



**SECTION 4**  
Environmental Assessment

**COWAL GOLD OPERATIONS  
MINE LIFE MODIFICATION**  
Environmental Assessment  
2016



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## 4 ENVIRONMENTAL ASSESSMENT

### 4.1 HYDROGEOLOGY

The Hydrogeological Assessment for the Modification was conducted by Coffey Services Australia Pty Ltd (Coffey) (2016) and is presented in Appendix A. The report is separated into two assessments for the mine site and borefields to address the hydrogeological effects of the Modification including:

1. changes to mining activities within ML1535 (i.e. deepening of the open pit, changes to the TSF configuration/heights, continued open pit dewatering and use of the mining lease saline bores); and
2. continued operation of the off-site Bland Creek Palaeochannel Borefield and Eastern Saline Borefield for water supply.

The Hydrogeological Assessment and Hydrological Assessment (prepared by HEC [2016] [Appendix B]) have been conducted in an integrated manner (e.g. predicted groundwater inflow to the open pit has been included in the Hydrological Assessment's site water balance).

#### 4.1.1 Existing Environment

##### **Baseline Groundwater Data**

A significant number of hydrogeological studies and site testwork have been conducted for the CGO area and surrounds, including:

- *Lake Cowal Project – Laboratory Testing of Tailings* (Knight Piesold Pty Ltd, 1994);
- *Lake Cowal Project Hydrogeological Modelling and Dewatering Study* (Coffey Partners International Pty Ltd [Coffey Partners International], 1995);
- the EIS, which included the groundwater studies *Hydrogeological Assessment of Lake Cowal Project Water Management Review* (Coffey Partners International, 1997) and *Groundwater Studies – Pre-assessment Groundwater Issues* (Kalf and Associates Pty Ltd, 1997);
- *Cowal Northern Tailings Storage Facility – Floor Permeability* (URS Australia Pty Limited, 2005);
- *Cowal Southern Tailings Storage Facility – Floor Permeability* (URS Australia Pty Limited, 2006);

- *Cowal Gold Project – Preliminary Hydrogeochemical Review of the Groundwater System* (Parsons Brinckerhoff Australia Pty Ltd, 2007);
- *Cowal Gold Mine E42 Modification Hydrogeological and Tailings Seepage Assessment* (Coffey Geotechnics, 2008);
- *Cowal Gold Mine – Groundwater Level Investigation* (Coffey Geotechnics, 2009a);
- *Cowal Gold Mine – E42 Modification Modified Request Environmental Assessment* (Coffey Geotechnics, 2009b); and
- *Hydrogeological Assessment – Cowal Gold Mine Extension Modification* (Coffey Geotechnics, 2013).

A comprehensive review of existing geological and hydrogeological information, as well as relevant monitoring data and mapping, was undertaken by Coffey (2016) (Appendix A), including evaluation of the following:

- previous hydrogeological investigations (listed above);
- data collected from the existing CGO groundwater monitoring network in accordance with the existing WMP, and the SWGMBMP;
- available information on local water bores and groundwater usage in the vicinity of the CGO, including DPI-Water monitoring bores;
- publicly available regional geological data;
- detailed local geological data held by Evolution; and
- geographic information including aerial photography, satellite imagery, digital elevation models, geophysical, cadastral and hydrological data sets.

Existing groundwater monitoring locations, including for the Bland Creek Palaeochannel, are shown on Figure 2-3 and Figure 4-1.

The Hydrogeological Assessment has considered the requirements of relevant Water Sharing Plans listed under the *NSW Water Management Act, 2000*.





### **Existing Groundwater Regime**

The Water Sharing Plans relevant to the CGO include the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* and the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011*. The *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011* was amended on 1 July 2016 however these changes to the Water Sharing Plan do not affect the pre-existing licensing arrangements at the CGO.

The conceptual groundwater model of the existing groundwater regime in the region developed by Coffey (2016) supports the two groundwater systems identified in the relevant Water Sharing Plans, which are as follows:

- alluvial groundwater system; and
- fractured rock groundwater system.

#### *Alluvial Groundwater System*

Alluvial groundwater resources within the region are generally associated with two geological formations (Appendix A):

- the Cowra Formation, which comprises aquifers of isolated sand and gravel lenses in predominantly silt and clay alluvial deposits, with perched groundwater of generally higher salinity; and
- the Lachlan Formation (i.e. Bland Creek Palaeochannel), which comprises an aquifer of quartz gravel with groundwater of generally low salinity.

The existing CGO open pit intersects the Cowra Formation, but does not intersect the Lachlan Formation (Figure 4-2). The saline groundwater supply bores within the ML 1535 extract water from the Cowra Formation. The Bland Creek Palaeochannel Borefield extracts water from the Lachlan Formation, while the Eastern Saline Borefield extracts water from the Cowra Formation.

#### *Fractured Rock Groundwater System*

The fractured rock groundwater system underlies the alluvial groundwater system, and consists of the following geological formations:

- the Ordovician aged Lake Cowal Volcanics Complex, which comprise massive and stratified non-welded pyroclastic debris, overlying a partly brecciated lava sequence, overlying volcanic conglomerate interbedded with siltstone and mudstone; and

- overlying Siluro-Devonian Group and Ootha Formation, which comprise shallow to deep marine sedimentary units.

The existing CGO open pit intersects the Lake Cowal Volcanics Complex.

### **Existing Effects of Mining Activities at the CGO**

#### *Groundwater Inflows to the Open Pit and Open Pit Dewatering*

Groundwater inflow to the open pit is managed by dewatering bores and in-pit sumps (which also collect incidental rainfall). A ring of dewatering bores currently operate to control groundwater levels around the open pit. Horizontal drains in the pit wall accelerate depressurisation of the aquifer system by draining groundwater into the pit sumps.

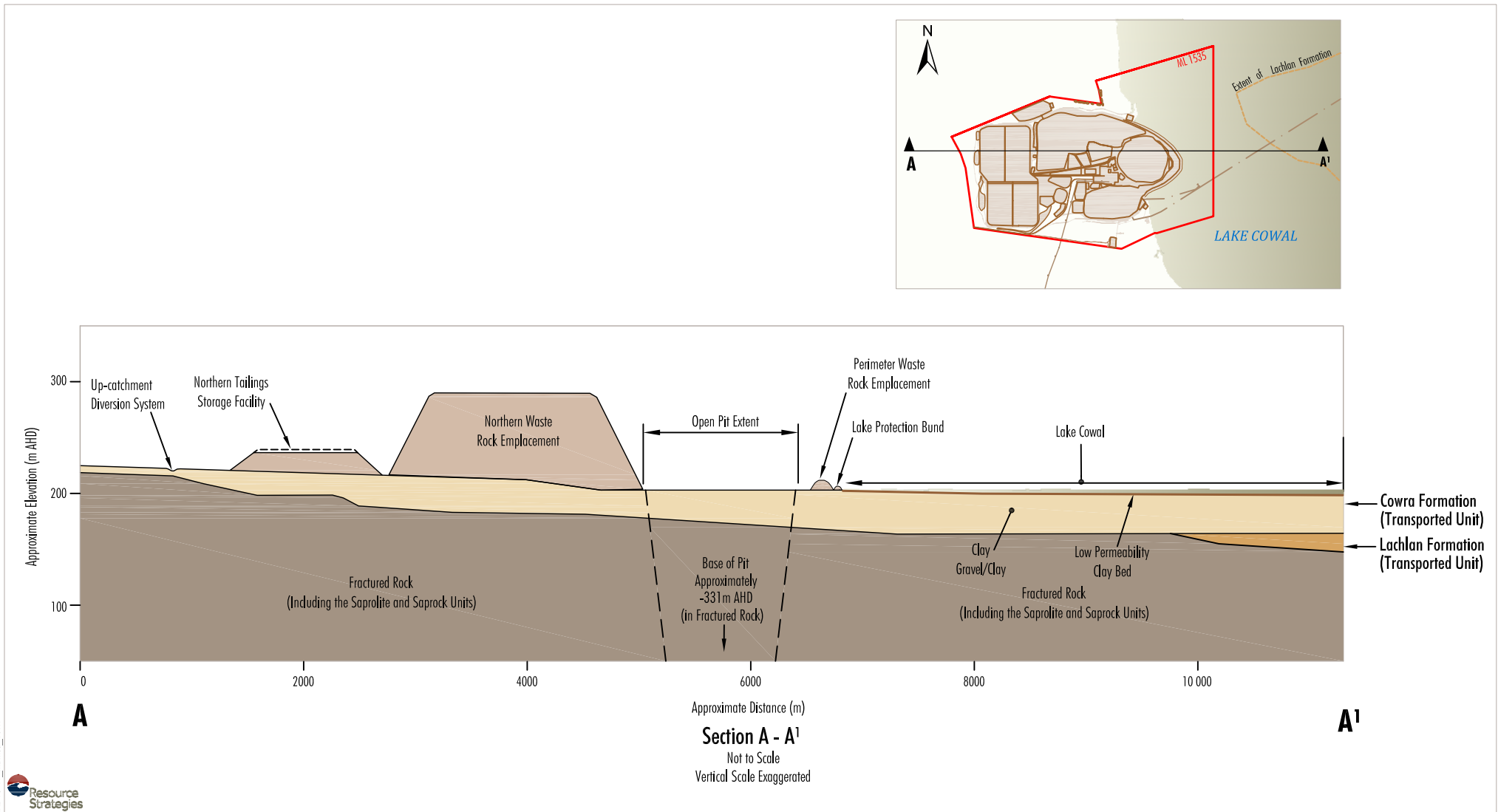
Current groundwater inflow to the open pit is estimated to be approximately 146 ML/annum, with approximately 10% of groundwater inflows from the alluvial groundwater system and 90% of groundwater inflows from the fractured rock groundwater system (Appendix A).

Groundwater inflow to the open pit is estimated to have generally decreased since 2008 as the adjacent aquifers surrounding the CGO open pit have become depressurised. No material increase in groundwater inflow to the open pit is estimated to have occurred during and following the 2010 and 2012, or the most recent 2016, lake-fill events based on monitored pit dewatering records (Appendix A).

Groundwater inflow to the open pit continues to be less than the predictions in previous assessments for the CGO (i.e. for the EIS, Modified Request and the Cowal Gold Mine [CGM] Extension Modification), based on monitored pit dewatering records.

#### *Measured Groundwater Water Level Drawdown*

Within ML 1535, monitoring data (Appendix A) shows some drawdown in the Cowra Formation due to groundwater inflow to the CGO open pit. The monitoring data indicates that this drawdown is localised, and is considered to have not significantly affected groundwater levels in the Cowra Formation or Lachlan Formation outside of ML 1535.



HAL-16-41 ML Mod 109A



- LEGEND**
- Host units for the Lachlan Unregulated and Alluvial Water Sources
  - Host units for the NSW Murray Darling Basin Fractured Rock Groundwater Sources
  - Modification Component



CGO MINE LIFE MODIFICATION  
**Conceptual Hydrogeological  
 Cross Section across ML 1535**

Source: Coffey (2016)

**Figure 4-2**

### ***Hydraulic Relationship between Lake Cowal and Groundwater Systems***

Previous studies indicated that Lake Cowal is hydraulically separated from the underlying aquifers, due to the very low permeability of the clay pan deposits that form the lake bed. Based on this, it was predicted there would be very low potential for significant quantities of water to infiltrate from Lake Cowal to the underlying aquifers (i.e. associated with the Cowra Formation).

Monitoring data collected since the 2010 and 2012 lake-fill events indicates that no increase in groundwater inflow to the open pit has occurred which supports the predictions of previous assessments regarding the hydraulic separation of Lake Cowal from the underlying aquifers (Appendix A). Further, monitoring data indicates that inflow to the open pit has generally been lower during lake-fill conditions (2010 onwards) compared with when the lake was dry (Appendix A).

### ***Existing Management of Groundwater Levels in the Bland Creek Palaeochannel***

Groundwater levels in the Bland Creek Palaeochannel are managed in accordance with the existing Groundwater Contingency Strategy, which involves the monitoring of groundwater levels, and the implementation of response measures should groundwater levels reach trigger levels developed in consultation with the DPI-Water and other groundwater users (Section 2.8.3).

The trigger levels are as follows:

- Bore GW036553 (Bland Creek Palaeochannel Borefield area) – trigger levels of 137.5 and 134 m AHD.
- Bore GW036597 (Billabong area) – trigger level 145.8 m AHD.
- Bore GW036611 (Maslin area) – trigger level 143.7 m AHD.

Groundwater levels at Bore GW036553 are monitored on a continuous basis by DPI-Water.

Investigation and mitigation contingency measures have been developed should groundwater levels reach either 137.5 m AHD (trigger for investigation) or 134 m AHD (trigger for mitigation) in the monitoring bore closest to Evolution's Bland Creek Palaeochannel Borefield (i.e. GW036553).

In the event that the groundwater level in Bore GW036553 is below 137.5 m AHD, one or more of the following contingency measures will be implemented in consultation with the DPI-Water:

- investigate the groundwater level in the Trigalana Bore (GW702286) or any other impacted stock and domestic bores;
- determine the pump setting in relevant stock and domestic bores;
- determine the drawdown rate in Bore GW702286 and other impacted stock and domestic bores;
- develop an impact mitigation plan for impacted stock and domestic bores; and/or
- set up an alternative water supply for the owner of Bore GW702286 and other owners of stock and domestic bores, if necessary.

In the event that the groundwater level in Bore GW036553 is below 134 m AHD, one or both of the following contingency measures will be implemented in consultation with the DPI-Water:

- alter the pumping regime of the Bland Creek Palaeochannel Borefield to maintain the water level in the impacted stock and domestic bores; and
- maintain a water supply to the owner/s of impacted stock and domestic bores.

To date, the effect of the Groundwater Contingency Strategy is that pumping from the Bland Creek Palaeochannel Borefield ceases when required to meet the trigger levels described above, and water requirements at the CGO are met by alternative internal or external water supplies, including Lachlan River water entitlements (Section 2.8.4).

It is noted that groundwater levels at Bore GW036597 (Billabong area) and Bore GW036611 (Maslin area), which are located some 6 km from the Bland Creek Palaeochannel Borefield, are largely influenced by groundwater use by other users (e.g. for irrigation).

## Tailings Storage Facility Seepage

### Floor Permeability

A number of seepage control measures have been incorporated into the design and operation of the TSFs at the CGO, with any potential residual seepage from the TSFs directed towards the open pit (Section 3.6).

URS Australia Pty Limited (2005; 2006) conducted field investigations and laboratory testing for both the northern and southern tailings storage facilities, concluding:

- Investigations consistently showed the uppermost 5 m of the TSF footprints to be essentially clay soils of extremely low permeability.
- Laboratory testing of typical samples from within 5 m of floor level yielded permeabilities less than the target permeability of  $1 \times 10^{-9}$  metres per second (m/s) (i.e.  $9 \times 10^{-5}$  metres per day [m/day]).
- Inspections of cut-off trench excavation and storage floor did not reveal any continuous zones or lenses of high permeability soil that might provide a preferential leakage path.

### Groundwater Levels

Groundwater monitoring (e.g. at monitoring bores MON02A and MON02B) (Figure 4-1) indicates that groundwater levels in the vicinity of the TSFs show a gradual rise since the commencement of tailings deposition for the CGO operations (Appendix A).

Assessment indicates that this gradual rise in groundwater levels is related to the percolation and movement of seepage from the TSFs. A description of potential impacts associated with rising groundwater levels due to tailings seepage, and associated contingency measures, is provided in Sections 4.1.2 and 4.1.3.

### Solute Transport

Seepage parameters were used in previous assessments to predict potential solute transport from the TSFs (Appendix A).

Due to the low permeability and retardation (i.e. due to sorption processes) of the geological layers surrounding the TSFs, it was predicted solute transport from seepage from the TSFs would not extend beyond a distance of approximately 200 m from the TSFs, and in the long-term, cyanide would degrade in the tailings storage and surface of the underlying aquitard and would be effectively removed from the subsurface (Appendix A).

Based on CGO groundwater monitoring results analysed up to June 2016, cyanide has not been observed at significant concentrations (i.e. has generally been below detection limits) in groundwater samples (Appendix A) from bores surrounding the TSFs.

Where monitoring has shown total cyanide to be present, its concentration at individual monitoring locations has not been consistent over time, and there is no consistent trend to suggest that significant concentrations of cyanide have leached from the TSFs into the surrounding groundwater (Appendix A).

### Other Groundwater Users

Evolution is the only known user of the saline alluvial aquifers that immediately surround the CGO mining operations.

In the region, there is reliance upon groundwater bores as a source of water for agricultural enterprises and other uses. The majority of the privately-owned pumping bores in the area are within the Lachlan Formation with a small number in the Cowra Formation (Appendix A). No privately-owned bores have been identified in the fractured rock groundwater system surrounding the CGO (Appendix A).

### Groundwater Dependent Ecosystems

No groundwater dependent ecosystems have been identified relevant to the CGO (including the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield).

The Bureau of Meteorology (BoM) Atlas of Groundwater Dependent Ecosystems (BoM, 2016) identifies stands of Dwyer's Red Gum (*Eucalyptus dwyeri*) 3 km to the north and 4 km to the southwest of ML 1535, however these are located outside the extent of influence on shallow groundwater predicted for the Modification (Appendix A).



## Groundwater Quality

### Mine Site (ML 1535)

Assessment of baseline groundwater salinity levels undertaken for the EIS by Coffey Partners International (1997) reported that:

- The alluvial groundwater system had very high salinity in the range of 19,000 to 72,000 microSiemens per centimetre ( $\mu\text{S}/\text{cm}$ ) within the open pit extent and 6,000 to 44,400  $\mu\text{S}/\text{cm}$  beneath the TSFs area.
- The fractured rock groundwater system also had very high salinity in the range of 50,900 to 63,700  $\mu\text{S}/\text{cm}$ .

Monitoring data indicates that, while open pit dewatering is causing a localised reduction in groundwater levels, groundwater pH and electrical conductivity (EC) appear to be unaffected by this drawdown (Appendix A).

Monitored groundwater pH levels and EC concentrations within ML 1535 are generally consistent with the background (i.e. pre-mining) monitored levels.

### Bland Creek Palaeochannel

Groundwater quality records from monitoring bores in the Bland Creek Palaeochannel Borefield indicate decreasing salinity with depth (Appendix A). Salinity levels in the Cowra Formation are approximately 31,300  $\mu\text{S}/\text{cm}$  (Upper Cowra) and 13,800  $\mu\text{S}/\text{cm}$  (Lower Cowra), and approximately 1,900  $\mu\text{S}/\text{cm}$  in the Lachlan Formation (Appendix A).

EC records from groundwater monitoring bores in the Bland Creek Palaeochannel indicate that salinity levels have remained reasonably constant within the three alluvial sequences since monitoring commenced in 2004. While fluctuations at BLPR2 have been recorded, salinity levels fell substantially in late 2013 before indicating an overall upward trend since late 2014 (Appendix A).

#### 4.1.2 Potential Impacts

In 2013, Coffey Geotechnics developed two numerical groundwater models to assess potential groundwater impacts associated with the CGO.

The mine site groundwater model was developed to predict the potential impacts associated with the CGO open pit, and was used to estimate groundwater inflow to the open pit and proportions from the alluvial and fractured rock groundwater systems consistent with the relevant Water Sharing Plans. The modelling considered both lake-fill and lake-dry scenarios.

The Bland Creek Palaeochannel groundwater model was used to assess potential impacts to regional aquifers associated with the continued use of the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield.

The groundwater models were developed in consideration of available geological and hydrological data at the time, including the historic use of regional aquifers by other groundwater users.

Coffey Geotechnics Pty Ltd (2013) also developed a solute transport model to predict potential impacts to water quality associated with seepage from the TSFs.

Kalf and Associates Pty Ltd (2013) peer reviewed this study and considered the modelling methodology adopted by Coffey Geotechnics Pty Ltd (2013), including model setup, structure and calibration, to be suitable.

The existing groundwater models have been updated for the Modification to consider additional groundwater data and incorporate the proposed changes to the approved CGO (i.e. deepening of the open pit, changes to the TSF configuration/heights, continued open pit dewatering and use of the mining lease saline bores, and continued operation of the off-site Bland Creek Palaeochannel Borefield and Eastern Saline Borefield for water supply).

#### Potential Impacts to Lake Cowal

Existing monitoring data indicates that groundwater inflow to the CGO open pit has not changed significantly during lake-fill conditions due to the hydraulic separation of the open pit and Lake Cowal (Section 4.1.1).

While the Modification would increase the depth of the open pit, the clay layers that act to isolate Lake Cowal from the underlying aquifers would remain.

Coffey (2016) concludes that the total impact to Lake Cowal associated with open pit dewatering at the CGO would be negligible (Appendix A). The incremental impact to Lake Cowal due to the Modification (i.e. in comparison to the approved CGO) would therefore also be negligible (Appendix A).

### **Groundwater Inflows to the Open Pit**

#### *During Mining*

No change in the maximum groundwater inflow is expected due to the Modification (Appendix A).

Over the operational life of the Modification, total groundwater inflow to the open pit is predicted to comprise (Appendix A):

- a maximum of approximately 228 ML/annum from the fractured rock groundwater system; and
- a maximum of approximately 24 ML/annum from the alluvial groundwater system.

It is predicted that the proportion of groundwater inflow from the fractured rock groundwater system would continue to increase as the open pit deepens.

No significant difference between groundwater inflow for the lake-fill and lake-dry scenarios was predicted (Appendix A), indicating the continued hydraulic separation of the CGO open pit and Lake Cowal (Section 4.1.1).

#### *Post-Mining*

No change in the maximum post-mining groundwater inflow is expected due to the Modification (Appendix A).

Maximum post-mining groundwater inflow is expected to reduce to approximately 46.3 ML/annum, comprising approximately 44 ML/annum from the fractured rock groundwater system and 2.3 ML/annum from the alluvial groundwater system.

### **Predicted Drawdown due to Open Pit Dewatering**

The maximum predicted groundwater drawdown contours for the Modification in the alluvial and fractured rock groundwater systems are shown on Figure 4-3, along with drawdown contours for the existing CGO.

As shown on Figure 4-3, the change in groundwater drawdown associated with the Modification would be generally limited to ML 1535.

### **Geochemical Considerations**

Waste rock and tailings associated with the extension to the CGO open pit for the Modification would be geochemically similar to waste rock and tailings from the existing open pit (Appendix C). Therefore, no change to the quality of seepage from the TSFs or waste rock emplacements is expected due to the Modification (i.e. in comparison to the quality of existing seepage).

### **Seepage from Tailings Storage Facilities**

An assessment of potential impacts to groundwater quality due to seepage from the TSFs was undertaken using an analytical particle tracking approach (Appendix A).

Consistent with the findings of previous assessments for the approved CGO, seepage from the TSFs to the underlying aquifers was predicted to slowly migrate towards the open pit (Appendix A).

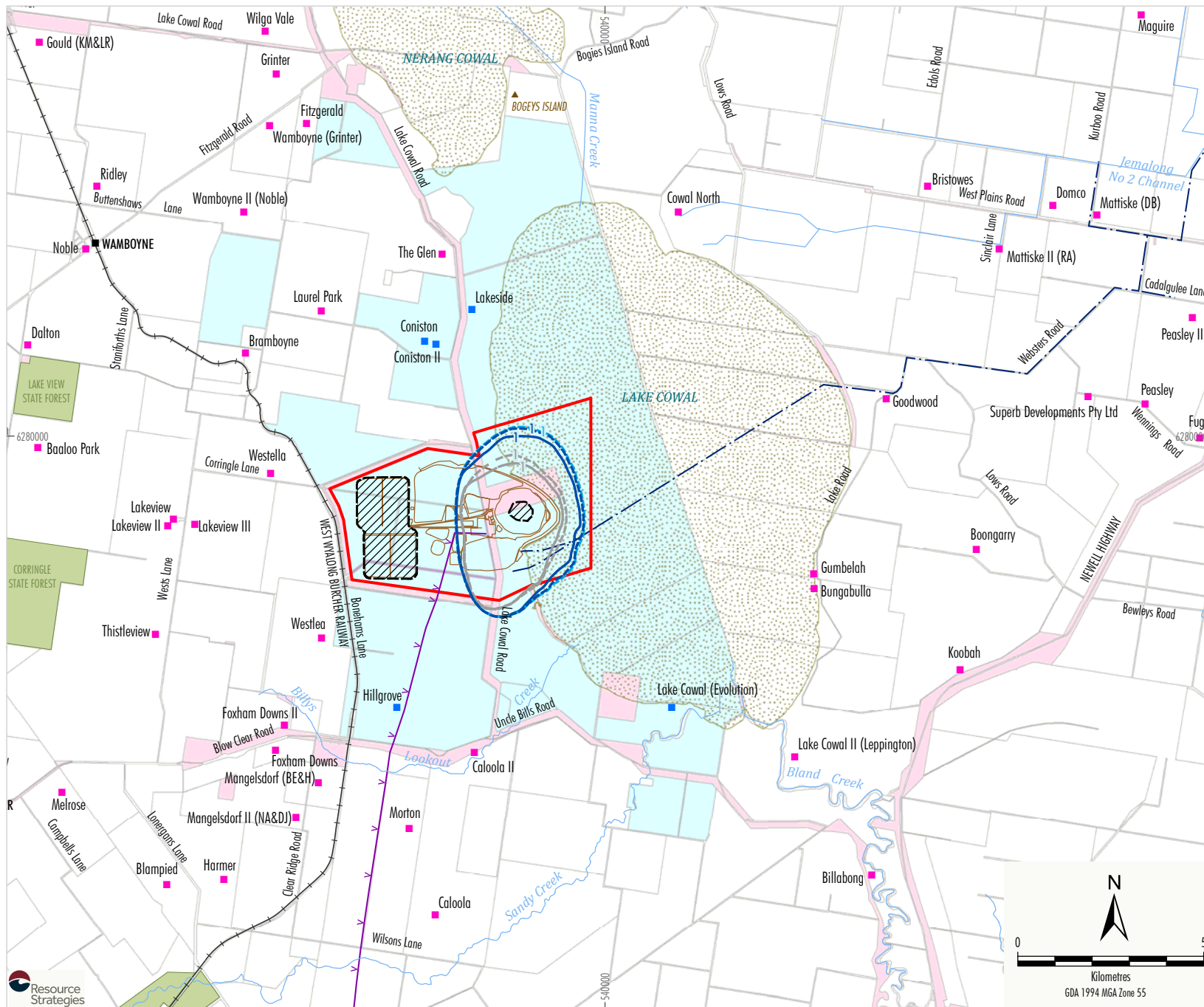
Therefore, solutes associated with potential seepage from the TSFs are expected to remain within groundwaters between the TSFs and the final void over the long term. The final void water level is expected to reach equilibrium well below spill level (Appendix B).

As described above, no change to the quality of seepage from TSFs is expected due to the Modification. Therefore, no additional impacts to groundwater quality associated with seepage from the TSFs are expected due to the Modification (Appendix A).

### **Seepage from Waste Rock Emplacements**

The existing northern and southern waste rock emplacements have been constructed with a low permeability layer such that any seepage from the waste rock emplacements is intercepted by this layer and preferentially flows towards the open pit (Section 2.4).

As described above, no change to the quality of seepage from the waste rock emplacements is expected due to the Modification. Therefore, no additional impacts to groundwater quality associated with seepage from the waste rock emplacements are expected due to the Modification.

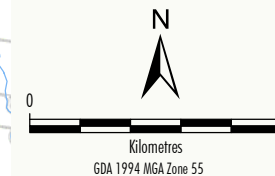


- LEGEND**
- Mining Lease Boundary (ML 1535)
  - Railway
  - Pipeline
  - Electricity Transmission Line
  - State Forest
  - Company-owned
  - Crown Land
  - Local Government
  - Privately Owned
  - Company-owned Dwelling
  - Privately-owned Dwelling
- Alluvial Groundwater**
- Approved CGO Predicted Maximum Drawdown (m)
  - Modification Predicted Maximum Drawdown (Transported Unit) (m)
- Fractured Rock Groundwater**
- Approved CGO Predicted Maximum Drawdown (m)
  - Modification Predicted Maximum Drawdown (Saprolite Unit) (m)
  - Modification Predicted Maximum Drawdown (Saprock Unit) (m)

Source: Evolution (2016); Land and Property Information (2016); Coffey (2016); Barrick (2013)



**CGO MINE LIFE MODIFICATION**  
**Predicted Maximum Watertable**  
**Drawdown Contours at the**  
**End of Mine Life**



**Figure 4-3**

### **Groundwater Levels around the Tailings Storage Facilities**

If current groundwater level trends were extrapolated linearly, the water level at MON02B (i.e. located adjacent to the southern tailings storage facility) (Figure 4-1) is predicted to reach the ground surface in approximately the Year 21 (2025) (Appendix A).

Evolution is currently evaluating management measures including potentially pumping groundwater from bores in the vicinity of MON02B back to the southern tailings storage facility to maintain groundwater levels below ground surface in the vicinity of the TSFs.

Evolution would continue to monitor groundwater levels surrounding the TSFs. If required, contingency measures to control groundwater levels would include (Appendix A):

- the installation of additional bores to pump groundwater back to the TSF (i.e. pump back system); or
- the installation of trench drains and sumps to collect groundwater and control further rise in groundwater levels.

Following mine closure, the elevated groundwater levels surrounding the TSFs are expected to dissipate over time as the head of water within the TSFs gradually reduces (i.e. due to evaporation and groundwater movement towards the final void) (Appendix A).

### **Continued Use of the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield**

The Modification would involve the continued use of the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield in accordance with existing daily and annual extraction limits.

In addition, there would be no change to the existing Groundwater Contingency Strategy (i.e. trigger levels and contingency measures for the management of groundwater use in the Bland Creek Palaeochannel) (Section 4.1.1).

Coffey (2016) has considered potential cumulative drawdown effects associated with the continued use of the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield for the Modification and the continued extraction of groundwater by other users (e.g. irrigators).

It is estimated that a yield of approximately 5.1 ML/day from the Bland Creek Palaeochannel could be sustained for the life of the Modification such that groundwater levels do not fall below relevant trigger levels at Bores GW036553, GW036597 and GW036611 (Appendix A).

This includes a yield of approximately 1.5 ML/day from the Eastern Saline Borefield, and the continued extraction of groundwater by other users based on historic rates (Appendix A).

Historically, water supply operations have been undertaken in accordance with the Groundwater Contingency Strategy such that pumping from the Bland Creek Palaeochannel Borefield has ceased and alternative supply (e.g. Lachlan River surface water entitlements) has been used. Modelling in Appendix A shows that water levels have been maintained above the relevant contingency levels and that water levels can continue to be maintained for the remainder of the mine life.

### **Groundwater Quality**

#### *Mine Site (ML 1535)*

No additional impacts to groundwater quality in the aquifers surrounding the CGO are predicted due to groundwater inflow to the open pit or seepage from the TSFs for the Modification (Appendix A).

#### *Bland Creek Palaeochannel*

The continued use of the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield during the life of the Modification is not predicted to result in additional impacts to groundwater quality in the Bland Creek Palaeochannel (Appendix A).

### **Groundwater Users**

#### *Mine Site (ML 1535)*

There are no other known users of the saline aquifers surrounding ML 1535 (i.e. other than Evolution). Given this, and that potential groundwater impacts are predicted to be generally contained within ML 1535, no impacts to other groundwater users are predicted.



*Bland Creek Palaeochannel*

As described in Section 4.1.1, Evolution would continue to operate in accordance with the Groundwater Contingency Strategy and, therefore, no additional impacts to other groundwater users are predicted due to the continued use of the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield during the life of the Modification (Appendix A).

**Baseflow Losses**

The existing surface water resources and their characteristics are described in Section 4.2.1.

No streams gaining baseflow from the surrounding groundwater system have been identified and therefore, no additional impacts associated with baseflow losses (i.e. stream leakage) are predicted due to the Modification.

**Cumulative Impacts**

The predictive groundwater modelling considered relevant cumulative impacts associated with the extraction of groundwater by other users (e.g. for irrigation) (Appendix A).

Evolution would continue to operate the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield in accordance with the existing Groundwater Contingency Strategy to minimise impacts to other groundwater users.

Contours showing cumulative drawdown associated with the coincident extraction of water from the Lachlan Formation and Cowra Formation by Evolution and other groundwater users are provided in Appendix A.

**Groundwater Dependent Ecosystems**

No groundwater dependent ecosystems relevant to the CGO (including the Bland Creek Palaeochannel Borefield and Eastern Saline Borefield) have been identified, and therefore, no impacts to groundwater dependent ecosystems are predicted due to the Modification (Appendix A).

**4.1.3 Mitigation Measures, Management and Monitoring****Groundwater Licensing**

A description of groundwater licensing requirements for the CGO and consideration of the requirements of the NSW Aquifer Interference Policy are provided in Attachment 2.

A summary of water licensing requirements under the relevant Water Sharing Plans is provided in Table 4-1.

Comparison of Evolution's licence entitlements against predicted annual licensing requirements (Table 4-1) indicates adequate licences are available to account for the potential take of water associated with the Modification within the alluvial and fractured rock aquifers.

**Table 4-1  
Groundwater Licensing Requirement Summary**

Water Sharing Plan/Relevant Legislation	Management Zone/ Groundwater Source	Relevant Licence	Existing Licensed Volume <sup>1,2</sup> (ML/annum)	Predicted Maximum Annual Licensing Requirements <sup>1,3</sup> (ML/annum)
<i>Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012</i>	Upper Lachlan Alluvial Zone 7 Management Zone	Pit dewatering (including pit inflows) and saline bores in ML 1535 (WAL 36615)	366	280
		Bland Creek Palaeochannel Borefield (WAL 31864)	3,650	3,650
		Eastern Saline Borefield (WAL 36569)	750 <sup>4</sup> (per bore)	548
<i>Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011</i>	Lachlan Fold Belt Murray Darling Basin Groundwater Source	Pit dewatering (WAL 36617)	3,294	228

<sup>1</sup> Assuming 1 ML per unit share.

<sup>2</sup> Source: Cowal Gold Operations Water Management Plan.

<sup>3</sup> Source: Appendices A and B.

<sup>4</sup> Eastern Saline Borefield licenses have zero ML licence allocation with an allowable temporary transfer of up to 750 ML/annum per bore.



Post-closure annual licensing requirements for the Modification are predicted to be much less than the licensing requirements during operations (Appendix A), and as such, it is expected that Evolution would have adequate licences to account for the potential post-closure take of water from the alluvial and fractured rock aquifers.

#### **Groundwater Monitoring and Management**

Existing groundwater monitoring and management measures, as detailed in the WMP, and the SWGMBMP would continue for the Modification.

The WMP would be updated, as required, to incorporate the recommendations made by Coffey (2016), including:

- Continued groundwater monitoring to validate the predictive modelling, particularly in the vicinity of the open pit, TSF and ML 1535 saline groundwater supply borefield (when in use).
- Continued monitoring of groundwater salinity in the Bland Creek Palaeochannel Borefield to assess potential saline migration.
- A final pit void water balance post-mine closure be conducted to assess long-term water levels in the pit void and the potential impact on groundwater quality in the immediate vicinity of the pit void.

#### **Groundwater Users**

The existing Groundwater Contingency Strategy (Section 4.1.1), as described in the WMP, would continue to be implemented to manage groundwater levels within the Bland Creek Palaeochannel.

## **4.2 SURFACE WATER**

A Hydrological Assessment for the Modification was conducted by HEC (2016) and is presented in Appendix B.

The existing CGO site water management infrastructure and proposed changes for the Modification are described in Sections 2.7 and 3.7, respectively.

### **4.2.1 Existing Environment**

#### **Baseline Surface Water Data**

HEC (2016) considered the following data for the Hydrological Assessment prepared for the Modification:

- long-term regional rainfall and evaporation records from the BoM weather stations;
- rainfall and evaporation records since 2002 from the CGO meteorological station (Figure 2-3);
- gauging station flow data on the Lachlan River and Bland Creek;
- data collected by Evolution from surface water quality monitoring sites within ML 1535 (including the UCDS, contained water storages and open pit) and Lake Cowal and surrounds (Figures 2-3 and 4-1);
- water usage and water quality data from the existing CGO water management system;
- waste rock emplacement rehabilitation monitoring programmes; and
- other regional topographic mapping data.

The Hydrological Assessment has also considered the requirements of the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* (which applies to all unregulated water sources in the Lachlan catchment) and the *Water Sharing Plan for the Lachlan Regulated River Water Source 2016*.

#### **Hydrological Setting**

The CGO is located on the western side of Lake Cowal, an ephemeral freshwater lake predominantly filled by runoff from Bland Creek to the south, and flood breakout from the Lachlan River to the north (Figure 1-2).

The Lachlan River is the major regional surface water system, forming part of the Murray Darling Basin. Flows in the Lachlan River are regulated by releases from Wyangala Dam (Appendix B).

Breakout from the Lachlan River to Lake Cowal occurred in late 2010 and in the first half of 2012 and again in 2016. No breakouts occurred between the period 1998 and 2010 (Appendix B).

Lake Cowal occupies an area of 105 square kilometres (km<sup>2</sup>), holds approximately 150 giganlitres (GL) of water (Appendix B) and has a maximum depth of approximately 4 m when full. When flows are sufficient, Lake Cowal overflows into Nerang Cowal to the northwest, and ultimately drains to the Lachlan River via Bogandillon Creek (Appendix B).

Bland Creek drains a catchment of approximately 9,500 km<sup>2</sup> which ultimately reports to Lake Cowal at its southern end (Appendix B).

Bland Creek and all other tributaries of Lake Cowal (including the drainage lines surrounding the CGO) are ephemeral. Flow records for Bland Creek indicate that runoff in the Bland Creek catchment is low, averaging approximately 5% of rainfall (Appendix B).

### **Site Water Management**

The existing CGO water management infrastructure is designed to separate Lake Cowal from the CGO, contain potentially contaminated water (contained water) generated within the mining area, and to divert all other water around the perimeter of the site (Section 2.7).

The major components of CGO water management infrastructure are (Section 2.7):

- lake isolation system (comprising the perimeter waste rock emplacement, permanent lake protection bund and temporary isolation bund);
- UCDS;
- ICDS;
- integrated erosion, sediment and salinity control system; and
- open pit sump and dewatering borefield.

The effectiveness of the lake isolation system was demonstrated under peak water levels in Lake Cowal during the lake-fill events in recent years (Plate 2-1). During the lake-fill periods, no material increase in groundwater inflow to the open pit is estimated to have occurred, based on pit dewatering monitoring data. This indicates that the lake protection bund and lacustrine clay on the lake's bed are preventing significant loss of water from the lake to the open pit (Section 4.1.2 and Appendix A).

### **Lake Cowal Surface Water Quality**

Baseline water quality in Lake Cowal was typically slightly to moderately alkaline (pH 8.27 to 8.67) with low to moderate suspended solids concentrations (total suspended solids concentrations of 24 to 222 mg/L) (North Limited, 1998).

EC was also low, varying between 222 and 1,557 µS/cm (North Limited, 1998) and appeared to be inversely related to lake volume (i.e. solute concentrations increased as lake volumes decreased).

Baseline cadmium, arsenic, lead, mercury and zinc levels were low, and mostly below relevant detection limits, however, copper concentrations were found to be higher than the Australian and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ) (2000) limit for the protection of aquatic ecosystems (Appendix B).

Lake Cowal water quality monitoring and analysis is undertaken for the CGO in accordance with the requirements of Development Consent (DA 14/98), EPL 11912, WMP and SWGMBMP and has included review of available surface water quality monitoring data for the lake-fill events compared to the (pre-mining) baseline data.

Review of water quality monitoring results to date indicates the following:

- the range of pH was high relative to ANZECC/ARMCANZ (2000) default triggers and baseline ranges, however has been similarly elevated at sites near and distant to the CGO;
- average copper, lead and zinc concentrations were high relative to both ANZECC/ARMCANZ (2000) default triggers and baseline ranges, however has been similarly elevated at sites on the opposite (eastern) side of Lake Cowal;
- average turbidity was significantly higher than the ANZECC/ARMCANZ (2000) default trigger value and higher than baseline levels, however turbidity levels have occurred uniformly at sites close to and distant from the CGO; and
- total phosphorous concentrations were significantly higher than the ANZECC/ARMCANZ (2000) default trigger value for fresh water lakes however concentrations have been similar at sites both close to the CGO and on the other side of Lake Cowal (it is also noted, measured total phosphorus is less than the baseline average).

CGO water management infrastructure fully contains surface water runoff from the CGO up to design storage capacity. Exceedance of storage capacity of contained storages D1 and D4 has the potential to influence lake water quality. This has not occurred to date. Additionally, the deposition of mine generated dust onto the lake and runoff from the outside batters and inundated parts of the lake isolation bund (Appendix B) also have the potential to influence lake water quality.

The data supports that there is no evidence that the existing CGO has resulted in changes to water quality in Lake Cowal (Appendix B).

#### ***Licensed Surface Water Extraction from the Lachlan River***

Water from the Lachlan River is used, when required, to meet external water demands for the CGO in accordance with High Security (WAL 14981 and WAL 13749) and General Security (WAL 13748) WALs held by Evolution (Section 2.8.4).

Throughout the operating history of the CGO, the Lachlan River regulated source has proven to be a reliable supply of temporary water (Appendix B).

#### ***Post-Closure Water Management***

A description of the post-closure water management strategy for the approved CGO is provided in Appendix B. Key aspects of the post-closure water management strategy for the approved CGO include:

- the lake isolation system and UCDS would be maintained post-closure;
- the open pit would be left as a final void; and
- runoff from rehabilitated mining landforms would be directed to the final void via a network of low energy drainage swales.

As the final void for the approved CGO was predicted to act as a permanent groundwater sink, and would have no outflow apart from evaporation (i.e. would not spill under any climatic scenario), water quality in the final void was predicted to trend to hyper-salinity (Appendix B).

### **4.2.2 Potential Impacts**

#### ***Revised Site Water Balance***

A revised site water balance for the Modification has been prepared by HEC (2016) for the Modification (Appendix B).

No spills from contained water storages were predicted for the revised site water balance (Appendix B), including for contained water storages D1 and D4 (Figure 3-1), which would continue to be emptied via pumping in between rainfall events (Appendix B).

#### ***Surface Water Quality***

Overall there has been no apparent causal link between the existing operations at the CGO and water quality changes in Lake Cowal (Appendix B).

The Modification would not change the existing lake isolation system, or design objectives of the ICDS and UCDS.

Given the above, HEC (2016) conclude that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification (Appendix B).

#### ***Catchment and Hydrology***

As there is no change to the UCDS and ICDS, there is no change to the catchment excised by the Modification that would otherwise report to Lake Cowal.

#### ***Geochemical Considerations***

Waste rock and ore produced from the deepening of the open pit for the Modification are expected to be relatively geochemically similar to those produced for the existing CGO operations. As such, GEM (2016) considers that no changes to the site water quality monitoring programs for the open pit, waste rock emplacements, low grade ore stockpile, ROM ore stockpile, and TSFs are expected to be necessary (Appendix C). However, it is recommended that these programs be reviewed on an annual basis, and modified as necessary, in order to maintain and rationalise these programs.

Consideration of geochemistry with respect to groundwater seepage is described in Section 4.1.2.

### **Licensed Surface Water Extraction from the Lachlan River**

Water from the Lachlan River would continue to be accessed at the CGO for the Modification by purchasing temporary water available from the regulated Lachlan River trading market in accordance with High Security (WAL 14981 and WAL 13749) and General Security (WAL 13748) WALs held by Evolution (Section 3.8.4).

Site water supply would continue to be preferentially supplied from internal water sources followed by external groundwater sources, including the Lachlan River (Section 3.8.3). Notwithstanding, since the commencement of operations at the CGO there has been a reliable supply of temporary water available from the Lachlan River trading market, including during periods of drought. DPI-Water trading records show that between approximately 4,000 ML and 274,000 ML of temporary water has been traded annually since records began in the 2004 to 2005 season (Appendix B).

By comparison, the predicted average water requirement from the Lachlan River under a 10<sup>th</sup> percentile (dry) rainfall sequence is 1,445 ML over the life of the Modification (Table 3-2) (Appendix B).

Modelling indicates that reliance on external sources is likely to slightly increase as a result of the Modification (Appendix B).

### **Other Surface Water Users**

As described above, no additional impacts to the water quality or hydrology of Lake Cowal are predicted due to the Modification, and surface water extraction from the Lachlan River would continue to be undertaken in accordance with the conditions of WALs.

On this basis, no additional impacts to other surface water users are predicted due to the Modification.

### **Post-closure Water Management**

The Modification would not change the objectives of the existing post-closure water management strategy (Appendix B). The conceptual post-closure water management system is shown on Figure 3-4.

HEC (2016) has considered the effect of the Modification (e.g. deepening of the CGO open pit) on the final void water balance.

It is predicted that, compared with predictions for the currently approved CGO, it would take longer for the final void water level to reach equilibrium (Appendix B).

At a final void level of RL 130 m, the surface area of the final void proposed as part of the Modification is approximately 3% greater. For an equivalent final void water level, it is therefore expected that evaporation rates would be slightly higher and therefore the final void water level would be slightly lower than that predicted as part of the CGM Extension Modification (Appendix B).

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. Due to the slightly higher evaporation rates, it is expected that this trend to hyper-salinity would be faster for the Modification (Appendix B). However, water quality in the final void at any given point in time will vary with depth as a result of mixing and stratification processes that will occur as a result of temperature and salinity differentials (Appendix B).

Further description regarding post-closure landform concepts, is discussed in Section 5.

## **4.2.3 Mitigation Measures, Management and Monitoring**

### **Relevant Management and Monitoring Plans**

The WMP and SWGMBMP and ESCMP would be reviewed, and revised as necessary, to reflect the Modification.

The WMP would continue to describe the operational water management system and provisions for review of the site water balance, erosion and sediment control measures, surface water and groundwater monitoring and management.

### **Surface Water Licensing**

Within the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012*, the CGO is located within the Western Bland Creek Water Source.

As there is no change to the UCDS and ICDS, there is no change to the catchment excised by the Modification that would otherwise report to Lake Cowal, and therefore no access licences would be required for the Modification.

The *Water Sharing Plan for the Lachlan Regulated River Water Source 2003* covers licensed surface water accessed for the CGO from the Lachlan River. No additional surface water access licences beyond those already held by Evolution (i.e. WAL 14981, WAL 13749 and WAL 13748) from the Lachlan River would be required for the Modification.

Further detail regarding surface water access licenses held by Evolution is provided in Attachment 2.

#### *Harvestable Right*

None of the storages on-site are used to harvest runoff from land and all storages are used to contain runoff, mine water or effluent, or are used to control soil erosion (Appendix B). It is concluded, that these storages are not relevant to any harvestable rights calculation.

### **4.3 NOISE**

A Noise and Blasting Assessment for the Modification was undertaken by Renzo Tonin & Associates (2016) (Appendix D).

Aspects relating to operational noise are described in the subsections below. Potential blasting impacts of the Modification are described in Section 4.5.2.

#### **4.3.1 Existing Environment**

##### ***Previous Assessment***

A noise and blasting assessment of the currently approved CGO was undertaken by SLR Consulting (2013) for the CGM Extension Modification.

Noise modelling conducted for the CGM Extension Modification indicated that eight privately-owned receivers would experience noise levels above the Project-specific noise level (PSNL) of 35 A-weighted decibels (dBA) equivalent continuous noise level ( $L_{Aeq}(15 \text{ minute})$ ), including seven receivers in the noise management zone (i.e. 1 to 5 decibels [dB] above the PSNL) and one receiver in the noise affectation zone (>5 dB above the PSNL). Two receivers predicted to be in the management zone were, however, retained in the Noise Affectation Zone and afforded acquisition upon request in Condition 6.4(a), Schedule 2 of the modified Development Consent (DA 14/98).

The receiver predicted to be in the Noise Affectation Zone (Coniston) has since been acquired by Evolution and is now a mine-owned residence. The existing Development Consent criteria are provided in Table 4-2, along with the predicted intrusive noise levels at privately-owned receivers for the Modification.

The exceedances of the PSNL were approved for the CGO, subject to the management, mitigation and monitoring of potential noise impacts in accordance with the requirements of the CGO Development Consent (DA 14/98). This includes:

- Development Consent noise limits for privately-owned receivers (Condition 6.4[c] of Schedule 2 of the CGO Development Consent [DA 14/98]);
- the right to request property acquisition for some receivers, in accordance with the requirements of Condition 6.4(a) of Schedule 2 of the CGO Development Consent (DA 14/98); and
- the right to request additional mitigation measures for some receivers, in accordance with the requirements of Condition 6.4(b) of Schedule 2 of the CGO Development Consent (DA 14/98).

#### ***Noise Management and Monitoring***

Existing noise management and monitoring measures are described in the NMP.

The existing monitoring programme includes operator-attended monitoring at locations representative of six privately-owned dwelling locations and two reference locations (i.e. at the New Lake Foreshore within ML 1535 and on Evolution-owned land, south of ML 1535) (Figure 2-3). The existing monitoring programme also includes an on-site Automatic Weather Station and sample temperature gradient measurements coinciding with winter season noise surveys.

Based on the results of operator-attended monitoring, intrusive noise levels from the CGO were determined to be in accordance with Development Consent (DA 14/98) noise limits for the period January 2013 to July 2016 (Appendix D).



**Table 4-2  
Predicted Intrusive Noise Levels for the Currently Approved CGO and for the Modification**

Receiver	Receiver ID	Approved CGO	The Modification <sup>1</sup>
		(dBA L <sub>Aeq(15 minute)</sub> )	
Bramboyne	20	36 <sup>7</sup>	38
Bungabulla	61a	36 <sup>7</sup>	34
Caloola II	90b	35	38
Coniston	1a	<sup>5</sup>	<sup>6</sup>
Foxham Downs II	49b	35	37
Gumbelah <sup>3</sup>	38	36 <sup>7</sup>	35
Lakeview	22a	35	37
Lakeview II	22b	35	37
Lakeview III <sup>2</sup>	22c	35	39
Laurel Park <sup>3</sup>	15	37 <sup>7</sup>	39
The Glen	36a	36 <sup>7</sup>	38
Westella <sup>4</sup>	21	<sup>5</sup>	44
Westlea	42	<sup>5</sup>	43
All other receivers	-	35	35 or less

Source: After Appendix D.

Notes: Refer to Figures 4-4a and 4-4b for receiver locations.

Receivers in the Noise Management Zone. Receiver in the Noise Affection Zone.

<sup>1</sup> Maximum predicted noise level – all scenarios.

<sup>2</sup> Formerly known as Westella.

<sup>3</sup> Evolution has a noise agreement in place with the owner of this property.

<sup>4</sup> Formerly known as McLintock.

<sup>5</sup> Predicted to be within the Noise Management Zone in the CGM Extension Modification, however was retained in the Noise Affection Zone and afforded acquisition upon request in Condition 6.4(a), Schedule 2 of the modified Development Consent (DA 14/98).

<sup>6</sup> This property has recently been acquired by Evolution.

<sup>7</sup> Development Consent Noise Impact Assessment Criteria.

### Complaints

A total of three noise-related complaints have been received from the date of submission of the CGM Extension Modification in September 2013 to September 2016. Investigations undertaken in response to the noise-related complaints indicated that the CGO was operating in accordance with the relevant Development Consent (DA 14/98) noise limits (Appendix D).

#### 4.3.2 Potential Impacts

Renzo Tonin & Associates (2016) has conducted predictive noise modelling to determine potential noise impacts associated with the Modification (Appendix D).

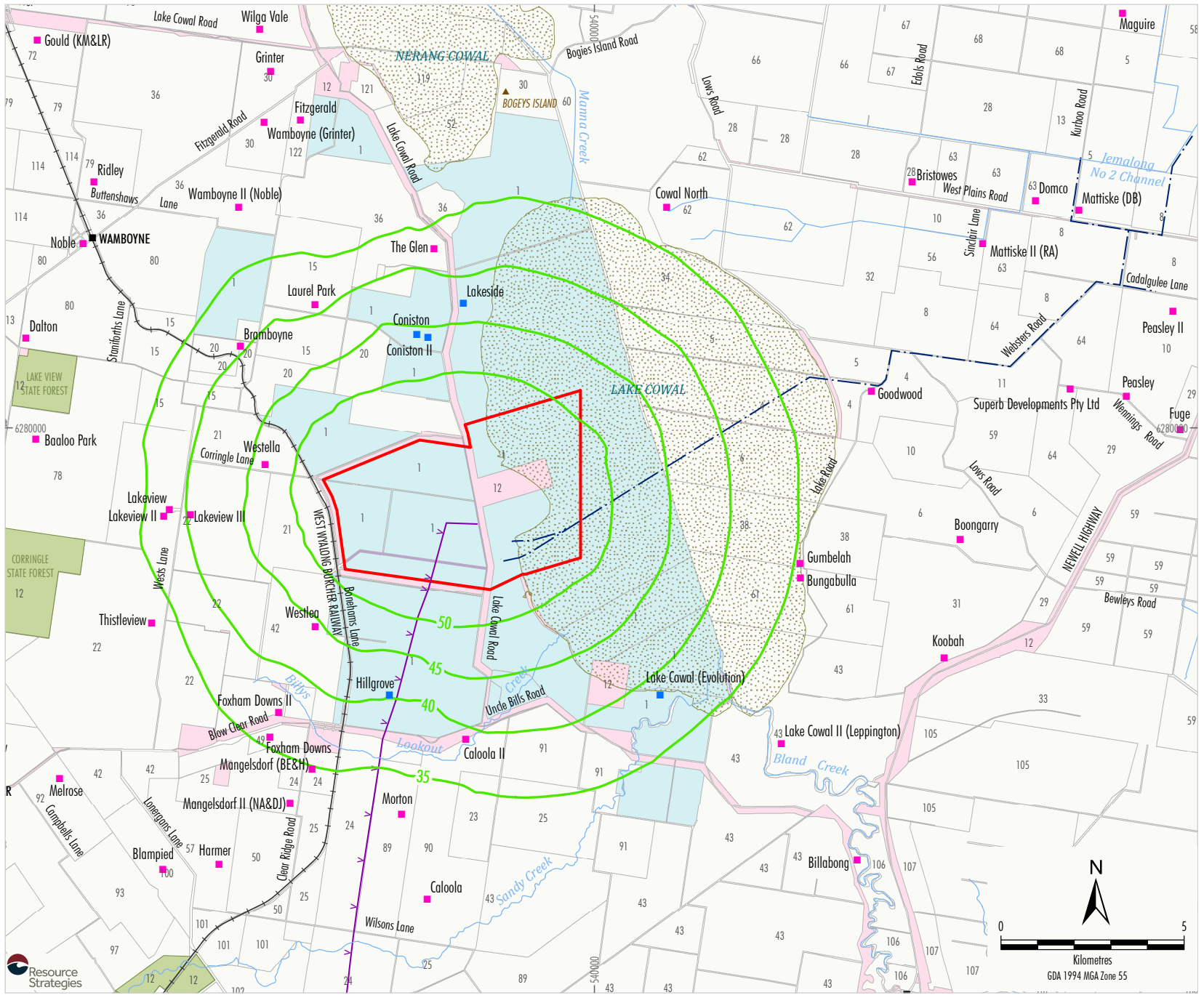
The noise modelling methodology is based on previous predictive noise modelling conducted for the CGO (e.g. for the CGM Extension Modification), with revisions as required to account for the Modification (Appendix D).

### Operational Noise Criteria

The NSW *Industrial Noise Policy* (INP) (EPA, 2000) prescribes detailed calculation routines for establishing project-specific L<sub>Aeq(15 minute)</sub> intrusive criteria and L<sub>Aeq(period)</sub> amenity criteria. The INP project-specific intrusive and amenity assessment criteria for the Modification (i.e. PSNLs) are presented in Table 4-3. Intrusive criteria are applied on a project-only basis whilst amenity criteria are applied cumulatively with other industrial sources.

In those cases where the INP project-specific assessment criteria are exceeded, it does not automatically follow that all people exposed to the noise would find the noise noticeable or unacceptable.

The NSW Government (2014) *Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum and Extractive Industry Developments* (Voluntary Land Acquisition and Mitigation Policy) provides some useful context in regard to characterising the practical implications of exceedances of the INP criteria (Table 4-4).

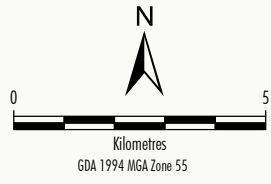


- LEGEND**
- Mining Lease Boundary (ML 1535)
  - Railway
  - Pipeline
  - Electricity Transmission Line
  - State Forest
  - Company-owned Dwelling
  - Privately-owned Dwelling
  - Predicted ( $L_{Aeq}(15\text{minute})$ ) Noise Contours Night-time Inversion (dBA)

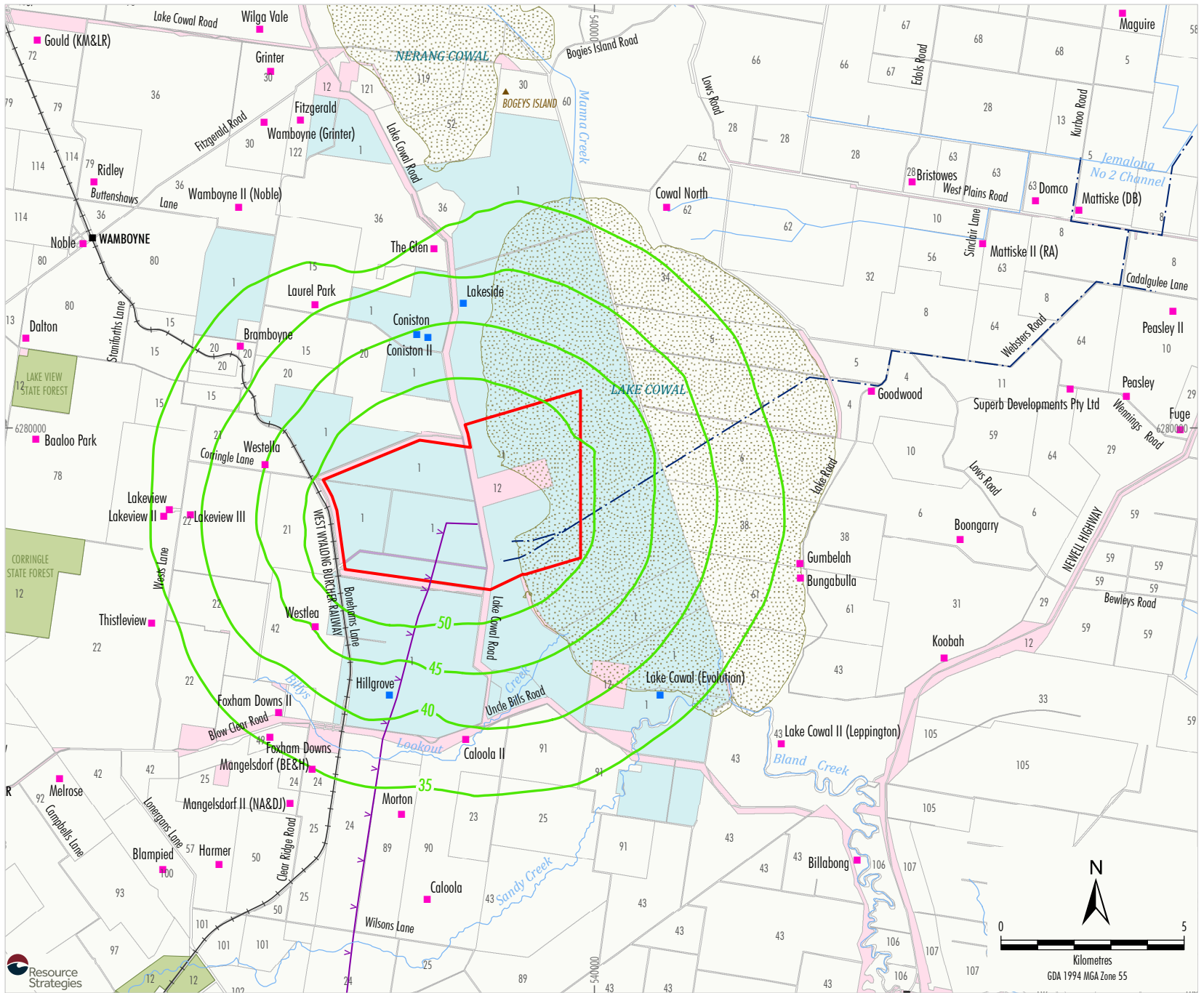
Refer to Figure 1-3b for Landholder Key  
 Source: Evolution (2016); Land and Property Information (2016); Renzo Tonin (2016)



**CGO MINE LIFE MODIFICATION**  
**Predicted Noise Contours**  
**Night-time Inversion (2018)**



**Figure 4-4a**

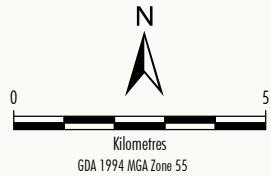


- LEGEND**
- Mining Lease Boundary (ML 1535)
  - Railway
  - Pipeline
  - Electricity Transmission Line
  - State Forest
  - Company-owned Dwelling
  - Privately-owned Dwelling
  - Predicted ( $L_{Aeq}(15\text{minute})$ ) Noise Contours
  - Night-time Inversion (dBA)

Refer to Figure 1-3b for Landholder Key  
 Source: Evolution (2016); Land and Property Information (2016); Renzo Tonin (2016)



**CGO MINE LIFE MODIFICATION**  
**Predicted Noise Contours**  
**Night-time Inversion (2022)**



**Figure 4-4b**

**Table 4-3**  
**INP Project-specific Intrusive and Amenity Assessment Criteria (dBA)**

Receiver	Intrusiveness Criteria $L_{Aeq(15\text{ minute})}$			Amenity Criteria $L_{Aeq(\text{period})}$		
	Day	Evening	Night	Day	Evening	Night
All residential receivers	35	35	35	50	45	40
Relocated Crown Reserve	-	-	-	50 when in use		

Source: After Appendix D.

<sup>1</sup> Daytime 7.00 am to 6.00 pm, Evening 6.00 pm to 10.00 pm, Night-time 10.00 pm to 7.00 am.

**Table 4-4**  
**Characterisation of the Significance of Noise Impacts and Potential Treatments**

Residual Noise Exceeds INP Criteria By	Characterisation of Significance of Residual Impacts	Potential Treatments
0 to 2 dBA above the PSNL	Impacts are considered to be <b>negligible</b>	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls.
3 to 5 dBA above the PSNL in the INP <u>but</u> the development would contribute less than 1 dB to the total industrial noise level	Impacts are considered to be <b>marginal</b>	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
3 to 5 dBA above the PSNL in the INP <u>and</u> the development would contribute more than 1 dB to the total industrial noise level	Impacts are considered to be <b>moderate</b>	As for marginal impacts but also upgraded facade elements like windows, doors, roof insulation etc. to further increase the ability of the building facade to reduce noise levels.
>5 dBA above the PSNL in the INP	Impacts are considered to be <b>significant</b>	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions.

Source: After NSW Government (2014).

For the purposes of assessing potential noise impacts consistent with the Voluntary Land Acquisition and Mitigation Policy, exceedances can be separated into a Noise Management Zone (i.e. negligible, marginal or moderate impacts of 1 to 5 dBA above the criteria) and a Noise Affection Zone (i.e. greater than 5 dBA above the criteria, with impacts considered to be significant) (Table 4-4).

Table 4-4 presents the methodology used for assessing operational noise against the INP project-specific noise assessment criteria.

### **Noise Modelling Methodology**

#### *Assessable Meteorological Conditions*

Assessable meteorological conditions for the Modification have been determined in accordance with the requirements of the INP based on available meteorological data (including temperature gradient measurements) from 2010 to 2013, to be consistent with the meteorology used for the CGM Extension Modification assessment (Appendix D).

Prevailing winds were not determined to be a feature of any season during the daytime, evening or night, and therefore, wind effects are not considered to be relevant assessable meteorological conditions (Appendix D).

Strong temperature inversions up to 8°C/100 m were determined to be assessable meteorological conditions (Appendix D).

The assessable meteorological conditions for the Modification (i.e. strong temperature inversions) are consistent with those for previous noise assessments for the CGO (Appendix D).

#### *Modelling Scenarios*

The proposed changes to the CGO would not bring mining operations closer to any privately-owned receivers (Figure 3-1).

Renzo Tonin & Associates (2016) modelled two key scenarios representing mining operations in Year 14 (2018) and Year 18 (2022) to assess potential noise impacts associated with the Modification.



Year 14 was selected as it is the year with the highest combined material movement (i.e. ore and waste rock), with the maximum mobile fleet in operation.

Year 18 was selected as it is when waste emplacement on the northern waste rock emplacement would take place at near to the maximum height of the emplacement (i.e. 308 m RL).

For both Years 14 and 18, all mining operations were modelled as occurring 24 hours per day, with the exception of tailings lift construction and TSF buttressing works, which would occur during daytime only (7.00 am to 6.00 pm).

### **Potential Impacts (Intrusive)**

Maximum predicted intrusive noise levels under assessable meteorological conditions for the Modification are presented in Table 4-2. Noise contours for the Modification are presented in Figures 4-4a and 4-4b for Years 14 and 18, respectively.

Noise levels for the Modification are predicted to comply with relevant Development Consent noise limits and PSNLs at all privately-owned receivers, with the exception of eight (8) receivers on six (6) properties (i.e. excluding the two receivers currently in the Noise Affection Zone) (Table 4-2) (Appendix D).

Three privately-owned receivers (Coniston, Westella [Formerly McLintock] and Westlea) are in the Noise Affection Zone for the approved CGO (Table 4-5). The Coniston property has recently been acquired by Evolution.

Based on predicted noise levels for the Modification, Westella and Westlea would remain in the Noise Affection Zone (Table 4-5).

Five privately-owned receivers (Bramboyne, Bungabulla, Gumbelah, Laurel Park and The Glen) were identified as being in the Noise Management Zone for the approved CGO (Table 4-5).

For the Modification, Bungabulla and Gumbelah are no longer identified as being within the Noise Management Zone as predicted noise levels at these receivers are 35 dBA  $L_{Aeq(15\text{ minute})}$  or less (Table 4-5).

Based on predicted noise impacts for the Modification, Bramboyne, Laurel Park and The Glen would remain in the Noise Management Zone (Table 4-5). Caloola II, Foxham Downs II, Lakeview, Lakeview II and Lakeview III would also be in the Noise Management Zone.

In summary, based on maximum predicted intrusive noise levels under assessable meteorological conditions for the Modification, it is predicted that (Table 4-5):

- eight privately-owned receivers would be within the Noise Management Zone; and
- two privately-owned receivers would be within the Noise Affection Zone.

By comparison, for the approved CGO there are (Table 4-5):

- five privately-owned receivers within the Noise Management Zone; and
- three privately-owned receivers within the Noise Affection Zone.

### **Potential Impacts (Amenity)**

Renzo Tonin & Associates (2016) assessed the INP amenity criteria at privately-owned receivers and the Relocated Crown Reserve. No exceedances of the project-specific amenity criteria were predicted (Appendix D).

### **Potential Impacts (Sleep Disturbance)**

Appendix D also presents an assessment of potential sleep disturbance impacts. A sleep disturbance screening criterion ( $L_{A1(1\text{ minute})}$ ) of 15 dBA above the Rating Background Level has been adopted by the EPA. The sleep disturbance screening criterion for the Modification is therefore a  $L_{A1(1\text{ minute})}$  of 45 dBA. An upper limit criterion of 65 dBA has also been adopted for the assessment (Appendix D).

Five privately-owned receivers (Lakeview III, Laurel Park, The Glen, Westella and Westlea) were predicted to exceed the screening criterion, however in each case the upper limit criterion was not predicted to be exceeded (Appendix D). It is noted that these receivers are in the Noise Management Zone or Noise Affection Zone (Table 4-5).



### Land Assessment

The Voluntary Land Acquisition and Mitigation Policy states:

*The noise generated by the development would contribute to exceedances of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.*

Renzo Tonin & Associates (2016) determined the recommended maximum noise levels (night – 45 dBA  $L_{Aeq(Period)}$ ) would not be exceeded on more than 25% of any privately-owned land (contiguous lots owned by the same landowner) not in the Noise Affection Zone (Table 4-5) (Appendix D).

### Consideration of Reasonable and Feasible Mitigation Options

Noise modelling conducted by SLR Consulting (2013) for the CGM Extension Modification assessed the effectiveness of:

- noise bunds to shield mobile equipment operating on the waste rock emplacements during adverse weather; and
- locating mobile equipment on the eastern side of the waste rock emplacements (i.e. away from the closest receivers to the west of the CGO) during adverse weather conditions.

The noise modelling indicated that while these measures would reduce noise levels, the predicted reductions during adverse weather conditions were very limited (SLR Consulting, 2013).

SLR Consulting (2013) also assessed the effectiveness of scheduling the TSF lift works during the daytime only. As this was shown to appreciably reduce predicted evening and night-time noise levels at privately-owned receivers, undertaking TSF lift works during the daytime only was incorporated into the predictive modelling for the CGM Extension Modification. This measure has also been incorporated into the predictive modelling for the Modification.

The existing CGO mobile equipment fleet would continue to be operated for the Modification, with some additional equipment required to mine the deeper open pit for the Modification (Section 3.3). Evolution has investigated retrofitting the existing haul truck fleet with noise attenuation kits, however the expected capital cost for this is not considered to be reasonable. Ongoing operational costs associated with maintaining the effectiveness of the noise attenuation would be additional to this capital cost.

Given the additional haul trucks required for the Modification would use the same haul routes as the existing haul truck fleet (and the existing fleet would outnumber the new haul trucks), the noise levels experienced by privately-owned receivers would be dominated by the existing fleet. Therefore it is not considered by Evolution to be reasonable to purchase extra quiet (XQ) haul trucks for the Modification, as the additional cost would not result in materially lower predicted noise levels at the nearest privately-owned receivers.

A summary of the consideration of reasonable and feasible mitigation options against the Voluntary Land Acquisition and Mitigation Policy is provided in Table 4-6.

**Table 4-5  
Summary of Privately-owned Receivers in the Noise Management and Noise Affection Zones**

Zone	Approved CGO	The Modification
Noise Affection Zone (>5 dBA above PSNL)	Coniston <sup>1</sup> , Westella <sup>2</sup> , Westlea (3)	Westella <sup>2</sup> , Westlea (2)
Noise Management Zone (1 to 5 dB above PSNL)	Bramboyne, Bungabulla, Gumbelah <sup>3</sup> , Laurel Park <sup>3</sup> , The Glen (5)	Bramboyne, Caloola II, Foxham Downs II, Lakeview, Lakeview II, Lakeview III, Laurel Park <sup>3</sup> , The Glen (8)

Source: After Appendix D.

Notes: Refer to Figures 4-4a and 4-4b for receiver locations.

Values in parentheses represent the numbers of privately-owned receivers in each zone.

<sup>1</sup> This property has recently been acquired by Evolution.

<sup>2</sup> Formerly known as McLintock.

<sup>3</sup> Evolution has a noise agreement in place with the owner of this property.

**Table 4-6**  
**Consideration of Reasonable and Feasible Mitigation Options against the Voluntary Land Acquisition and Mitigation Policy**

Voluntary Land Acquisition and Mitigation Policy Approach to Decision Making	Response
<p>1. <i>The applicant must clearly demonstrate that all viable project alternatives have been considered, and all reasonable and feasible avoidance and mitigation measures have been incorporated into the project design to minimise environmental and social impacts and comply with the relevant assessment criteria. Adequate consultation must have occurred with potentially affected community members to identify and respond to potential social and environmental impacts during the preparation of the environmental impact statement.</i></p>	<ul style="list-style-type: none"> <li>• Exceedances are predicted to occur infrequently and under noise enhancing meteorological conditions: <ul style="list-style-type: none"> <li>- Daytime noise levels under calm meteorological conditions comply with the relevant PSNLs.</li> <li>- Occasional moderate inversions in daytime ‘shoulder’ periods would result in some exceedances of the PSNLs.</li> <li>- Night-time noise under strong inversion conditions is the worst-case noise scenario from a noise modelling perspective.</li> </ul> </li> <li>• The infrequency of predicted exceedances is supported by compliance monitoring undertaken for the existing CGO by Evolution and the limited number of complaints (Section 4.3.1).</li> <li>• Acoustic modelling undertaken for the Modification shows that the haul trucks operating on the main haul routes from the open pit up to the active waste rock emplacements/mineralised material stockpiles are the prominent night time noise sources (Appendix D).</li> <li>• The results of previous acoustic modelling have been considered: <ul style="list-style-type: none"> <li>- Operation of the TSF construction fleet during daytime only, was previously shown to appreciably reduce night-time noise levels and has been implemented for the Modification.</li> <li>- Acoustic bunding and/or relocating noise sources on the waste rock emplacements, was previously not found to effectively control noise and therefore was not implemented for the Modification.</li> </ul> </li> <li>• Because of the proposed open pit depth extension, the Modification involves an additional five CAT 789 haul trucks. This results in a minor overall increase in the night-time site sound power levels of less than 1 dB (Appendix D). Mitigation of the site haul truck fleet sound power levels has been considered, as described below: <ul style="list-style-type: none"> <li>- Replacement of the existing fleet of 12 x CAT 789 trucks is not required for the remaining life of mine (i.e. from an operational perspective), and the replacement cost of these trucks to XQ models is considered prohibitive by Evolution.</li> <li>- Retrofitting the existing fleet with noise attenuation kits has also been considered by Evolution, however the capital cost and ongoing operational costs associated with maintaining the acoustic efficiency is considered to be cost prohibitive.</li> <li>- Commissioning of the new fleet (five CAT 789 haul trucks) as XQ models would have limited acoustic benefit as the existing fleet (12 x CAT 789 haul trucks) would continue to operate on the same haul roads at significantly higher sound power levels, and therefore, continue to be the prominent noise contributors (Appendix D). In addition, the additional cost of purchasing XQ trucks (as opposed to standard trucks) for no material noise performance benefit is considered unreasonable by Evolution.</li> </ul> </li> </ul>
<p>2. <i>If the applicant cannot comply with the relevant assessment criteria, or the acquisition or mitigation criteria are likely to be exceeded, then the applicant should consider a negotiated agreement with the affected landowner or acquisition of the affected land. If the applicant acquires the land, or enters into a negotiated agreement with the landowner, then that land is not subject to the assessment, mitigation or acquisition criteria set out in this policy, with the exception of the provisions contained under the heading “Use of acquired land”.</i></p>	<ul style="list-style-type: none"> <li>• Development Consent DA 14/98 provides receivers Westella (21) and Westlea (42) the right to request Evolution to acquire their landholding and the status of these receivers would not change due to the Modification.</li> <li>• No other significant exceedances (&gt;5 dB above the PSNLs) are predicted for the Modification.</li> <li>• Moderate exceedances (3 to 5 dB above the PSNLs) are predicted for the Modification at Bramboyne (20), Caloola II (90b), Lakeview III (22c), Laurel Park (15) and The Glen (36a).</li> <li>• Evolution has a negotiated agreement with the owner of Laurel Park (15) (note: one of the owners of Laurel Park also owns Bramboyne [20]).</li> <li>• Evolution has consulted with the owners of the receivers where moderate exceedances are predicted and has explained the noise modelling results in the context of NSW Government (2014). In particular, Evolution has advised that noise mitigation measures at the receiver are proposed and these measures would be formalised either via private agreements with Evolution and/or via the CGO’s modified Development Consent Conditions.</li> </ul>

**Table 4-6 (Continued)**  
**Consideration of Reasonable and Feasible Mitigation Options against the Voluntary Land Acquisition and Mitigation Policy**

Voluntary Land Acquisition and Mitigation Policy Approach to Decision Making	Response
<p>3. <i>If the applicant has not acquired the land or entered into a negotiated agreement with the landowner, then it is up to the consent authority to weigh up the relevant economic, social and environmental impacts of the development, in accordance with the requirements of section 79C of the Environmental Planning &amp; Assessment Act 1979, and to decide whether the development should be approved or not.</i></p>	<ul style="list-style-type: none"> <li>• The Modification involves continued operations at the existing CGO within ML 1535 for an additional 8 years with minimal changes to existing infrastructure and is considered justified because the Modification would (Section 6.2): <ul style="list-style-type: none"> <li>- Facilitate the continuity of employment for the existing CGO workforce.</li> <li>- Continue to stimulate economic demand in the local and regional economy.</li> <li>- Result in additional economic contributions to regional and NSW output and business turnover and household income for an additional 8 years; as well as significant additional contributions to State royalties, State taxes, Commonwealth tax revenue and applicable contributions to local councils.</li> </ul> </li> </ul>

Source: After Appendix D; NSW Government (2014).

### 4.3.3 Mitigation Measures, Management and Monitoring

#### Noise Management Plan

Evolution would continue to implement the noise management measures and monitoring programme detailed in the NMP.

The NMP would be reviewed and revised to incorporate the Modification. This would include additional provisions for providing mitigation to privately-owned receivers with predicted noise levels 3 to 5 dBA above the PSNLs, if requested, in accordance with the Voluntary Land Acquisition and Mitigation Policy (Table 4-5).

Reasonable and feasible acoustic mitigation measures (including provision of mechanical ventilation/comfort systems [e.g. air conditioning] to enable windows to be closed without compromising internal air quality/amenity) would be considered at the following privately-owned receivers:

- Bramboyne;
- Caloola II;
- Lakeview III; and
- The Glen.

In accordance with the Voluntary Land Acquisition and Mitigation Policy, the above mitigation measures would also be offered to those privately-owned receivers where voluntary acquisition rights apply (i.e. Westella and Westlea).

Note that while Laurel Park is predicted to experience noise levels up to 4 dBA above the PSNLs, Evolution has a noise mitigation agreement in place with the owner.

#### Tailings Lift Construction

To minimise potential noise impacts from the CGO during the evening and night-time, tailings lift construction works would be limited to daytime hours only (i.e. 7.00 am to 6.00 pm) (Section 3.3).

#### Noise Agreements

As noted above, Evolution has entered into noise mitigation agreements with the landowners of two private receivers (Laurel Park and Gumbelah) within the Noise Management Zone for the approved CGO. Noise mitigation/management agreements have also been discussed with other privately-owned receivers in accordance with the Voluntary Land Acquisition and Mitigation Policy.

Evolution would continue to offer noise mitigation agreements to all privately-owned receivers predicted to be within the moderate Noise Management and Noise Affection Zones.

## 4.4 AIR QUALITY

An Air Quality and Greenhouse Gas Assessment for the Modification was undertaken by Pacific Environment Limited (PEL) (2016) and is presented as Appendix E.

### 4.4.1 Existing Environment

#### Previous Assessment

An assessment of potential impacts associated with the currently approved CGO was conducted by PEL (2013) for the CGM Extension Modification.

The assessment predicted that no exceedances of relevant air quality criteria would occur at any privately-owned receivers due to the approved CGO, inclusive of the cumulative impact from background (i.e. non-mining) sources.

#### **Air Quality Management and Monitoring**

Air quality management and monitoring at the existing CGO is conducted in accordance with the AQMP. An example of existing air quality management at the CGO, the cover over the coarse ore stockpile, is provided in Plate 4-1.



**Plate 4-1: Cover Over the Coarse Ore Stockpile**

The existing CGO dust monitoring network currently consists of one high volume air sampler located near the Coniston residence measuring total suspended particulate (TSP) concentrations, and 14 dust deposition gauges. The locations of existing and historic dust deposition gauges are shown on Figure 2-3.

An analysis of the monitoring data by PEL (2016) indicates that the CGO has been operating in compliance with relevant TSP and dust deposition criteria.

While some dust deposition gauges recorded annual average dust deposition levels above the relevant criteria, these elevated dust deposition levels are considered by PEL (2016) to be attributable to local sources and not the CGO.

#### **Complaints**

No complaints have been received relating to air quality from the date of submission of the CGM Extension Modification in September 2013 to September 2016.

#### **4.4.2 Potential Impacts**

##### **Modelling Methodology**

PEL (2016) undertook dispersion modelling of the Modification using the CALPUFF modelling package.

Air quality modelling has been conducted to assess potential impacts for two operational scenarios, representative of Years 14 (2018) and 18 (2022) of the Modification.

Year 14 was selected as it is the operational year with the maximum total material (i.e. waste rock and ore) mined (Table 3-1). Year 18 was selected as it is towards the end of the open pit mine life. To be conservative, the material extraction rates for Year 17 were used to estimate emissions, using the mine layout of Year 18.

Emissions associated with the Modification for Years 14 and 18 were estimated using contemporary particulate matter emission estimating methodologies (Appendix E).

The dispersion modelling was based on 12 months of meteorological data from 2015, which was selected as a representative year for modelling based on analysis of meteorological data collected between January 2011 and December 2015 (Appendix E).

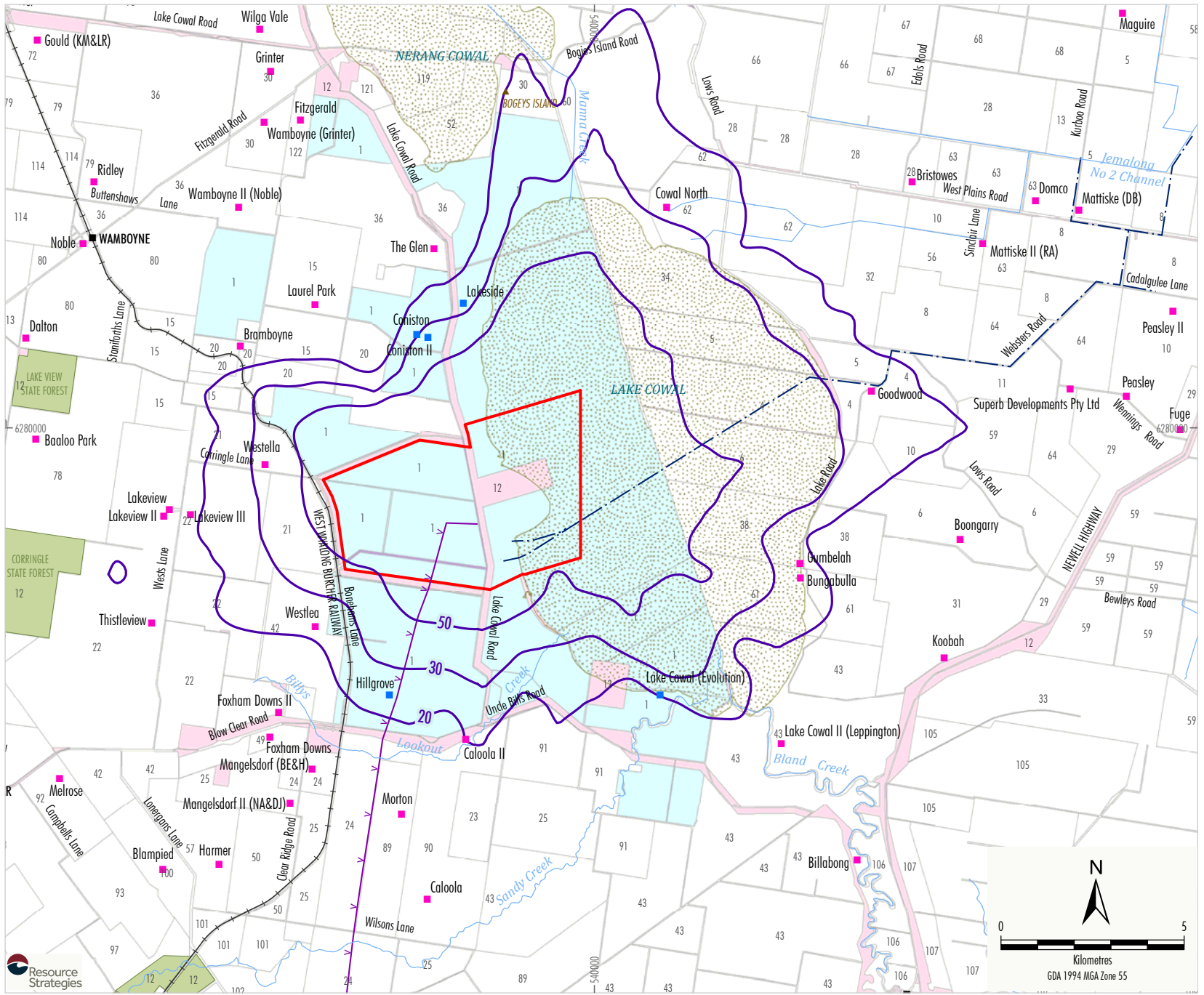
##### **Predicted Impacts**

Concentrations of TSP, particulate matter with an aerodynamic diameter less than 10 microns ( $PM_{10}$ ) and particulate matter with an aerodynamic diameter less than 2.5 microns ( $PM_{2.5}$ ) and dust deposition levels associated with the Modification were predicted at privately-owned receivers.

No exceedances of the relevant criteria for 24-hour  $PM_{10}$  criteria, or annual average TSP,  $PM_{10}$  or dust deposition criteria were predicted at any privately-owned receiver due to the Modification only or cumulatively with other non-mining sources (Appendix E). In addition, no exceedance of the 24-hour or annual average  $PM_{2.5}$  standards were predicted at any privately-owned receiver (Appendix E).

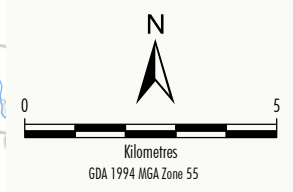
Contours showing predicted 24-hour  $PM_{10}$  concentrations for the Modification are provided on Figures 4-5a and 4-5b.





- LEGEND**
- Mining Lease Boundary (ML 1535)
  - Railway
  - Pipeline
  - Electricity Transmission Line
  - State Forest
  - Company-owned
  - Crown Land
  - Local Government
  - Privately Owned
  - Company-owned Dwelling
  - Privately-owned Dwelling
  - Project-only 24-hour PM<sub>10</sub> Air Quality Contour (µg/m<sup>3</sup>)

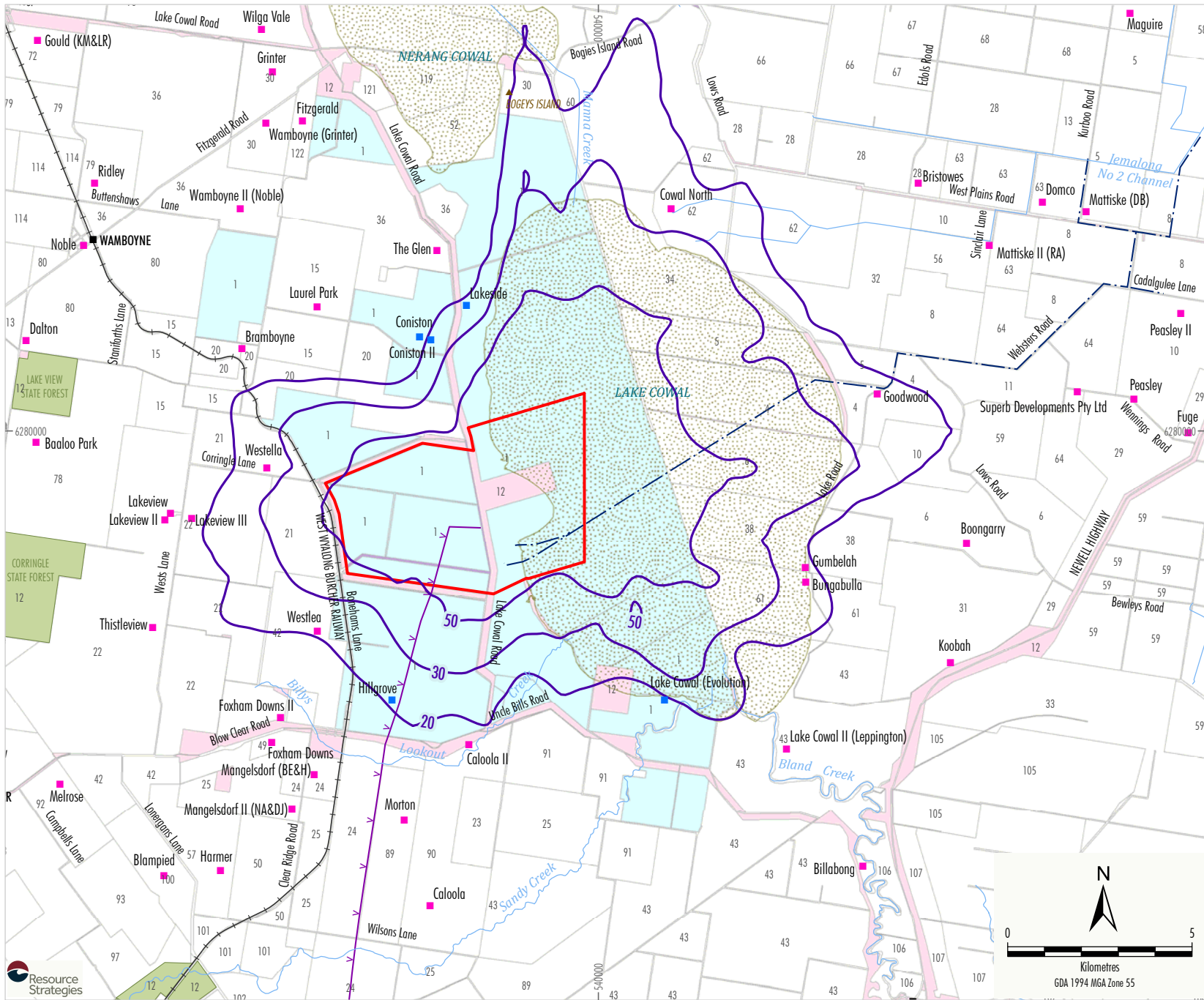
Refer to Figure 1-3b for Landholder Key  
 Source: Evolution (2016); Land and Property Information (2016); Pacific Environment Limited (2016)



**CGO MINE LIFE MODIFICATION**  
**Project 24-hour Average PM<sub>10</sub> Concentration (2018) - Modification Only**

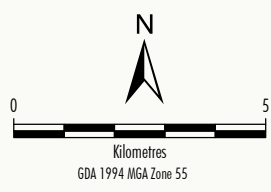
**Figure 4-5a**





- LEGEND**
- Mining Lease Boundary (ML 1535)
  - Railway
  - Pipeline
  - Electricity Transmission Line
  - State Forest
  - Company-owned
  - Crown Land
  - Local Government
  - Privately Owned
  - Company-owned Dwelling
  - Privately-owned Dwelling
  - Project-only 24-hour PM<sub>10</sub>
  - 50 Air Quality Contour (µg/m<sup>3</sup>)

Refer to Figure 1-3b for Landholder Key  
 Source: Evolution (2016); Land and Property Information (2016); Pacific Environment Limited (2016)



**CGO MINE LIFE MODIFICATION**  
**Project 24-hour Average PM<sub>10</sub>**  
**Concentration (2022) - Modification Only**

**Figure 4-5b**

#### 4.4.3 Mitigation Measures, Management and Monitoring

The existing mitigation, management and monitoring measures described in the AQMP would continue to be implemented for the Modification.

The AQMP would be revised as necessary for the Modification. This may include review and rationalising the number of dust deposition gauges in consultation with the EPA and DP&E.

### 4.5 OTHER ENVIRONMENTAL ASPECTS

#### 4.5.1 Road Transport

##### *Existing Conditions*

##### *Preferred Access Routes*

The preferred access routes to the approved CGO are as follows (Figure 2-3):

- West Wyalong Access Route – via Ungarie Road, Wamboyne Road, Blow Clear Road and Bonehams Lane.
- Forbes Access Route – via the Newell Highway, Carrawandool-Warroo Road, Bogies Island Road, Burcher Road, Wamboyne Dip Road, and Lake Cowal Road to the existing CGO.
- Condobolin Access Route – via the West Wyalong-Condobolin Road, Burcher Road, Wamboyne Dip Road, and Lake Cowal Road to the existing CGO entrance.

##### *Primary Access Route Upgrade*

The primary access route to the CGO (i.e. from West Wyalong) was upgraded prior to commencement of operations at the CGO in 2005 to accommodate the increased traffic on these roads, and to improve the safety and/or operational efficiency. The upgrades included the sealing and widening of sections of the access route, and the upgrade of major intersections. A section of the primary access road (Blow Clear Road, between Wamboyne Road and Bonehams Lane) (Figure 2-3) was resurfaced in 2016.

##### *Level of Service*

The previous Road Transport Assessment for the existing CGO (Masson Wilson Twiney Traffic and Transport Consultants, 2008) identified that the roads relevant to the CGO operate at a Level of Service B (i.e. where Level of Service A represents free flowing traffic, and Level of Service F represents queuing and delays).

##### *Employee Movements*

Nominal shift times for the CGO are:

- Administrative staff – 7.00 am to 5.00 pm.
- Operational (mining/processing) day shift – 6.00 am to 6.00 pm.
- Operational (mining/processing) night shift – 6.00 pm to 6.00 am.

Approximately 90% of CGO employees live locally (i.e. within the Bland, Forbes and Lachlan Shire Council areas). Evolution encourages employees to use employee shuttle bus services and car pooling to travel to and from the CGO.

##### *Truck Movements*

Potential CGO transport related impacts have been assessed for previous approval applications based on predicted/estimated truck movements. The majority of truck movements are associated with deliveries of reagents required for processing of ore. These previous estimates included a total of 30 two-way maximum daily truck movements (e.g. during peak demand for process consumables during oxide ore processing campaigns) to and from the approved CGO (i.e. 15 trucks in, 15 trucks out).

In recent months during primary ore processing, the number of movements has been an average of 12 two-way truck movements per day (i.e. 6 trucks in, 6 trucks out).

##### *Potential Impacts*

There would be no change to the preferred access routes to the CGO for the Modification.

The Modification would include upgrades to the leach circuit which would result in additional deliveries (i.e. an additional 2 to 4 movements per day or 1 to 2 trucks in, 1 to 2 trucks out) during periods of processing of primary ore relative to truck movements in recent months. There would, however be no change during oxide ore processing campaigns. Therefore, there would be no change to the total maximum daily truck movements.

The Modification would also result in a very minor short-term (i.e. approximately 6 months) increase in traffic movements associated with construction of the proposed leach circuit upgrades (i.e. transport of plant/equipment).

There would be no changes to employee vehicle movements associated with the Modification.

While the Modification would result in the CGO generated traffic using the surrounding road network for an additional 8 years, the primary access route to the CGO (i.e. from West Wyalong) was upgraded in 2005 specifically for the CGO, and the Blow Clear Road section of the primary access route was resurfaced in 2016.

Given the above, no change in the level of service of the road network surrounding the CGO is expected due to the Modification.

As there would be no changes to the existing CGO shift times, and no change to the distribution of the CGO workforce is expected due to the Modification (i.e. the majority of employees would continue to live locally), no additional fatigue management measures are considered to be required for the Modification.

As described in the Noise and Blasting Assessment for the Modification undertaken by Renzo Tonin & Associates (2016), the additional truck movements associated with the Modification would not be material to road traffic noise levels along the Mine Access Road (i.e. Ungarie, Wamboyne and Blow Clear Roads).

The continuation of CGO generated traffic for an additional 8 years would involve a continuation of associated road traffic noise impacts. However, road traffic noise associated with the CGO was previously determined (for the CGM Extension Modification) to be within the relevant noise criteria (SLR Consulting, 2013).

#### **Mitigation and Management**

The additional heavy vehicle deliveries would be assessed in an update of the *Transport of Hazardous Materials Study* which would be prepared in consultation with relevant Councils, the RMS and the transport provider, and would be subject to approval by the DP&E (Hazards Branch).

The preferred mine access routes would continue to be the only routes used by employees and contractors travelling to and from the mine site.

In addition, Evolution would continue to encourage the use of the existing employee shuttle bus service and car pooling to minimise potential traffic generation for the Modification.

Evolution would continue to consult with local councils and relevant transport providers regarding restricting the use of compression braking along the CGO's primary access route (including the installation of road signage).

Additionally, Evolution would continue existing arrangements and contributions to local councils for the Modification for the proposed 8 year mine life extension.

#### **4.5.2 Blasting**

##### ***Existing Compliance and Complaints***

Potential impacts associated with blasting at the existing CGO are monitored and managed in accordance with the BLMP. Blast monitoring (ground vibration and overpressure) for every blast is conducted at the locations shown on Figure 2-3.

From the date of submission of the CGM Extension Modification in September 2013 to September 2016, blast monitoring indicated that ground vibration and overpressure levels associated with blasting at the CGO were compliant with relevant Development Consent criteria at privately-owned receivers.

A total of eight blast-related complaints were received from the date of submission of the CGM Extension Modification in September 2013 to September 2016. Investigations undertaken in response to each blast-related complaint indicated that in each case the CGO was operating in accordance with relevant ground vibration and overpressure criteria.

##### ***Potential Impacts***

The typical blast design details and the average blasting frequency for the existing CGO operations would remain unchanged for the Modification (Section 3.3), and the location of blasts would not change relative to privately-owned receivers.

Therefore, the blasting impacts of the Modification would be similar to those currently approved, and compliance with relevant blast overpressure and vibration criteria is expected to continue at all privately-owned receivers (Appendix D).

### Mitigation and Management

Blast monitoring and management would continue in accordance with the currently approved BLMP.

#### 4.5.3 Greenhouse Gas Emissions

A greenhouse gas emissions inventory for the Modification has been prepared by PEL (2016) and is presented in Appendix E.

In accordance with the National Greenhouse Accounts Factors (Commonwealth Department of Environmental and Energy, 2016), direct greenhouse emissions are referred to as Scope 1 emissions, and indirect emissions are referred to as Scopes 2 and 3 emissions.

The major sources of greenhouse gas emissions associated with the Modification include carbon dioxide and methane, which are formed and released during the combustion of fuels used on-site, including the following:

- fuel consumption during mining operations (Scope 1);
- use of explosives during mining operations (Scope 1);
- on-site electricity use (Scope 2);
- production and transport of fuels (Scope 3); and
- electricity lost in transmission and distribution networks (Scope 3).

Annual average Scope 1 emissions for the Modification are estimated to be approximately 40,807 tonnes of carbon dioxide equivalent (Appendix E).

Evolution would continue to calculate and report annual greenhouse gas emissions and energy consumption from the CGO in accordance with its existing requirements under the Commonwealth National Greenhouse and Energy Reporting System (Appendix E).

#### 4.5.4 Flora and Fauna

The Modification would not change the approved surface development extent of the CGO (i.e. no land clearance beyond currently approved disturbance areas would occur).

As a result, the Modification would not disturb any existing fauna habitat or vegetation within ML 1535 or its surrounds.

### Fauna Interaction with the Tailings Storage Facilities

As described in Section 3.6, the Modification would involve additional lifts to the existing TSFs and converting the area between the TSFs into a new storage area. As a result, the surface area of the TSFs would marginally increase compared to the existing TSFs.

Notwithstanding, the potential risks to fauna interacting with the TSFs would not change as a result of the Modification given:

- the TSFs would continue to be designed and operated to deter fauna visitation to the facilities;
- there would be no increase in the annual rate of tailings deposition; and
- the approved cyanide concentration limits of the aqueous component of the tailings slurry stream would be maintained (i.e. cyanide levels of the aqueous component of the tailings slurry would not exceed 20 mg/L CN<sub>WAD</sub> [90<sup>th</sup> percentile over 6 months] and 30 mg/L CN<sub>WAD</sub> [maximum permissible limit at any time] at the process plant).

Cyanide bearing TSFs can potentially pose a risk to fauna (Donato *et al.*, 2007) and a number of measures have been adopted at the CGO to minimise those potential impacts at the TSFs as described in the CGO's CMP and Fauna and Flora Management Plan.

Overall, the way in which the TSFs are managed at the CGO has resulted in no animals, native or exotic, having died as a result of cyanide poisoning at the TSFs (Donato Environmental Services, 2006 to 2016).

### Water Quality Changes

The potential impacts from the CGO on Lake Cowal have been a key consideration in the management of the CGO (Goldney *et al.*, 1997). To date there have been no detectable adverse impacts on the ecology (vertebrates, invertebrates and flora) of Lake Cowal attributed to the CGO based on long-term wetland bird monitoring (after Australian Museum Business Services, 2013; Gell and Peake, 2013 a-c; Gell and Peake, 2014a-c; Gell, 2015 a-c; Gell, 2016a-b) and other fauna surveys such as fish monitoring (frc Environmental, 2011 and 2012).



Surface water monitoring in ML1535 and Lake Cowal is showing that site water is not affecting Lake Cowal and that there is also no apparent causal link between the mining operations and water quality in Lake Cowal (Appendix B).

HEC (2016) conclude that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification (Appendix B).

#### ***Fauna Interaction with the Final Void***

Consistent with the approved CGO, the final void associated with the Modification is predicted to slowly fill with water and trend towards hypersaline conditions in the long-term (Appendix B). As such, the Modification is unlikely to increase the potential for adverse impacts on fauna from their interaction with the final void because the same trend as for the currently approved CGO would occur (i.e. trend towards hypersaline conditions in the long-term) (Appendix B).

#### ***Other Potential Impacts***

The extension of the operational life of the CGO for an additional 8 years would extend the time that some potential impacts from the CGO would occur (e.g. the potential impacts from fauna vehicular strikes, noise, dust and artificial lighting). However, the continued operation of the mine for an additional 8 years is not likely to pose a significant impact on any flora and fauna because:

- Annual vehicular traffic movements at the CGO would not significantly increase as a result of the Modification.
- No material increase in approved noise levels is expected due to the Modification (Appendix D).
- Blasting protocols (i.e. size, frequency and location) would not change as a result of the Modification (Section 3.3).
- Dust deposition levels would not significantly increase as a result of the Modification (Appendix E).
- Light emissions would be of a similar nature to light emissions from the currently approved CGO (Section 4.6.8).
- The risk of high frequency fire would not increase as a result of the Modification.
- Continued management of the CGO in accordance with the existing management plans (e.g. FFMP).

#### ***Existing Mitigation Measures at the CGO***

The approved CGO implements the following environmental management plans and other documents (prepared in accordance with the Development Consent [DA 14/98] conditions) relevant to the management of flora and fauna at the approved CGO:

- FFMP;
- TSMP;
- RMP;
- BOMP;
- CWMP;
- LMP; and
- AQMP.

Mitigation measures provided in the environmental management plans listed above include:

- revegetation of the mine landforms;
- delineation of disturbance areas;
- pre-clearance surveys;
- vegetation clearance procedure, including pre-clearance surveys and fauna management strategies;
- vehicle speed limits and road signage;
- mechanisms to keep fauna away from the TSFs;
- cyanide destruction processes;
- monitoring of fauna usage of the final void;
- a Biodiversity Offset Strategy;
- remnant woodland enhancement in the CGO surrounds;
- protection of remnant vegetation within ML 1535;
- bushfire management; and
- weed and pest control measures.

These measures would be continued for the Modification.

#### **4.5.5 Aboriginal Cultural Heritage**

The Modification would not involve an increase to the existing surface development extent of the CGO (i.e. changes associated with the Modification would be confined to existing/approved disturbance areas).



Therefore, no impacts on items of Aboriginal cultural heritage would occur due to the Modification.

The existing CGO layout and the Modification layout have been designed to avoid and minimise potential impacts to Aboriginal cultural heritage.

The following general management measures would be undertaken during the life of the CGO in accordance with existing permits and consents under sections 87 and 90 of the *National Parks and Wildlife Act, 1974* (NPW Act):

- Existing management measures currently employed at the CGO would continue to be implemented for the Modification.
- The background distribution of artefactual material would continue to be managed in manner consistent with existing sites within the CGO and the IACHMP.
- Any items collected would be analysed consistent with current requirements and protocols. These include measurement of the artefacts to describe the nature and variation of the lithic items.
- In the unlikely event that human skeletal remains are identified during the life of the CGO, ground disturbance works in the vicinity of the human skeletal remains would cease immediately and the discovery be immediately reported to the NSW Police. If it is suspected that the remains may be of Aboriginal origin then this would also be reported to the NSW Police. Evolution would then contact the OEH and representatives of the Aboriginal community. Any activities regarding the identification of skeletal remains would be undertaken and conducted in accordance with the recommendations of *The Skeleton Manual – A Handbook for the Identification of Aboriginal Skeletal Remains* (NSW National Parks and Wildlife Service [NPWS], 1986).
- Evolution would involve the CGO's registered Aboriginal parties in relevant matters regarding the CGO when necessary.

#### 4.5.6 Non-Aboriginal Heritage

No registered non-Aboriginal heritage items would be potentially impacted by the Modification.

The only non-Aboriginal heritage items in the ML 1535 area and surrounds listed as heritage items under the Bland LEP were the Cowal West Homestead and Shearing (Wool) Shed. Demolition of the Cowal West Homestead Complex (i.e. the Homestead, Shearing Shed and Hayshed) was approved for the E42 Modification Modified Request (Barrick [Cowal] Limited [Barrick], 2009), and occurred during 2011 to 2012. The relocation and reconstruction of the Shearing Shed at the Lake Cowal Conservation Centre was completed in April 2013.

#### 4.5.7 Land Resources

The Modification would not change the current land use within ML 1535 or existing land uses on Evolution-owned lands surrounding the CGO.

Further, the Modification would not change the currently proposed final land use within ML 1535, which includes fenced rehabilitation areas with grazing excluded and areas suitable for agricultural production including commercial and recreational fishing of lake areas or managed grazing by livestock (Section 5.3.1).

The Modification would result in a minor change to topography within ML 1535 due to the increase in height of the TSFs. The final elevations of the northern and southern tailings storage facilities would be approximately 264 m AHD and 272 m AHD, respectively (Figure 3-4), some 16 m and 17 m higher than the currently approved TSFs, respectively. The final elevations of the modified TSFs (and the CGO's approved final landforms) would continue to be lower than the elevations of landforms surrounding the CGO, including Wamboyne Mountain which rises to 412 m AHD and the north-south oriented ridgeline system to the west of the CGO, which reaches a maximum elevation of 368 m AHD at Billy's Lookout.

To minimise potential environmental impacts, the modified TSFs have been designed to minimise additional surface disturbance. As such, there would be no change to the approved surface development extent at the CGO.

The TSFs and waste rock emplacements would be progressively rehabilitated during the life of the Modification. To improve the compatibility of CGO final landforms with surrounding landforms, revegetation species would continue to include native and/or endemic grass, shrub and/or tree species characteristic of vegetation communities found on other elevated landforms in the region that are suited to the CGO final landform characteristics (Appendix F).

The size and depth of the open pit are determined by the location of the orebody, and the slope of the pit walls (i.e. to achieve suitable geotechnical stability). Consistent with the approved CGO, the open pit would remain as a final void, and is predicted to act as a permanent groundwater sink (Section 4.2.1).

Further justification for the design of the final landforms for the Modification is provided in Section 6.2.

Potential visual impacts associated with the Modification are described in Section 4.5.8.

#### **Mitigation Measures and Management**

The Rehabilitation and Landscape Management Strategy for the Modification (Section 5) describes the long-term land use strategy for the Modification and the integration of CGO final landforms with the surrounding landscape via progressive rehabilitation. The existing RMP would be revised to incorporate the rehabilitation concepts for the Modification (Section 5.4).

Mine closure concepts and post-mining land use strategies would continue to be developed in future MOPs in consultation with the DRE and other relevant regulatory agencies.

#### **4.5.8 Visual Character**

The existing CGO has modified the topography within ML 1535, and as such, the existing CGO has modified the visual landscape from relevant viewpoints surrounding the CGO. The main modifying elements of the existing CGO include the waste rock emplacements, the TSFs, ore stockpiles, the process plant and infrastructure areas and the mine access road.

A visual assessment was conducted for the approved CGO as part of the CGM Extension Modification (Barrick, 2013a). The visual assessment considered changes to the visual landscape as a result of increased heights of the waste rock emplacements and TSFs.

The Modification would involve converting the area between the existing TSFs into a new storage area as well as increasing the final heights of the TSFs.

However, it is considered unlikely that the modified TSFs would result in significant visual impacts relative to the existing CGO given:

- the location of the TSFs would not change and would remain a part of the existing visual landscape;
- the proposed final heights of the TSFs would remain well below the waste rock emplacements, which are the dominant mine landforms of the existing landscape; and
- the visual contrast between the undisturbed natural areas and newly constructed embankments of the TSFs would be similar to the existing visual landscape of the CGO and would reduce once rehabilitated.

In accordance with the Landscape Management Plan, the following measures have been implemented at the existing CGO to maintain and improve visual amenity:

- progressive rehabilitation of CGO landforms (Plates 5-1 to 5-4 in Section 5);
- trees and shrubs have been established in accordance with the requirements of the Bland Shire Council for the maintenance of visual amenity from outside ML 1535; and
- the visual appearance of buildings, structures, facilities or works have been designed in consideration of blending with the surrounding landscape.

The measures above would continue to be implemented for the Modification to reduce the contrast between CGO landforms and the surrounding landscape.

Revegetation species for CGO landforms would continue to include native grass, shrub and/or tree species characteristic of vegetation communities found on other elevated landforms in the region that are suited to the characteristic of the CGO final landforms (Appendix F).

#### **Night-Lighting**

Night-lighting is emitted from the following three main sources at the existing CGO:

- overhead lighting of the process plant area and administration area;
- mobile lighting rigs on top of waste rock emplacements or surrounding the open pit; and
- mobile vehicle mounted lights (e.g. work vehicles in various locations within ML 1535).

Direct views of night-lighting sources, including mobile machinery lights and operational lighting, are available from some exposed positions. Night-lighting impacts on the local and sub-regional settings occur with a glow above operational areas that contrasts with the night sky. This effect decreases with distance, however, is visible at nearby residences and along transport routes.

The Modification would involve the continued use of night-lighting at the CGO, however the elevation, intensity and location of existing CGO night-lighting would not change and existing mitigation measures (detailed below) would continue to be implemented. Despite the elevations of the TSFs increasing, construction works would be restricted to daytime hours only, therefore there would be no need for lighting the TSFs and no change to existing night-lighting impacts.

Therefore, it is expected that potential night-lighting impacts would be similar to those associated with the approved CGO.

The following measures are currently employed to mitigate potential impacts from night-lighting at the existing CGO and would continue to be implemented for the Modification:

- restriction of night-lighting to the minimum required for operations and safety requirements, where appropriate;
- use of unidirectional lighting techniques;
- installing fixed or mobile rig lighting to shine below the horizontal or below building lines; and
- use of light shields to limit the spill of lighting.

#### 4.5.9 Socio-Economics

The Modification would provide incremental (i.e. in comparison to the approved CGO) net benefits to Australia due to the additional 8 years of operations.

The Modification would also provide incremental non-market benefits of employment provided by the Modification.

#### **Regional Economic Impacts**

The CGO is acknowledged as a key contributor to the regional economy.

The Modification would provide for an additional 8 years of direct and indirect contributions to the Lachlan Statistical Area 3 regional economy (which includes a number of LGAs including the Bland, Forbes and Lachlan LGAs). Contributions would include regional output or business turnover, regional value, household income and jobs.

#### **Community Infrastructure**

The Modification would provide continued employment for the CGO's approved workforce (i.e. for an additional 8 years). There is not expected to be any additional direct workforce associated with the Modification. While there may be some additional flow-on employment in the region as a result of the increased operational expenditure of the CGO in the region, this is likely to be modest, and in the context of long-term population decline in the region, is unlikely to place any strain on existing community infrastructure.

In contrast, extending the life of the approved CGO may slow the decline of the regional population and hence slow any overall decline in the provision of community infrastructure and services to the region.

#### **Cessation of the CGO**

Consistent with the existing CGO Development Consent (DA 14/98), prior to closure of the CGO, Evolution would work with local councils and the community to prepare a workforce phase-out plan to minimise potential impacts associated with CGO employment cessation.

#### 4.5.10 Hazard and Risk

##### **Hazard Identification and Risk Assessment for the Modification**

Potentially hazardous materials are handled, used and transported everyday at the CGO and their management is documented in the CGO's Hazardous Waste and Chemical Management Plan, CMP and the Transport of Hazardous Materials Study.

The proposed upgrades to the existing leach circuit would increase cyanide consumption and some other process consumables (Section 3.5). This would result in additional heavy vehicle deliveries. However, the additional deliveries required would only involve a small increase to the current total daily truck deliveries at the CGO during primary ore processing (approximately an additional one to two trucks per day) and would not change the maximum deliveries which would occur during oxide ore processing campaigns.

Notwithstanding, no new hazardous materials would be used, and no change to the CGO's existing consumables storage areas, handling procedures or transport routes would be required for the Modification.

These additional heavy vehicle movements during primary ore processing would be undertaken in accordance with existing protocols and procedures detailed in the CGO's approved Transport of Hazardous Materials Study. The handling and storage of process consumables on-site would continue to be undertaken in accordance with measures detailed in the CGO's approved Hazardous Waste and Chemical Management Plan.

In addition, and as described in Section 3.5.2, the Modification would not change:

- the existing cyanide destruction methods currently used at the CGO (i.e. either Caro's Acid or the INCO process) (Section 2.5.2); or
- the approved CN<sub>WAD</sub> concentration limits of the aqueous component of the tailings slurry stream (Section 2.5.2).

The mitigation and management measures described in the CMP (including the cyanide monitoring process) would continue to be implemented for the Modification.

Given the above, the Modification would not change the potential impact mechanisms to the public and public property, and their associated consequences of likelihoods, to the extent that risk levels would change from those previously assessed in the Preliminary Hazard Analysis (PHA), HAZOP study or FHA.

#### **Hazard Prevention and Mitigation Measures**

Hazard prevention and mitigation would continue to be implemented for the Modification in accordance with the recommendations and management measures detailed in existing management plans, assessments and studies, including the PHA, HAZOP study, FHA, Fire Safety Study, Safety Management System, THMS, ERP/PIRMP, BMP, internal Bushfire Management Plan, CMP and Hazardous Waste and Chemical Management Plan.

Notwithstanding, relevant management plans (e.g. Transport of Hazardous Materials Study) would be reviewed and if necessary revised to reflect any additional changes associated with the Modification.

A summary of the relevant management plans, assessments and studies is provided below.

#### **Preliminary Hazard Analysis**

A PHA conducted as part of the original EIS analysed the off-site risks to the environment, public safety and public property of potential hazardous events. The study ranked the risks and reviewed the adequacy of the safeguards and recommended improvements where necessary.

The PHA concluded that the highest risks to the environment, public safety and public property from the approved CGO were associated with the following scenarios (ANSTO Safety and Reliability, 1997):

- spillage of material during transport;
- a major spillage of material from on-site storage tanks coincident with catastrophic bund failure;
- spillage of diesel fuel onto the ground outside the mine site;
- wildlife entering the tailings storages following damage to the fence;
- birds using the tailings storages when an accidental release of cyanide occurs; and
- release of hazardous material in the event of a fire.

The PHA included a number of recommended risk reduction measures relevant to the environment and public safety that have been incorporated into the approved CGO design to reduce the likelihood or the consequences of incidents that could cause damage.

The recommended risk reduction measures relevant to the environment and public safety have been incorporated into relevant approved CGO management plans and implemented, as outlined below. No hazardous events or incidents have occurred at the CGO since the commencement of operations that have changed the assumed consequence and likelihood ratings described in the PHA.

#### **Hazard and Operability Study**

In accordance with the Hazard Industry Planning Advisory Page (HIPAP) No. 8 *Hazard and Operability Studies* (NSW Department of Urban Affairs and Planning [DUAP], 1995) and as agreed with the former Department of Planning (now the DP&E), the scope of the HAZOP study included storage and/or handling areas of the approved CGO relevant to dangerous goods, hazardous materials and/or materials with the potential for off-site impact.

The HAZOP included a review of the monitoring, control, alarm and shutdown systems associated with the cyanide process. Control measures to maintain cyanide concentrations within compliance levels were also proposed. No hazardous events were determined during the study that had not been previously known and which had the potential for significant off-site risk (Pinnacle Risk Management, 2004a).

#### *Final Hazard Analysis*

A FHA was also conducted for the approved CGO and was designed to extend and update the analysis in the PHA. Major findings of the FHA are summarised below (Pinnacle Risk Management, 2004b):

- For the storage quantities of dangerous goods and hazardous materials on-site that had increased since the PHA, there was no measurable change to the site's risk profile.
- As per the findings in the PHA, off-site risk to the environment and public was dominated by transport related incidents. The higher risk materials include sodium cyanide, ammonium nitrate, sulphuric acid, hydrogen peroxide and liquified petroleum gas. It was noted that the routes used to transport the dangerous goods would be reviewed in the Transport of Hazardous Materials Study.
- The cyanide control measures to prevent the cyanide concentrations increasing in the tailings disposal facility presented in the HAZOP study were considered acceptable.
- Two additional hazardous materials were assessed (i.e. sodium metabisulphite and copper sulphate) and concluded to pose no significant risks.
- As per the PHA, the site bunding system was seen as a very effective barrier to prevent on-site spills causing potential off-site environmental impact.

Overall, the FHA concluded that the approved CGO complied with the HIPAP No. 4 and HIPAP No. 6 guidelines for tolerable fatality, injury, irritation and societal risk (Pinnacle Risk Management, 2004b). The FHA also concluded that the risks to the biophysical environment, the risk of propagation and the potential impact on cumulative risks in the area from releases were considered to be generally negligible (*ibid.*). Overall, the assessment concluded that the CGO would not pose any unacceptable levels of risk (*ibid.*).

No hazardous events or incidents have occurred at the approved CGO since the commencement of operations that have changed the assumed consequence and likelihood ratings described in the FHA.

#### *Fire Safety Study*

A Fire Safety Study was conducted for the approved CGO and its objective was to assess the proposed fire prevention, detection, protection and fighting measures for appropriateness for specific fire hazards and adequacy to meet the extent of potential fires at the process plant (Pinnacle Risk Management, 2005). No further actions to those detailed in the HAZOP were recommended in the Fire Safety Study.

#### *Safety Management System*

A Safety Management System has been developed for the approved CGO in accordance with HIPAP No. 9 *Guidelines for the Development of Safety Management Systems* (DUAP, 1998). The Safety Management System sets out a comprehensive safety management system that covers all on-site operations and associated transport activities involving hazardous materials. The Safety Management System describes all safety related procedures, responsibilities and policies, and identifies mechanisms designed to assist in adherence to procedures.

#### *Transport of Hazardous Materials Study*

Transport risks associated with the approved CGO were analysed in the Transport of Hazardous Materials Study. The Transport of Hazardous Materials Study includes a detailed plan of actions to be undertaken to mitigate the potential effects of any spill of hazardous material during transport to the CGO.

#### *Emergency Response Plan/Pollution Incident Response Plan*

Emergency response procedures for a range of potential emergency situations (e.g. fires, explosions, spills, natural disasters, etc.) that could occur at the CGO have been documented in the Emergency Response Plan. The Emergency Response Plan includes provision for annual review to assist in the identification of any new potential hazards as well as opportunities to improve the effectiveness of control measures, if required.



In accordance with the requirements of Part 5.7A of the NSW *Protection of the Environment Operations Act, 1997*, a Pollution Incident Response Management Plan is required for the CGO. The EPA accepted the CGO's approved Emergency Response Plan as the Pollution Incident Response Management Plan on 12 September 2012.

#### *Blast Management Plan*

The BLMP outlines provisions relating to notification procedures of blast times, blast design/control and a blast monitoring programme. Strategies and procedures in the event of airblast overpressure or ground vibration criteria exceedances are also outlined in the management plan, including the implementation of remedial measures.

#### *Bushfire Management Plan*

Management measures relevant to bushfire hazards are detailed in the CGO's internal Bushfire Management Plan, including details on operational arrangement, on-site fire protection, hazard management and the implementation of fuel management strategies.

#### *Cyanide Management Plan*

The CMP includes hazard prevention and mitigation measures, particularly with regards to potential risks to fauna associated with the use of cyanide. Measures included in the CMP include the implementation of a cyanide monitoring programme, contingency measures for cyanide reduction, fauna visitation deterrence measures at the TSFs, and cyanide storage and handling procedures.

#### *Hazardous Waste and Chemical Management Plan*

Hazard prevention and mitigation measures relevant to hazardous wastes and chemicals have been documented in the Hazardous Waste and Chemical Management Plan. The management plan also requires the maintenance of a fuel and oil register and a hazardous substances and dangerous goods register.

The Hazardous Waste and Chemical Management Plan and associated strategies, inventories and registers have been developed to facilitate efficient audit functions by providing audit criteria that would be used to evaluate the effectiveness of hazard prevention and mitigation measures.