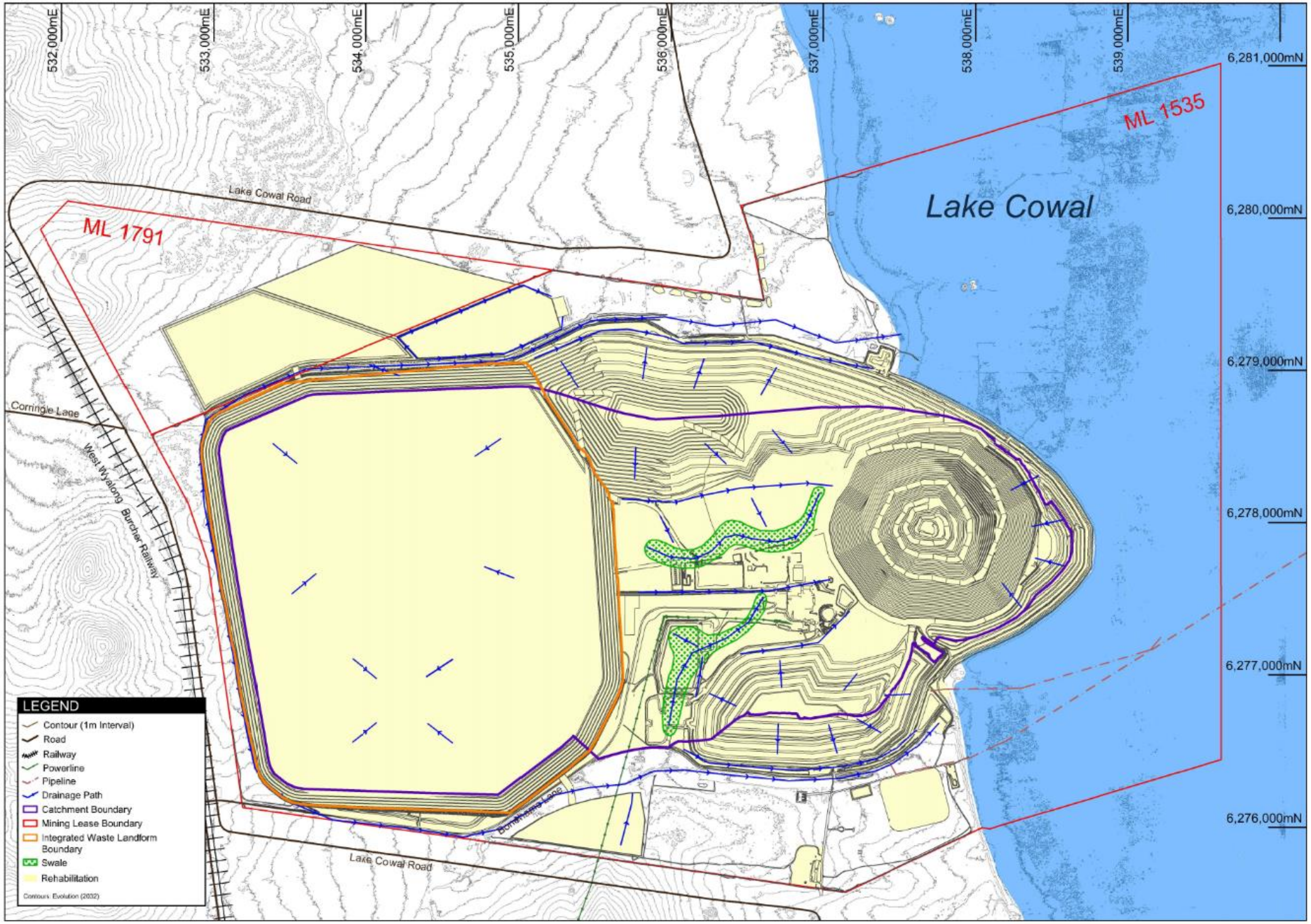

Figure 15 Conceptual General Arrangement Post-Mining

6.0 SIMULATED PERFORMANCE OF OPERATIONAL WATER MANAGEMENT SYSTEM

The ability of the water management system to achieve the objectives of containment of site runoff and security of supply was assessed by simulating the dynamic behaviour of the water balance over the remaining mine life (from 30 April 2020) under a range of different climatic conditions that may be encountered. The water balance model structure is generally as per the schematic in Figure 12, with planned new raw water storage D10 modelled as an expansion to D9 from January 2024 onwards and extraction of ore from the underground mine commencing in April 2022 (refer Section 4.2.1).

The structure of this section is as follows:

- A description of the model structure, set-up data and assumptions (Section 6.1).
- Details of model predictions for the remaining mine life (Section 6.2).
- A qualitative assessment of the possible effects of climate change on model results (Section 6.3).
- A summary of water storage interaction with Lake Cowal (Section 5.4).

6.1 MODEL DESCRIPTION

6.1.1 General

The water balance model developed for the CGO simulates all the inflows, outflows, transfers and changes in storage of water on-site at each model time step (i.e. 6-hourly basis). The model simulates changes in stored volumes of water in all site storages (contained water storages, TSFs, the IWL, the underground mine and open pit) in response to inflows (rainfall runoff, groundwater inflow, tailings water, groundwater bore extraction and licensed extraction from the Lachlan River) and outflows (evaporation, process plant use and dust suppression use).

For each storage, the model simulates:

> *Change in Storage = Inflow – Outflow*
>
> Where:
>
>> *Inflow* includes rainfall runoff, groundwater inflows to the open pit and underground mine, water liberated from settling tailings ('bleed' water – for the TSFs and IWL) and all pumped inflows from other storages, groundwater bores or the Lachlan River (via the Jemalong irrigation channel).
>>
>> *Outflow* includes evaporation and all pumped outflows to other storages or to a water use[16].

Runoff from all mine areas (i.e. within the ICDS) is modelled as reporting to one of the contained water storages or the open pit. Pumping rates between model storages were set based on information consistent with that provided for the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013), Modification 14 Surface Water Assessment (HEC, 2018) and updated information to reflect current pumping rates.

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[16] The model also provides for and tracks spill if the simulated storage capacity of a water storage is exceeded.

The main water use at the CGO is for supply to the Process Plant. As indicated in Section 4.2.1, a priority system is in use (and was modelled) for supply to contained water storage D6 (the main supply source for the Process Plant). Supply is first drawn from the TSFs (return water), the open pit, the underground mine and contained water storages. Make-up supply is then sourced (to top-up storages D6 and D9/D10) from the three water supply borefields (refer Section 4.2.1). Ultimate make-up supply is then drawn from Lachlan River water entitlements. Lachlan River water is sourced via the Jemalong Irrigation channel – a channel loss rate of 1.3 ML/day was assumed based on information provided as part of the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013). The model was used to assess the future make up water supply requirements under the range of model conditions simulated.

Contained water storages D1 and D4 (which capture runoff from waste rock emplacement areas) are reliant upon pumping to transfer accumulated water to the remainder of the ICDS. Pump extraction rates assumed in the model are summarised in Table 12.

Table 12 Modelled Pump Rates

From	To	Modelled Pump Rate (L/s)
D1	D6	200†
D4	D6	85
D4	D9	20
D5	D6	83
D2	D6	93
D2	D9	93
D3	D6	50
D8B	D9	93
TSF and IWL Reclaim	D6	180*
Open Cut Sump	D6 or D9/D10	50
Underground	D6	Unlimited#

L/s = litres per second

* Rate assumed doubled during 2030-31 predominantly oxide ore processing phase.

† Rate assumed doubled from current rate due to catchment expansion resulting from IWL.

\# Assumed 5 ML sump capacity with all excess underground water pumped to D6.

Whilst not simulated explicitly in the model, runoff from the outer batter of the perimeter waste rock emplacement (which collects between the Lake Protection Bund and Temporary Isolation Bund) will be pumped back to D6 (via D1 or D4). In the model this was simulated as an increase in runoff to D6 (equivalent to the rate of runoff from the outer batter of the perimeter waste rock emplacement), even if this led to overflow from storage D6 (which overflows internally within the ICDS – ultimately reporting to the open pit).

6.1.2 Climatic Data

A total of 131 years of daily rainfall and pan evaporation data (from 1889 to 2019) used in the model was sourced from the SILO Point Data[17]. The SILO Point Data was compared with the CGO rainfall data record (for the period from 2002 to April 2020) and found to be well correlated – refer Figure 16 which shows a plot of monthly rainfall totals from the CGO record versus monthly rainfall totals from SILO Point Data.

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[17] The SILO Point Data is a system which provides synthetic data sets for a specified point by interpolation between surrounding point records held by the BoM. Refer https://www.longpaddock.qld.gov.au/silo/point-data/.

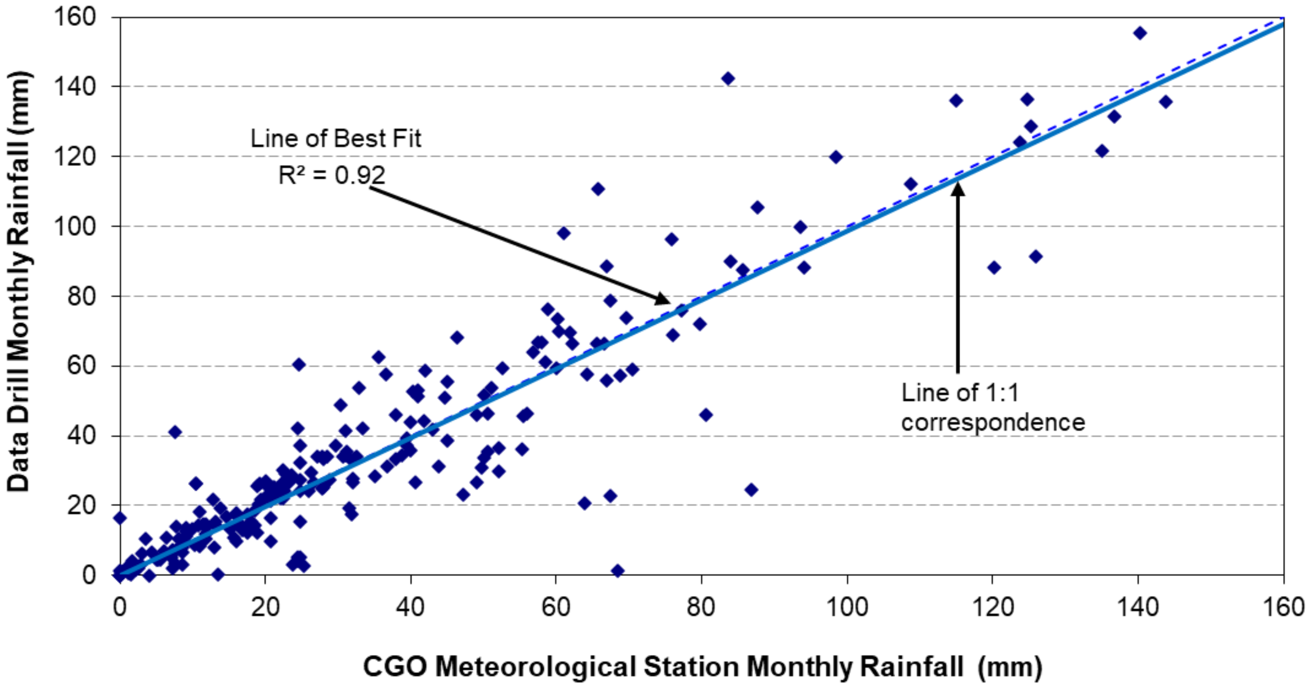

Figure 16 Monthly Rainfall Comparison – CGO Meteorological Station and SILO Point Data

Monthly pan evaporation factors (to convert pan evaporation to estimates of open water evaporation) were obtained from pan factors given in McMahon *et al*. (2013) for the nearest available location (Table 13).

Table 13 Seasonal Evaporation Pan Factors

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wagga Wagga AMO Pan Factor*	0.81	0.81	0.81	0.86	0.94	0.98	1.07	1.10	1.05	0.99	0.89	0.84

* From McMahon *et al*. (2013), located approximately 160 km south of CGO.

The model was run repeatedly, simulating 131 possible mine life “sequences”, each approximately 19 years in length (corresponding to the remaining mine life). The sequences were formed by moving along the SILO Point Data record one year at a time with the first sequence comprising the first 19 years in the record, the second sequence years 2 to 21 in the record while the third sequence comprised years 3 to 22 and so on. The start and end of the SILO Point Data record was ‘linked’ so that additional sequences, which included years from both the beginning and end of the historical record, were combined to generate additional climatic sequences. Using this methodology 131, 19-year sequences of daily rainfall and evaporation were formulated for use in the model simulations. CGO recorded daily rainfall data was used from November 2006 onwards[18] instead of the SILO Point Data.

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[18] Date of commencement of automatic weather station operation.

6.1.3 Runoff Simulation

The Australian Water Balance Model (AWBM) (Boughton, 2004) was used to simulate runoff from rainfall on the various catchments and landforms across the CGO area. The AWBM is a nationally-recognised catchment-scale water balance model that estimates streamflow from rainfall and evaporation. Modelling of the following six different sub-catchment types was undertaken:

- natural surface/undisturbed;
- waste rock emplacements;
- rehabilitated areas;
- hardstand (including roads and infrastructure areas);
- open pit; and
- tailings.

AWBM parameters for undisturbed areas were taken from model calibrations undertaken for a regional stream[19]. The rainfall-runoff model was calibrated as part of the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013). Table 14 gives the AWBM parameters used in the model.

Table 14 Water Balance Model AWBM Parameters

Parameter	Natural Surface	Waste Rock	Rehabilitated Areas	Hardstand	Open Pit	Tailings
C_1 (mm)	10	5	21	2	5	0
C_2 (mm)	101.3	75	56	6	15	50
C_3 (mm)	202.7	-	120	-	-	-
A_1	0.234	0.4	0.13	0.5	0.34	0.07
A_2	0.333	0.6	0.43	0.5	0.66	0.93
A_3	0.433	-	0.44	-	-	-
BFI	0.21	0.4	0.2	0.0	0.1	0.0
K_{base} (day^{-1})	0.806	0.97	0.92	-	0.9	-
K_{surf} (day^{-1})	0.5	0.2	0.2	0.1	0.1	0.2

Note: An evapotranspiration factor of 0.85 was used in the model as recommended by Boughton (2006).

6.1.4 Groundwater Inflow and Borefield Supplies

Groundwater inflow to the open cut pit and underground mine were set to a time-varying rate as predicted by groundwater modelling (Coffey, 2020a). Figure 17 summarises the predicted annual inflow volume for the open cut pit, underground mine and combined total inflow rate. Note that the inflow volume for 2039 is to the end of August only.

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[19] GS410048 - Kyeamba Creek at Ladysmith.

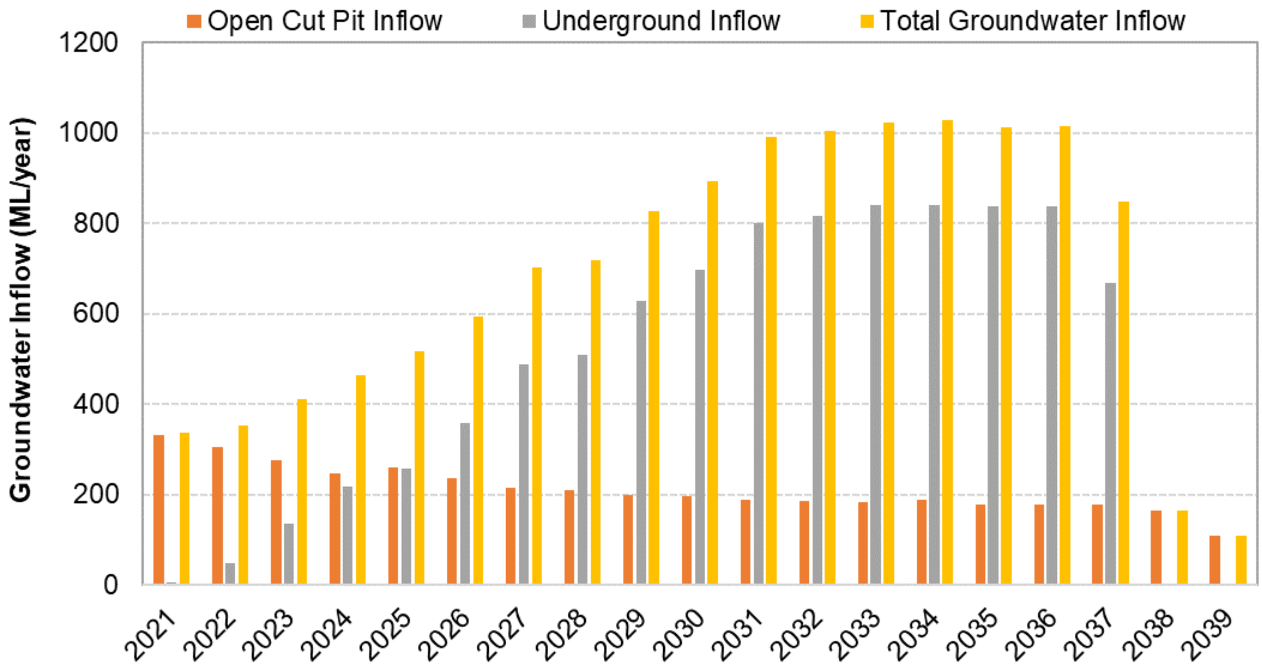

Figure 17 **Predicted Mine Groundwater Inflow Rate**

The maximum pumped rate from the saline groundwater supply bores within ML 1535 was set to 0.7 ML/day (equivalent to 1 ML/day for 5 days/week). These bores are only available as a water source when the water level in Lake Cowal is low enough to allow access. Rather than simulating the water level in Lake Cowal as part of the water balance model, the availability of these bores was approximated by comparing the annual rainfall total for the given model year against long term median annual rainfall – if the annual rainfall in any simulated year was above the long term median, the bores were assumed unavailable.

The maximum pumped rate from the eastern saline borefield was set to the sustainable rate of 1.5 ML/d and these bores were assumed available for the duration of the mine life (refer Section 4.2.3).

Extraction from the Bland Creek Palaeochannel bores is controlled according to the following approved limits (refer Section 4.2.4):

- A maximum daily extraction rate of 15 ML/day.
- A maximum annual extraction rate of 3,650 ML.

In order to simulate a more sustainable rate of extraction from the Bland Creek Palaeochannel Borefield, the maximum daily extraction rate was reduced to[20] 10 ML/day.

Supply via the mine borefield pipelines (i.e. Bland Creek Palaeochannel Borefield, eastern saline borefield and Lachlan River water entitlements) to storages D9/D10 was limited to 22 ML/day maximum rate based on duplication of the existing pipeline with a capacity of 11 ML/day.

6.1.5 CGO Water Demands

The process plant make-up water demand (total) is required to replace water pumped with process tailings to the TSFs, IWL and to tailings paste backfill. Process plant water demand (total) was based on projected future processing tonnages (refer Section 4.2.1 and Table 9), tailings paste backfill volume and assumed tailings and paste backfill solids content. The total tailings tonnage, tailings

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[20] Consistent with the maximum recorded rate from Bland Creek Palaeochannel Borefield between January 2018 and April 2020.

paste backfill tonnage and tailings tonnage to the TSFs and IWL, as provided by Evolution, are shown in Table 15.

Table 15 Estimated Tailings Tonnages

Calendar Year	Total Tailings (Mt)	Tailings to Paste Backfill (Mt)	Tailings to TSFs and IWL (Mt)
2020	8.1	0.0	8.1
2021	8.4	0.0	8.4
2022	8.2	0.1	8.2
2023	8.2	0.2	8.0
2024	8.5	0.6	8.0
2025	8.4	0.8	7.5
2026	8.4	0.9	7.5
2027	8.4	0.8	7.5
2028	8.4	0.8	7.5
2029	8.4	0.8	7.5
2030	8.4	0.9	7.5
2031	8.4	0.9	7.5
2032	8.4	0.9	7.5
2033	7.0	0.9	6.1
2034	3.7	0.9	2.8
2035	1.8	1.0	0.8
2036	1.8	1.0	0.8
2037	1.8	1.0	0.8
2038	1.1	0.7	0.4
2039	0.1	0.1	0.1

* 1 July to 30 June

Mt = Million tonnes.

Note: There may be discrepancies in totals due to rounding.

For primary ore (based on the average tailings solids content monitored for the 2 years to December 2010[21]) a solids content of 52% applies (note that recent data provided by Evolution is consistent with the assumed tailings solids content). The solids content was assumed to apply up to and including 2029 (a period during which oxide ore would only comprise a minor portion of the ore processed).

The tailings solids content during a previous period (2006/2007) of processing of oxide ore alone (i.e. no primary ore) averaged 37%. The tailings solids content for processing of both primary and oxide ore was estimated by interpolation between 52% and 37% on the basis of planned relative tonnes of oxide and primary ore (refer Table 9). This resulted in an average solids contents of 50.1% between 2020 and 2031 when oxide ore is to be processed and a corresponding average process plant demand of 22 ML/day.

As stated in Section 4.1.2, a portion of tailings would be processed and used to produce a backfill to support the excavated stopes. The processed tailings for paste backfill is estimated to have a solids content of 70%, as advised by Evolution.

A portion of process plant make-up water is required to be of high quality (low salinity water). This water is used in areas such as the semi-autogenous grinding mill and ball mill cooling towers, carbon elution circuit and scientific instrumentation. This water is produced from a reverse osmosis (RO)

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[21] Data provided for the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013).

plant at CGO. The RO plant is fed by water from external water supplies only (Bland Creek Palaeochannel borefield, eastern saline borefield and Lachlan River water entitlements) and brine from the RO plant is discharged to the TSFs. The modelled RO plant demand was set at 0.29 ML/day as advised by Evolution.

Demand for haul road dust suppression water was set to an average 0.61 ML/day, varying monthly from 0.19 ML/day up to 1.05 ML/day, based on monitored data provided by Evolution. Dust suppression demand was set to zero on days with 10 mm of rain or more.

Water is also required for tailings storage and IWL embankment construction works. A constant demand rate of 0.25 ML/day was set in the model for this purpose (assumed drawn from D2) plus an additional 0.015 ML/day from 2020 to 2024 for IWL embankment construction works, as advised by Evolution.

Demand for the underground mine would comprise dust suppression and cooling water requirements, estimated at a maximum rate of 2.5 ML/day as advised by Evolution. While the majority of this water would report to the underground sumps and be returned to the surface for reuse, it was assumed that 20% of the water sent underground would be removed as vent loss and increased ore moisture content.

6.1.6 IWL Initial Reclaim Water Losses

During the initial stages of the operation of the IWL, tailings would be discharged over areas that have not previously received tailings and there is likely to be a reduction in the rate of reclaim water available. These initial water losses have been estimated on behalf of Evolution by CMW Geosciences. These reductions, expressed as a percentage of water that would otherwise be available, are summarised in Table 16 as a function of time. These were applied as a percentage reduction to the calculated tailings bleed water rate.

Table 16 IWL Initial Water Bleed Water Reductions

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	20.8%	35.2%	42.1%	49.9%	71.1%	71.4%	71.1%	71.2%	71.1%	70.4%	33.5%	66.8%
2022	84.4%	84.9%	85.2%	85.6%	86.0%	86.3%	86.3%	86.2%	85.9%	85.6%	22.2%	36.9%
2023	44.4%	74.3%	74.4%	75.1%	75.0%	75.2%	75.1%	75.1%	75.0%	74.6%	74.0%	73.9%
2024	90.8%	93.7%	94.4%	95.2%	97.3%	99.1%	99.1%	98.4%	97.1%	96.5%	93.0%	93.6%

6.2 SIMULATED FUTURE PERFORMANCE

The water balance model was used to simulate the likely performance of the water management system over the simulated 131 climatic sequences. The model was run commencing at 30 April 2020 with storage volumes and mine conditions as they were at that date (based on data supplied by Evolution). The simulation was run until 30 August 2039 with the following parameters set (refer Section 4.2.1):

- Borefield pipeline capacity of 22 ML/day at 100% availability.
- Oxide tailings bleed reduction = 2% (per model calibration – refer Modification 11 Surface Water Assessment – Gilbert & Associates [2013]) – assumed to occur in 2030 and 2031 when processing of oxide ore dominates.
- Bland Creek Palaeochannel Borefield daily extraction rate limited to 10 ML/day.
- No limit on extraction from Lachlan River entitlements. If borefield supplies are inadequate to meet the demands for water importation to the CGO, water is sourced from the Lachlan River and is limited only by the capacity of the borefield pipelines (i.e. 22 ML/day).

Model results are presented in the sub-sections below.

6.2.1 Overall Water Balance

Table 17 summarises the water balance model results of average system inflows and outflows for the model realisations which equate to the 10th percentile (low rainfall), median and 90th percentile (high rainfall) average annual rainfall depths.

Table 17 Water Balance Model Results (Averaged over Remaining Mine Life ML/year)

	10th percentile Rainfall Sequence (Dry)	Median Rainfall Sequence	90th percentile Rainfall Sequence (Wet)
Inflows (ML/year)			
Catchment Runoff	1,114	1,380	1,443
Tailings Bleed	2,579	2,579	2,579
Open Pit and Underground Mine Groundwater	685	685	685
Saline Groundwater Supply Bores (within ML 1535)	52	43	49
Bland Creek Palaeochannel Bores	1,777	1,628	1,597
Eastern Saline Bores	438	430	421
Lachlan River Licensed Extraction*	754	686	676
Total Inflow	**7,399**	**7,430**	**7,449**
Outflows (ML/year)			
Evaporation	960	1,011	1,037
Haul Road Dust Suppression	223	222	221
Construction Water	93	93	93
Process Plant Supply	5,880	5,880	5,880
Overflow	0	0	0
Underground Mine Vent Loss	134	134	134
Total Outflow	**7,290**	**7,340**	**7,364**

ML/year = megalitres per year

* Modelled volume of water actually reaching CGO – excludes irrigation channel losses (refer Section 6.1.1).

The results summarised in Table 17 show that, for the median rainfall sequence, the predicted total inflows average 7,430 ML/year while total outflows average 7,340 ML/year. Model results indicate that an average of 1,628 ML/year would be required to be sourced from the Bland Creek Palaeochannel Bores based on the median rainfall sequence - equivalent to 4.5 ML/day. This is above the long-term average of 4 ML/day predicted in the Hydrogeological Assessment (Coffey, 2020b) however if restrictions were placed on this value, the result would be an increase in the simulated volume of water sourced from the Lachlan River (refer Section 6.2.2).

The above water balance results include simulation of the approved water storage D10. Without simulation of D10, the predicted total inflows average 7,232 ML/year while total outflows average 7,209 ML/year, for the median rainfall sequence. The reduction in total inflow is largely due to a reduction in external water supply requirements necessary to maintain a high water storage volume in D10. The reduction in total outflow is largely due to a reduction in water surface evaporation associated with water storage D10.

6.2.2 CGO External Water Demand

The demand from external sources (the eastern saline borefield, the Bland Creek Palaeochannel borefield and licensed extraction from Lachlan River water entitlements) in Table 17 for the median rainfall sequence averages 2,744 ML/year with inclusion of water storage D10 and 2,592 ML/year without inclusion of water storage D10. This compares with 4,247 ML/year predicted as part of the Modification 14 Surface Water assessment (HEC, 2016), indicating that reliance on external sources is likely to decrease by up to 39% on average over the life of the Underground Development Project. This is predominately due to the reduction in processing rates of oxide ore from the open cut operations.

Figure 18 to Figure 20 show predicted annual water demands from external sources with inclusion of water storage D10. Figure 18 to Figure 20 plot the median annual water demands, the 90th percentile demand (i.e. the demand that was predicted not to be exceeded in 90% of the simulated 131 climatic sequences) and the 10th percentile demand (i.e. the demand that was predicted not to be exceeded in 10% of the simulated 131 climatic sequences). These percentile plots indicate ranges within which the predicted annual volumes could vary, within these risk or confidence limits/levels.

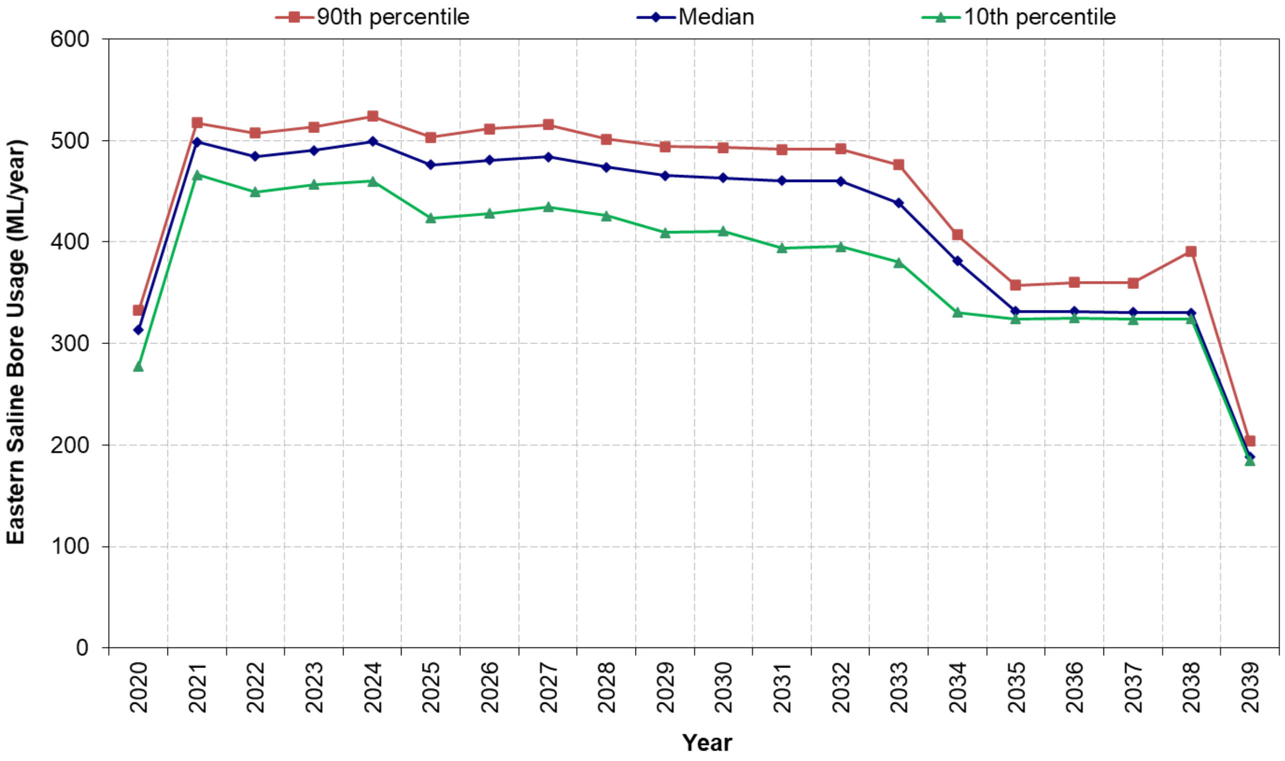

Figure 18 Predicted Annual Eastern Saline Borefield Usage

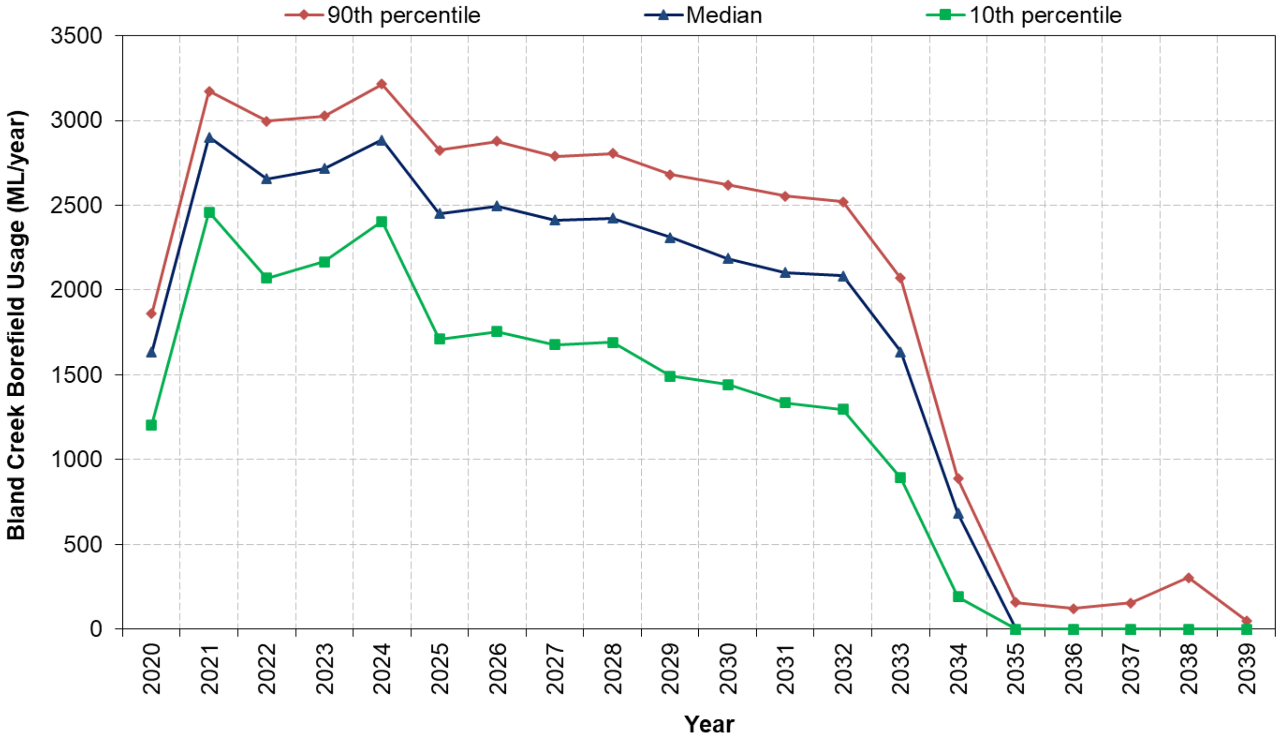

Figure 19 Predicted Annual Bland Creek Palaeochannel Borefield Usage

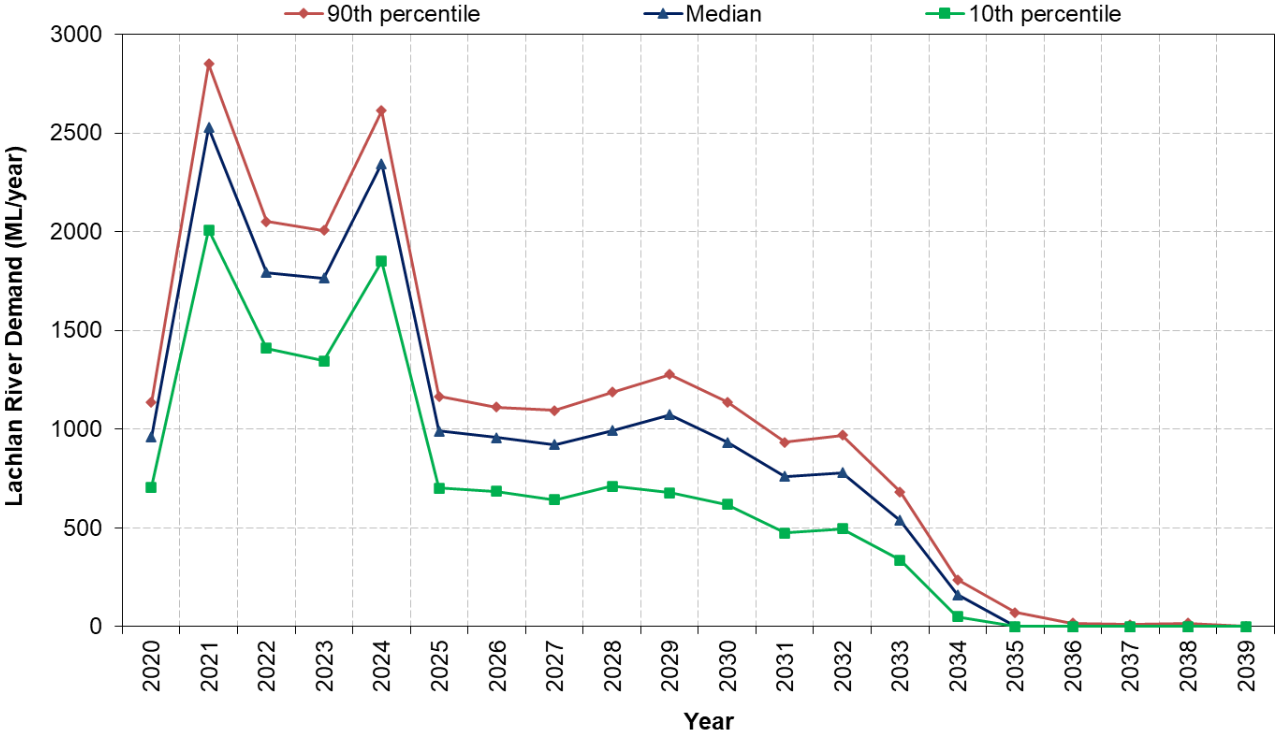

Figure 20 Predicted Annual Demand from Lachlan River Entitlements

Figure 18 shows that the median annual demand from the eastern saline borefield is predicted to decline from a maximum rate of approximately 500 ML/year during the period of open cut and underground mining to a rate of approximately 330 ML/year during the period of underground mining only.

Figure 19 shows that the median annual demand from the Bland Creek Palaeochannel borefield is predicted at a maximum rate of 2,901 ML/year during the period of open cut, with zero requirement predicted during the period of underground mining only.

Figure 20 shows that the predicted annual demand from licensed extraction from the Lachlan River is higher during the early years of the operation of the IWL (which is planned to commence in 2021) due to the reduced reclaim associated with early operation of the IWL. The annual demand from the Lachlan River is predicted to substantially decline from 2034 as the planned processing rates substantially decline.

The maximum predicted annual demand from the Lachlan River is approximately 2,850 ML based on the 90th percentile model results. Based on DPIE-Water trading records (refer Section 4.2.5), there has been adequate allocation assignment water available on the market from this source in previous years to meet this predicted demand requirement.

As stated in Section 4.2.4, modelling results detailed in Coffey (2020b) indicate that a maximum continuous rate of 4 ML/day can be supplied from the Bland Creek Palaeochannel Borefield while maintaining groundwater levels above the DPIE - Water trigger levels. To assess the impact on predicted annual demand from the Lachlan River with a reduced rate of supply from the Bland Creek Palaeochannel Borefield over the proposed life of mine, the maximum daily supply rate for the Bland Creek Palaeochannel Borefield was reduced to 9 ML/d (which maintained an average of 4 ML/d supply for the 19 year, 131 sequence model simulation).

Figure 21 shows the predicted annual water demand from the Bland Creek Palaeochannel Borefield with the maximum supply rate reduced to 9 ML/d and Figure 22 shows the predicted annual water demand from the Lachlan River with a reduced rate of supply from the Bland Creek Palaeochannel Borefield over the proposed life of mine.

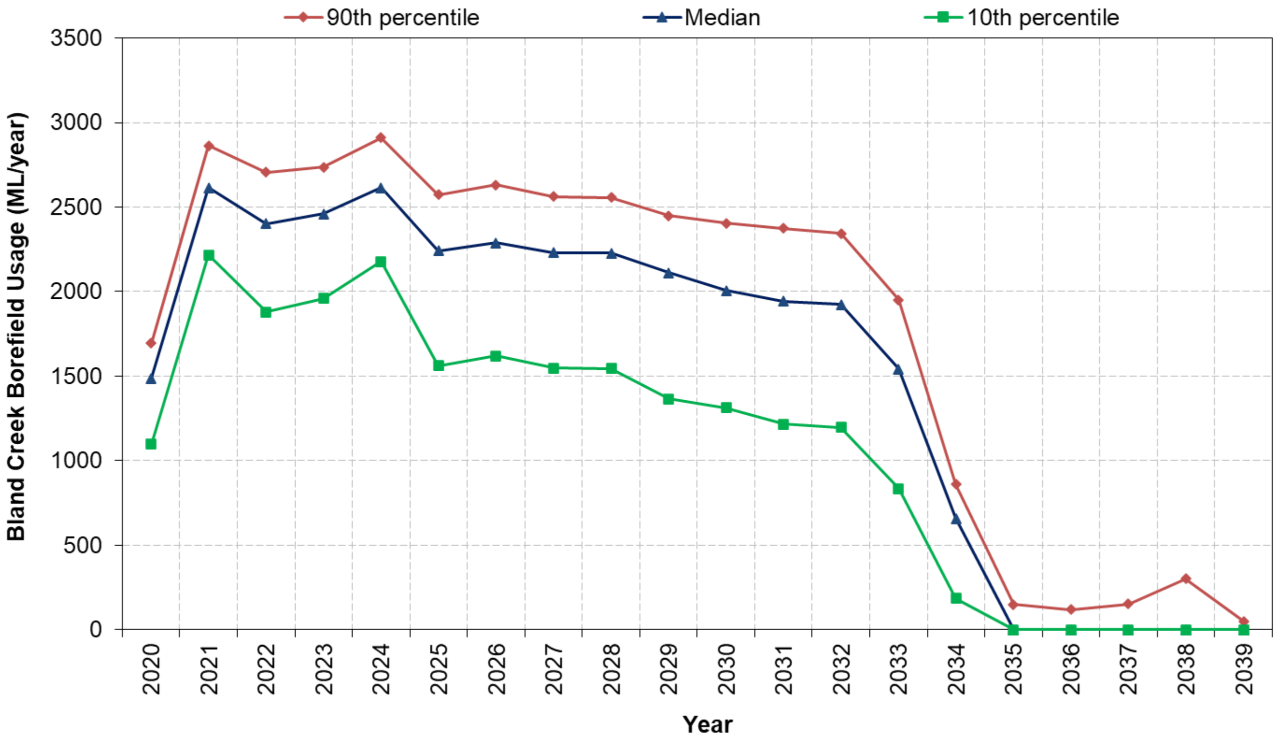

Figure 21 Predicted Annual Bland Creek Palaeochannel Borefield Usage – Maximum Supply 9 ML/d

Figure 22 illustrates that, if the maximum daily supply rate for the Bland Creek Palaeochannel Borefield was reduced to 9 ML/d (Figure 21) thereby maintaining an average supply of 4 ML/d over the life of the mine from this source, the predicted annual demand from the Lachlan River would increase to a maximum of 2,812 ML/year based on median rainfall results and 3,160 ML/year based on the 90th percentile rainfall results. Based on DPIE-Water trading records (refer Section 4.2.5), there has been adequate allocation assignment water available on the market from this source in previous years to meet the predicted demand requirement. It is intended that sourcing water from the Bland Creek Palaeochannel Borefield would continue in a similar manner as occurs currently, by alternating between this source and the Lachlan River to manage groundwater levels and provide flexibility with respect to extraction rates and the availability of allocation assignments in the Lachlan River.

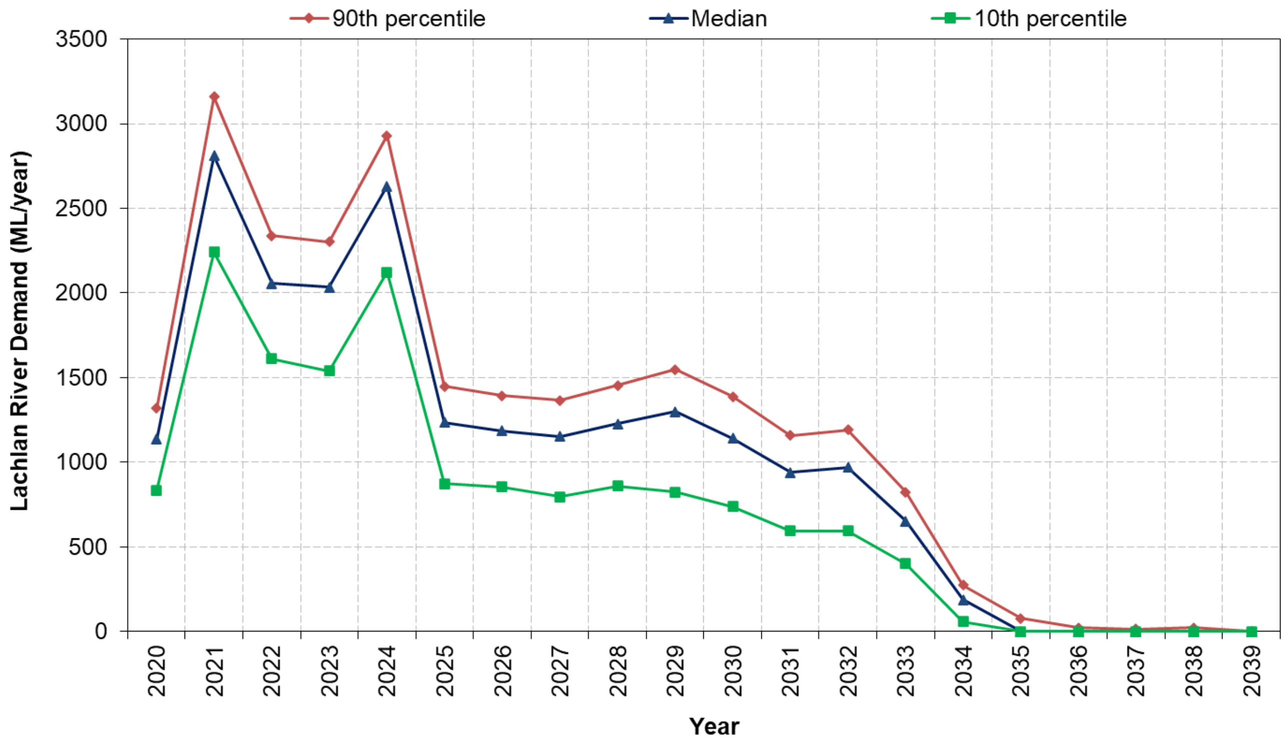

Figure 22 **Predicted Annual Demand from Lachlan River Entitlements - Maximum Bland Creek Palaeochannel Borefield 9 ML/d**

6.2.3 Supply Shortfall

No supply shortfalls were predicted for any of the 131 water balance model simulations with or without inclusion of water storage D10. The reduction in supply shortfalls as compared with the Modification 14 water balance results is due to the increase in available water supply from the duplication of the borefield pipeline to 22 ML/day (from 14 ML/day adopted for Modification 14) and the reduction in the expected oxide ore processing rates.

6.2.4 Maximum Pit Water Volume

The maximum water volume predicted in the open cut pit (to the end of open cut mining) and for all 131 model simulations was 1,359 ML. However, the risk of such a large water volume is low. Model results indicate that there is only a 5% risk of exceeding a pit water volume of 507 ML and a 50% chance that a pit water volume of 2 ML would be exceeded at any time during the proposed mine life.

6.3 CLIMATE CHANGE EFFECTS AND WATER BALANCE IMPLICATIONS

Recent (post 1950) changes to temperature are evident in many parts of the world including Australia. The Intergovernmental Panel on Climate Change (IPCC) has, in its most recent (fifth) assessment (2013), concluded that:

> *Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, and in global mean sea level rise; and it is extremely likely to have been the dominant cause of the observed warming since the mid-20th century.*

Predicting future climate using global climate models (GCMs) is now undertaken by a large number of research organizations around the world. In Australia much of this effort has been conducted and co-ordinated by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). CSIRO and BoM have recently published a comprehensive assessment of future climate change effects on Australia and future projections (CSIRO and BoM, 2015a). This is based on an understanding of the climate system, historical trends and model simulations of climate response to future global scenarios. Simulations have been drawn from an archive of more than 40 GCMs developed by groups around the world. Modelling has been undertaken for four Representative Concentration Pathways (RCPs) used by the latest IPCC assessment, which represent different future scenarios of greenhouse gas and aerosol emission changes and land-use change.

Predictions of future climate from these various models and RCPs have been used to formulate probability distributions for a range of climate variables including temperature, mean and extreme rainfall and potential evapotranspiration. Predictions are made relative to the IPCC reference period 1986 to 2005 for up to 14 future time periods between 2025 and 2090. Predictions for 2025 are relatively insensitive to future emission scenarios because they largely reflect greenhouse gases that have already been emitted. Longer term predictions become increasingly more sensitive to future emission scenarios.

Assessments of likely future concurrent rainfall and evapotranspiration changes have been undertaken using the online Climate Futures Tool (CSIRO and BoM, 2015b). Projected changes from all available climate models are classified into broad categories of future change defined by these two variables, which are the most relevant available parameters affecting rainfall runoff. The Climate Futures Tool excludes GCMs which were not found to perform satisfactorily over the Australian region. The assessments assumed a conservatively high emissions scenario – RCP 8.5 (representing a future with little curbing of emissions, with a carbon dioxide level continuing to rapidly rise to the end of the century).

An assessment was performed for 2040 (i.e. close to the planned end of CGO life) for the Central Slopes region of the continent which showed the mean annual change from the reference period to be -1.5% change (i.e. a reduction) in rainfall and 4.8% change (i.e. an increase) in evapotranspiration.

These effects are likely to, in the longer term, lead to reductions in rainfall runoff in the project area. However, the implications of climate change predictions on water management are unlikely to be significant over the remaining mine life because they are small compared to the natural climatic variability.

6.4 INTERACTION WITH LAKE COWAL

The proposed surface changes associated with the Underground Development Project and Modification 16 are to be contained within the current approved disturbance area. Therefore no additional impact on inflows to Lake Cowal is expected to occur as a result of the Project.

Additionally, although the underground development will extend beneath Lake Cowal, groundwater impacts to Lake Cowal are predicted to be negligible (Coffey, 2020a).

No overflows were predicted in the water balance model from either of the contained water storages (D1 and D4) that could overflow to Lake Cowal in any of the 131 model simulations. This outcome is contingent upon pumped dewatering of these storages in between rainfall events. Pump extraction rates of 200 L/s and 105 L/s for storages D1 and D4 were assumed respectively (refer Table 12).

As part of the Cowal Gold Project EIS (North Limited, 1998) a model of Lake Cowal and its catchment was used to investigate the effects that the mine would have on the water balance dynamics of Lake Cowal including changes to average water levels in the Lake and changes to the frequency and volume of overflows. The isolation of the mine area catchment from the Lake via the UCDS and the lake isolation bund will also reduce, to a small degree, inflows to the Lake as a result of on-site containment and use of water that would otherwise have drained from this area into the Lake.

The surface water assessment for Modification 14 (HEC, 2018) identified that inflows to Lake Cowal would be slightly reduced due to the development of the IWL and the realignment of the UCDS. The effect of the additional area that would be excised from the Lake Cowal catchment was approximately 0.64 km^2 or 4.7% of the total area previously excised. The effects of the catchment reduction on the water balance of the Lake were deemed to be negligible and unlikely to result in a noticeable impact on Lake levels or the Lake water balance.

7.0 FINAL VOID WATER BALANCE MODELLING

7.1 MODEL DESCRIPTION

A daily timestep, final void water and salt balance model has been set up using the GoldSim® simulation package. The model simulates the volume and salinity of the final void water body by simulating the inflows, outflows and resultant volume of water:

Change in Storage = Inflow – Outflow

Where:

Inflow includes direct rainfall, runoff and groundwater inflow.

Outflow includes evaporation.

7.2 KEY DATA AND ASSUMPTIONS

The model simulates inflow from remnant final void catchment rainfall runoff (including direct rainfall), groundwater inflow from bedrock as well as outflow due to evaporation on a daily basis. Key model input data include the following:

- A catchment area of 1,133 ha comprising 880 ha of partially rehabilitated waste rock sub-catchment, 118 ha of natural or fully rehabilitated sub-catchment and 135 ha of remnant open cut pit sub-catchment.
- A 131-year rainfall and evaporation data set (1889 to 2020 inclusive) for the CGO mine (refer Section 2.2). The data set was repeated several times over to generate an extended period of data for final void simulation – to ensure equilibrium water levels were reached during the simulation period.
- A constant pan factor of 0.8 was assumed for calculation of evaporation from the final void until the water level reached 10 m below the spill level (if this occurs) at which point the monthly pan factors were taken from McMahon *et al*. (2013) as listed in Table 13. The lower pan factor used for lower final void levels reflects lower evaporation likely at depth as a result of shading effects.
- Rainfall runoff was estimated using the AWBM applied to the final void sub-catchments, in a manner similar to the operational water balance model (refer Section 6.1.3). Direct rainfall was simulated on the contained water surface.

Predicted rates of groundwater flux versus water level in the open cut pit were provided by the groundwater specialist (Coffey, 2020a), as shown in Figure 23. Initially post-mining, the access tunnel voids and the paste backfill in the stopes would gradually fill with groundwater (Coffey, 2020a). As the groundwater inflow to the access tunnel voids and paste backfill starts to decline, the groundwater inflow to the open cut pit would increase (shown as the blue line in Figure 23). When the water level in the open cut pit increases to approximately -150 m, the groundwater inflow rate to the open cut pit would start to decline (shown as the orange line in Figure 23). The difference in predicted inflow rates considering low water levels in Lake Cowal as compared with high water levels in Lake Cowal is predicted to be negligible (Coffey, 2020a).

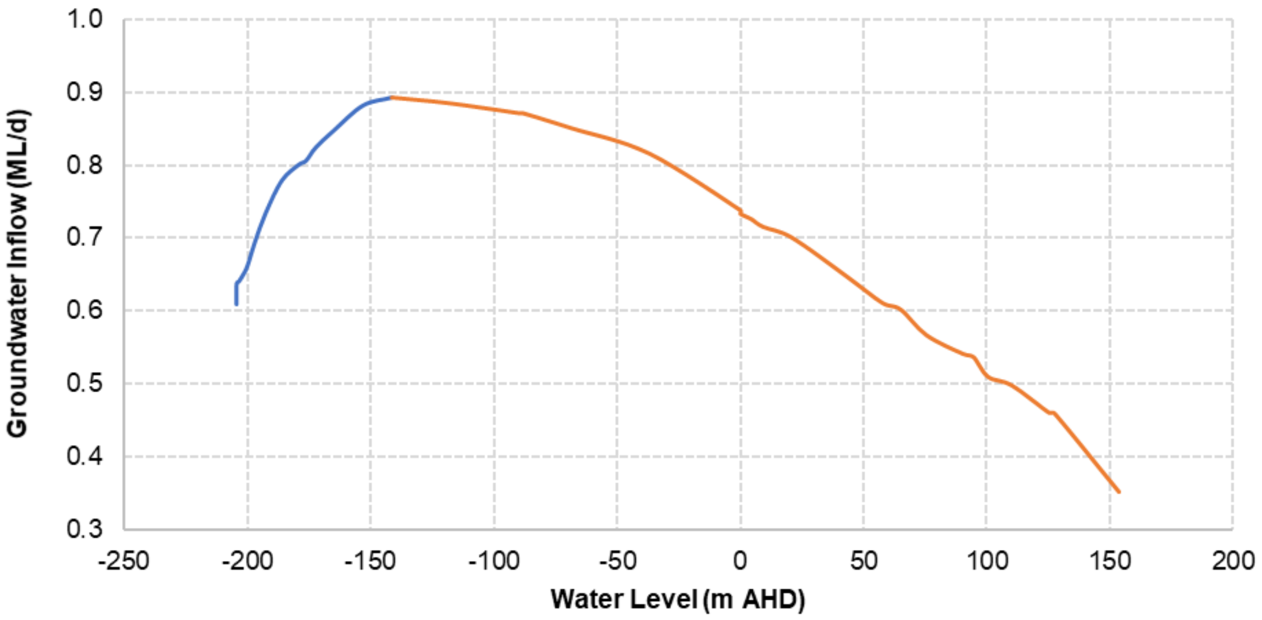

Figure 23 Predicted Post-Mining Groundwater Inflow

7.3 SIMULATED FUTURE WATER LEVELS AND INFERRED WATER QUALITY

The model-predicted final void water level is shown in Figure 24 in comparison with the final void spill level of 209 m AHD.

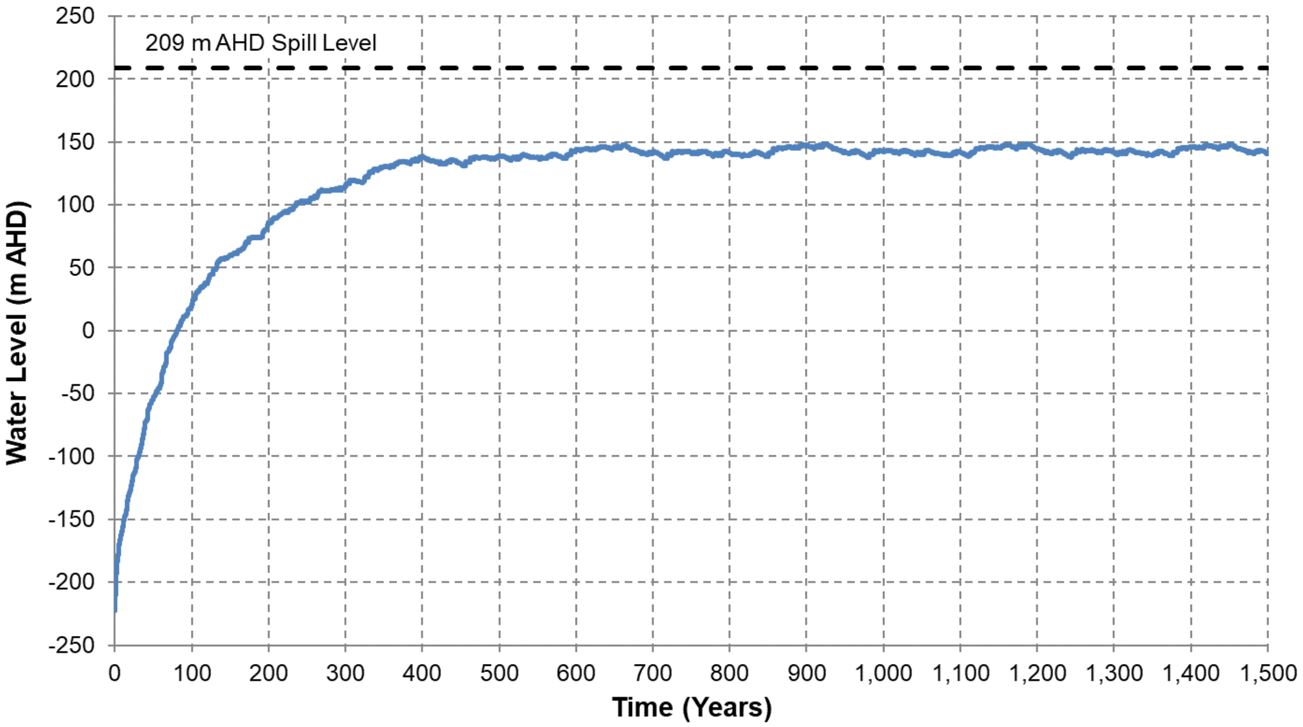

Figure 24 Predicted Final Void Water Level

The model predictions indicate that the final void would reach a peak equilibrium level of 148.6 m AHD - more than 60 m below the spill level (i.e. the final void would be contained). Equilibrium levels would be reached slowly over a period of more than 1600 years. Given the water level and groundwater flux relationship provided, groundwater outflow was not simulated to occur – i.e. the final void would remain a groundwater sink.

The void water quality would reflect the influence of the high salinity in the groundwater. Given that the only outflow from the final void would be evaporation, salinity is predicted to increase trending to hyper-salinity in the very long term. Water quality in the final void at any given point in time would vary with depth as a result of mixing and stratification processes that would occur as a result of temperature and salinity differentials.

7.4 IMPLICATIONS OF CLIMATE CHANGE ON FINAL VOID WATER BALANCE

As described in Section 6.3, climate change predictions have been derived for the CGO region using the Climate Futures Tool (CSIRO and BoM, 2015b). An assessment was performed for 2090 (i.e. 50 years post the end of the proposed mine life)[22] for the Central Slopes region of the continent which showed the mean annual change from the reference period to be -3.3% change (i.e. a reduction) in rainfall and 13.7% change (i.e. an increase) in evapotranspiration.

The final void water balance model was simulated with the predictions of monthly mean change in the percentage of rainfall and evapotranspiration, as derived from the Climate Futures Tool as at 2090, applied to the rainfall and evapotranspiration rates adopted in the final void water balance model. The model-predicted final void water level considering potential climate change impacts is shown in Figure 25.

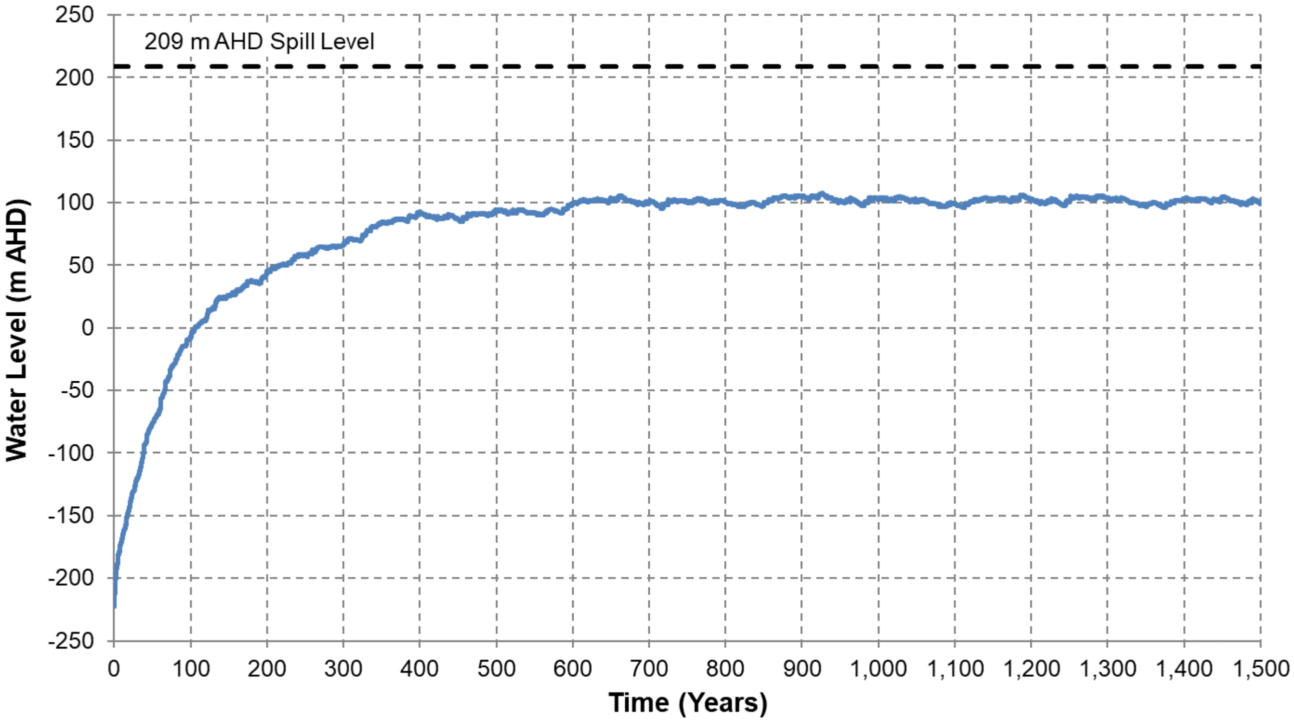

Figure 25 Predicted Final Void Water Level Considering Climate Change Prediction for 2090

The model predictions indicate that the final void would reach a peak equilibrium level of 107.5 m AHD - more than 101 m below the spill level (i.e. the final void would be contained). Equilibrium levels would be reached slowly over a period of more than 900 years.

Considering the increase in evapotranspiration rates predicted from the Climate Futures Tool predictions, the rate of progression to hyper-saline concentrations in the final void would likely occur more rapidly than under natural conditions.

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[22] No predictions are available beyond 2090.

8.0 POTENTIAL SURFACE WATER IMPACTS AND MITIGATION MEASURES

The following recommendations are made in consideration of the surface water management issues assessed for the Underground Development Project:

- The changes to water management outlined in this report be implemented in accordance with accepted and best practice management.
- The monitoring program and associated annual water management system performance reviews continue to be undertaken over the remaining CGO life.

8.1 OPERATIONAL PHASE

Due to the increased CGO water demand there are potential impacts on Lachlan River flows. Future water demand would be met (in part) by sourcing water from Lachlan River regulated flows (licensed extraction purchased on the open market). Given the provisions inherent in the *Water Management Act, 2000* regarding environmental flows, the impact of sourcing additional regulated flow from the Lachlan River would be neutral because, if not extracted by Evolution for use at CGO, the licences could be either purchased and the same water extracted by others or the water could be used by the existing licence holders if they were unable to sell the water on the open market.

As the reliance on external sources is likely to slightly increase as a result of the Underground Mine Project, the management of supply in a sustainable manner from each external source would be pertinent. It is recommended that sourcing water from the Bland Creek Palaeochannel Borefield continue in a similar manner as occurs currently, by alternating between this source and the Lachlan River to manage groundwater levels and provide flexibility with respect to extraction rates and the availability of allocation assignments in the Lachlan River.

Overall, there has been no apparent causal link between the mining operations and water quality changes in Lake Cowal and it is concluded that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Underground Mine Development.

Due to the potential for a small amount of the ore to be PAF, the Environmental Geochemical Assessment (GEM, 2020) recommends that a geochemical assessment of the ROM ore be untaken over a time period to develop a better understanding of the quantity and distribution of the PAF and PAF-LC material within the underground ore. Dependent on the outcomes of the assessment, further measures may be required to reduce the potential for exposure of this material on the surface of the stockpiles and to reduce the potential for increased salinity and metal solubility and release. The water quality monitoring programme has been reviewed with respect to the potential for enrichment of specific metals in the ROM ore and low grade ore, as described in Section 9.1.

8.2 POST-CLOSURE

Post-closure surface water impacts would include possible risks of structural instability of final mine landforms affecting Lake Cowal water quality (salinity and turbidity/sedimentation). There is also the risk of discharge from the final void water body to Lake Cowal and the potential for reduced inflow to Lake Cowal as a result of the increased catchment area of the final void.

The final void water balance modelling (Section 7.0) has indicated that the final void water level should stabilise well below spill level and below the local water table level under both natural conditions and with consideration to potential climate change effects. The majority of the CGO site post-closure would continue to drain to the final void and would therefore have no impact on the water quality of Lake Cowal. The final profiles of the waste rock emplacements, IWL and lake isolation system have been designed to effectively preclude instability which could cause impact on the Lake (North Limited, 1998). Stabilisation of the outer batters of the mine waste rock emplacements (using rock mulch and vegetation) would be undertaken well ahead of mine closure, allowing time for “proving” the stability of these batters.

Evolution is undertaking batter rehabilitation trials (using a number of different combinations of rock mulch, soil and vegetation). Results of these trials will inform the final design of the waste rock emplacement rehabilitation and will also allow prediction of sediment generation rates likely to be generated from the final landform to the Lake. North Limited (1998) predicted final landform sediment generation rates that were of the same magnitude as (albeit somewhat greater than) those predicted from the site under pre-mine conditions. However, given the direction of most of the site runoff to the final void, the area reporting to Lake Cowal would be reduced and therefore so would the net sediment yield to Lake Cowal. Likewise, the majority of salt generated from the final landform would be directed to the final void which is predicted to trend towards hyper-saline conditions in the long term (regardless of salt influx).

The Environmental Geochemistry Assessment (GEM, 2020) found that the proposed underground development waste rock is geochemically similar to the waste rock from the current open pit operations, indicating that the management strategies currently employed for the waste rock emplacements would not need to be modified to accommodate the development waste rock. The salt concentration in runoff from the rehabilitated outer waste rock emplacement to Lake Cowal would be expected to reduce with time as salts present in the near surface layers were removed by natural leaching. In the longer term the predicted steady state TDS concentration in runoff from the waste rock dump is not likely to exceed 100 mg/L (North Limited, 1998) or an EC of approximately 150 µS/cm. This is less than the minimum value in the baseline data for Lake Cowal of 222 µS/cm (refer Table 6). Salt fluxes were predicted to be extremely small compared with inflows to the Lake from Bland Creek and the Lachlan River.

Because the proposed surface changes associated with the Underground Development Project and Modification 16 are to be contained within the current approved disturbance area, no additional impact on inflows to Lake Cowal is expected to occur as a result of the Project. Additionally, although the underground development will extend beneath Lake Cowal, groundwater impacts to Lake Cowal are predicted to be negligible (Coffey, 2020a).

9.0 MONITORING, MITIGATION AND MANAGEMENT

9.1 OPERATIONAL MONITORING AND MANAGEMENT

Surface water monitoring is currently undertaken at the CGO in accordance with Development Consent Condition 4.5(b) and will continue for the remainder of the mine life. Surface water monitoring will be undertaken at specific areas within the Mining Lease area including the contained water storages, UCDS, ICDS, open pit and tailings storage facilities (Evolution, 2018). Surface water monitoring will continue to be undertaken in Lake Cowal (when lake water levels permit) at monitoring sites along the six transects used during the baseline monitoring programme to enable evaluation of water quality data against records of baseline monitoring, in accordance with Development Consent Condition 4.4(a)(ii).

Due to the potential enrichment of sliver, arsenic, cadmium, copper, lead, selenium and zinc in the ROM ore and low grade ore, GEM (2020) recommended that these metals and total alkalinity are included in the site water quality monitoring programme. The current site water quality monitoring programme includes monitoring of arsenic, cadmium, copper, lead, selenium, zinc and total alkalinity as defined in the CGO Water Management Plan (Evolution, 2018). It is proposed that the monitoring programme is revised to also include monitoring of silver as recommended in GEM (2020).

The results from the monitoring programmes will continue to be maintained in a database for review and assessment and used to assist in the management of the quality and quantity of surface and groundwater within and around the mine site. The monitoring report results and any specialist interpretations of trends observed in the monitoring data will be reported annually in the Annual Review (Evolution, 2018).

The Underground Development Project should alternate between external borefield water supply and supply from the Lachlan River to manage groundwater levels and provide flexibility with respect to extraction rates and the availability of allocation assignments in the Lachlan River. As such, it is recommended that the site water balance model and numerical groundwater model are updated and verified on a regular basis to maintain the models as reliable tools for assessing the effectiveness of the site water management system. Annual forecast water balance modelling will inform near term water supply reliability for the Underground Development Project as it progresses.

9.2 POST-MINING MONITORING AND MANAGEMENT

Water quality monitoring should continue for two years following cessation of operations with monitoring data reviewed at annual intervals (as part of the annual review process) over this period. Reviews should involve assessment against long-term performance objectives that are derived from baseline conditions or a justifiable departure from these, with due allowance for climatic variations. If objectives are not substantially met within the two-year period, management measures should be revised and the monitoring period extended.

The surface water quality monitoring programme during and following mine closure (including monitoring of water quality in the final void) would be developed in consultation with relevant Government agencies (Evolution, 2018). The geotechnical stability of the final void would be reviewed by an appropriately qualified and experienced person and the stability of the final void would continue to be surveyed from the cessation of mining until lease relinquishment (i.e. until the final void walls can be demonstrated to be geotechnically stable and present an acceptably low risk of environmental harm). Survey assessments would be undertaken annually to determine and quantify any movement of the lake protection bund until permanent stability is demonstrated (Evolution, 2018).

9.3 POTENTIAL CONTINGENCY MEASURES

Potential contingency measures in the event of unforeseen impacts or impacts in excess of those predicted would include:

- conducting additional monitoring (e.g. increase in monitoring frequency or additional sampling locations) to confirm impacts and inform the proposed contingency measures; and
- refinements to the water management system design such as additional containment dams, increases to storage or pumping capacity, installation of new structures as required to address the identified issue.

10.0 SUMMARY AND CONCLUSIONS

Evolution proposes to extend mining operations at the CGO through the Underground Development Project and through Modification 16 which will address the ancillary surface changes associated with the Underground Development Project.

The site water balance results indicate that the existing water management storages and infrastructure are sufficient to accommodate the water demand and dewatering requirements associated with the proposed Underground Development Project. The following summarises the key outcomes of the water balance assessment for the Underground Development Project:

- The maximum water demand to accommodate processing of primary and oxide ore from the proposed underground mine and open cut pit operations is estimated at 25 ML/d in 2024. This compares with an average process plant demand of 22 ML/d in 2019 for the current CGO.
- Site water balance model results indicate that the demand from external sources, based on the median rainfall sequence, would average 2,744 ML/year with up to 2,850 ML/year to be sourced from the Lachlan River based on the 90th percentile model results.
- If supply from the Bland Creek Paleochannel Borefield was reduced to an average of 4 ML/d over the life of the Project, equivalent to the predicted sustainable borefield yield, a maximum demand of 3,160 ML/year would be required from the Lachlan River based on the 90th percentile model results.
- Based on DPIE-Water trading records, there has been adequate allocation assignment water available on the market from this source in previous years to meet this predicted demand requirement.

The surface changes proposed for Modification 16 will be contained within the existing approved disturbance area and management of surface water runoff and surface infrastructure will continue to be undertaken in accordance with the approved operations. The following summarises the key outcomes of the surface water assessment for Modification 16:

- Runoff from the ore stockpile areas and additional waste rock associated with the underground mine operations would continue to be captured and contained within the approved disturbance area. Because the proposed underground development waste rock is geochemically similar to the waste rock from the current open cut pit operations, the management strategies currently employed for the waste rock emplacements are not expected to require modification in order to accommodate the additional waste rock.
- Due to the potential enrichment of arsenic, cadmium, copper, lead, selenium and zinc in the ROM ore and low grade ore, it is recommended that these metals and total alkalinity continue to be included in the site water quality monitoring programme. It is proposed that the site water quality monitoring programme is revised to also include monitoring of silver.
- Augmentation of on-site water storages would be undertaken within the existing catchment area/disturbance area of each storage. No overflows were predicted in water balance model simulations from either of the contained water storages (D1 and D4) that could overflow to Lake Cowal in any of the model simulations.
- Final void water balance model predictions indicate that the final void would reach a peak equilibrium water level of 148.6 m AHD - more than 60 m below the spill level (i.e. the final void would be contained). Equilibrium levels would be reached slowly over a period of more than 1,600 years. Given the water level and groundwater flux relationship provided,

groundwater outflow was not simulated to occur – i.e. the final void would remain a groundwater sink.

Because the proposed surface changes associated with the Underground Development Project and Modification 16 are to be contained within the current approved disturbance area, no impact on inflows to Lake Cowal or the water quality of Lake Cowal is expected to occur as a result of the Underground Development Project or Modification 16.

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