Report and recommendations of the Environmental Protection Authority

Gold Mining Developments on Lake Lefroy - Beyond 2010

St Ives Gold Mining Company Pty Ltd

Report 1411
August 2011
### Environmental Impact Assessment Process Timelines

<table>
<thead>
<tr>
<th>Date</th>
<th>Progress stages</th>
<th>Time (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-09-09</td>
<td>Level of Assessment set</td>
<td></td>
</tr>
<tr>
<td>02-06-10</td>
<td>Final ESD approved</td>
<td>37</td>
</tr>
<tr>
<td>20-12-10</td>
<td>Environmental Review Document (ERD) released for public review</td>
<td>28</td>
</tr>
<tr>
<td>24-01-11</td>
<td>Public review period for ERD closed</td>
<td>6</td>
</tr>
<tr>
<td>27-04-11</td>
<td>Final Proponent response to ERD issues raised</td>
<td>14</td>
</tr>
<tr>
<td>03-08-11</td>
<td>Publication of EPA report (3 days after report to Minister)</td>
<td>13</td>
</tr>
<tr>
<td>17-08-11</td>
<td>Close of appeals period</td>
<td>2</td>
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### STATEMENT ON TIMELINES

Timelines for an assessment may vary according to the complexity of the project and are usually agreed with the proponent soon after the level of assessment is determined.

In this case, the Environmental Protection Authority did not meet its agreed timeline objective for the completion of the assessment and provision of a recommendation to the Minister.

Dr Paul Vogel  
Chairman  
3 August 2011
Summary and recommendations

This report provides the Environmental Protection Authority’s (EPA’s) advice and recommendations to the Minister for Environment on the proposal by St Ives Gold Mining Company Pty Ltd to expand existing gold mining operations on Lake Lefroy, which includes dewatering discharge to the lake surface.

Section 44 of the Environmental Protection Act 1986 (EP Act) requires the EPA to report to the Minister for Environment on the outcome of its assessment of a proposal. The report must set out:

- The key environmental factors identified in the course of the assessment; and
- The EPA’s recommendations as to whether or not the proposal may be implemented, and, if the EPA recommends that implementation be allowed, the conditions and procedures to which implementation should be subject.

The EPA may include in the report any other advice and recommendations as it sees fit.

The EPA is also required to have regard for the principles set out in section 4A of the EP Act.

Key environmental factors and principles

The EPA decided that the following key environmental factors relevant to the proposal required detailed evaluation in the report:

(a) surface water discharge; and
(b) mine closure and rehabilitation.

There were a number of other factors which were relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

The following principles were considered by the EPA in relation to the proposal:

(a) the precautionary principle;
(b) the principle of intergenerational equity;
(c) the principle of the conservation of biological diversity and ecological integrity;
(d) principles related to improved valuation, pricing and incentive mechanisms; and
(e) the principle of waste minimisation.
Conclusion
The EPA has considered the proposal by St Ives Gold Mining Company Pty Ltd (SIGM) to expand existing gold mining operations on Lake Lefroy, including dewatering discharge of 30 gigalitres (GL) per annum to the lake surface.

The proposal will result in an additional 440 hectares (ha) of disturbance to the lake, on top of the existing 1273 ha of disturbance that has already occurred under existing approvals. This would take the total disturbance area to approximately 1713 ha.

The EPA notes that Lake Lefroy is a hypersaline salt lake that generally has low levels of aquatic life and does not experience a freshwater phase, like other salt lakes in the region, following rainfall events. This freshwater phase contributes to the higher diversity and density of aquatic life found in the other salt lakes of the region. The riparian zone and playas and clay pans that surround Lake Lefroy are considered important in terms of providing habitat for aquatic biota and supporting the ecological function of the area. The playa lakes and clay pans support a wide range of species such as zooplankton, benthic invertebrate fauna, cyanobacteria, diatoms and Schizothrix spp. (algal mats) and play a vital role in “seeding” Lake Lefroy with aquatic life during a fill event.

The EPA considers that the most significant potential impacts to the environment are:

• inundation of the riparian zone and the playas and clay pans with hypersaline water as a result of dewatering discharge; and

• increased disturbance of the lake bed contributing to a higher than natural rise in water levels in the lake during flooding following a large rainfall event.

The total area of riparian zone potentially disturbed is up to 118.25 ha, being 13 ha of direct disturbance and 106 ha of indirect disturbance through inundation. The predicted area of inundation has been determined by the development of a surface water impact model. The modelling techniques were sufficiently robust that the EPA considers the predicted area of impact is representative of the likely impacts. The area to be disturbed does not contain any Threatened Ecological Communities or Declared Rare Flora. The EPA considers that the loss of riparian vegetation from clearing and inundation and the loss of a freshwater phase in the playas and clay pans through inundation will not significantly impact on the ecological function of the lake as a whole. The areas disturbed represent a small portion of the total riparian zone of Lake Lefroy with the majority of playas and clay pans that fringe the lake not being disturbed by this proposal.

However, to further verify the accuracy of the predictions of the proponent in relation to the model that predicts areas of inundation, the EPA has
recommended a condition that the model be verified and calibrated following any rainfall events of 100 mm or greater in a 72 hour period.

Due to the importance of the riparian zone and playas and clay pans to the ecosystem of Lake Lefroy, the EPA has also recommended a condition that the proponent monitor the riparian zone and playas and clay pans to verify that the ecosystem function of these areas is not being significantly impacted by the proposal.

There is some potential for a build up of heavy metals associated with the dewatering discharge. The EPA has also provided other advice that the Department of Environment and Conservation (DEC) licence for the St Ives Gold Mine will need to be amended to include monitoring of heavy metal levels in the discharge.

The EPA notes that the proponent has prepared a draft mine closure plan, which is intended to be updated throughout the life of the project. The EPA expects that future versions of the mine closure plan will be consistent with the EPA and Department of Mines and Petroleum’s (DMP’s) Guidelines for Preparing Mine Closure Plans.

The EPA acknowledges that there have been problems with rehabilitation at the St Ives Gold Mine undertaken to date. The EPA encourages the proponent to continue to undertake research into improving closure and rehabilitation techniques. The EPA also urges the proponent to use its best endeavours to identify opportunities to backfill the pit voids to reduce the project footprint, particularly the height of waste rock dumps which is not consistent with natural landforms in the area.

The EPA has also provided other advice that it would support a Section 46 change to implementation commitments so that a single contemporary Ministerial Statement applies to the SIGM mining operations on Lake Lefroy.

In view of the statutory requirements of the Mining Act 1978 the EPA is satisfied that rehabilitation, and mine closure and decommissioning can be managed by the Department of Mines and Petroleum in accordance with the DMP/EPA Guidelines for Preparing Mine Closure Plans.

The EPA has therefore concluded that it is likely that the EPA’s objectives would be achieved provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4 and summarised in Section 4.

**Recommendations**

The EPA submits the following recommendations to the Minister for Environment:

1. That the Minister notes that the proposal being assessed is for further lake-based gold mining developments at Lake Lefroy;
2. That the Minister considers the report on the key environmental factors and principles as set out in Section 3;

3. That the Minister notes the EPA has concluded that it is likely that the EPA’s objectives would be achieved, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4 and summarised in Section 4;

4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report; and

5. That the Minister supports a section 46 change to Ministerial Statement 548 under the EP Act so that a single ministerial statement applies across the proposal area.

**Conditions**

Having considered the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by St Ives Gold Mining Company Pty Ltd to expand existing gold mining operations on Lake Lefroy, including dewatering discharge of 30 GL per annum to the lake surface, is approved for implementation.

These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) monitoring of the actual impacts of the proposal, particularly any impacts on the riparian zone of Lake Lefroy and the playas and clay pans that are adjacent to the lake;

(b) monitoring the area of inundation of the lake following large rainfall events;

(c) using data collected during monitoring to verify the predicted area of impact from the surface water modelled developed by the proponent;

(d) determining management measures and plans to implement the measures should the actual area of inundation exceed the predicted area of impact; and

(e) avoidance of an increased zone of influence on surface water and sediment quality from heavy metals discharged during dewatering.
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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for Environment on the key environmental factors and principles for the proposal by St Ives Gold Mining Company Pty Ltd (SIGM) (a wholly owned subsidiary of Gold Fields Limited) to expand existing gold mining operations on Lake Lefroy. The proposal includes dewatering discharge to the lake surface from lake- and land-based operations. The project is located approximately 20 kilometres (km) south east of Kambalda. The PER does not cover processing and other support facilities for the expansion as existing facilities are in place at Lake Lefroy and these are not proposed to change as part of this expansion of mining operations.

The level of assessment of the proposal was set at Public Environmental Review (PER) with a four week public review period. The public review period commenced on 20 December 2010 and closed on 24 January 2011.

In 1999 the lake-based developments operated by WMC Resources Ltd (WMC) were subject to a formal assessment by the EPA and assessed as a PER (Assess. No. 1250). The relevant environmental factors discussed in EPA Report No. 976 were nature conservation values, rehabilitation, groundwater quality, surface water quality and the overall effects on the ecology of the Lake Lefroy system. In 2000 the proposal was granted approval subject to conditions in Ministerial Statement No. (MS) 548. MS 548 was intended to cover operations at Lake Lefroy up to 2010.

Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the key environmental factors and principles for the proposal. The conditions to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides other advice by the EPA and Section 6 presents the EPA’s recommendations.

Appendix 5 contains a summary of submissions and the proponent’s response to submissions and is included as a matter of information only and does not form part of the EPA’s report and recommendations. Issues arising from this process, and which have been taken into account by the EPA, appear in the report itself.
2. The proposal

The proposal is located at Lake Lefroy in the Goldfields region of Western Australia (WA), 20 kilometres (km) south-east of Kambalda. SIGM proposes further mining beneath the lake surface and the proposal also includes dewatering discharge to the lake associated with existing land-based mining activities (Figures 1, 2 and 3).

The proposal is located inside the South-Western Interzone (Coolgardie Botanical District) as defined by Beard (Beard, 1990). The vegetation in the region is dominated by eucalypt woodlands, which become more open and develops a saltbush/bluebush understorey on more calcareous soils.

Lake Lefroy is an elongated salt lake covering approximately 554 square kilometres. It occurs within the Lefroy Palaeodrainage and forms part of a chain of lakes that drain on the eastern edge of the Great Western Plateau (Dames and Moore, 1999).

Surface water in the lake is sourced from direct precipitation, surface runoff (sheet flow), minor inputs from groundwater inflow and existing mine water discharge. A number of watercourses drain into the lake. It is estimated that the lake is completely dry for 25% of the year, and less than 50% of the lake becomes flooded each year (Clarke, 1994).

The lake has a thick halite salt crust which results in Lake Lefroy not experiencing a freshwater phase, like other salt lakes, after significant rainfall events (Dames and Moore, 1999). This lack of a freshwater phase is a key characteristic for the ecological function of the lake. It limits aquatic biota of the lake to those that can tolerate hypersaline conditions and means that any salt lake biota that relies on a freshwater phase as part of its lifecycle will not be viable. In contrast the small playas and clay pans that surround Lake Lefroy do undergo a freshwater phase and they form a significantly important part of the local ecosystem. The playa lakes and clay pans support a wide range of species such as zooplankton, benthic invertebrate fauna, cyanobacteria, diatoms and Schizothrix spp. (algal mats).

Gold and nickel mining has been conducted on Lake Lefroy since the late 1800s. As indicated above, mining operations that have occurred since 2000 have been operating under Ministerial Statement 548.

In late 2001 SIGM took over mining operations at the site from WMC. Since taking over mining operations two changes have been made to MS 548, these are:

1. the dewatering discharge limit was increased from a maximum of 5.475 gigalitres per annum (GL/a), to a maximum of 14.3 GL/a for lake based mining operations and a total of 20.0 GL/a from all SIGM operations approved via section 45C of the EP Act on 9 March 2005; and
2. the area of disturbance in accordance with Schedule 1 of MS 548 (805 hectares) to include a 20% leeway up to a maximum of 966 hectares (ha).

There has been some uncertainty and different interpretations over the years when determining the existing disturbance footprint from operations undertaken before the 2000 EPA assessment and from those carried out under MS 548. Through the use of satellite imagery, a GIS database and ground-truthing the existing disturbance footprint has been reassessed as 1273 ha. Section 4.2.2.2 of the PER describes the process to recalculate the existing disturbance in more detail.

This latest proposal by SIGM is for further development of the Lake Lefroy operations and includes:

- continuation of current mining operations approved under MS 548;
- development of new pits, expansion of existing pits and associated infrastructure (i.e. waste dumps, ROM pads, drilling platforms, access tracks);
- continued use of existing dewatering discharge points to Lake Lefroy and the establishment of one new discharge point; and
- an increase in maximum mine dewatering discharge from 20 GL/a to 30 GL/a.

It should be noted that the project area for the Beyond 2010 proposal incorporates those areas managed under the existing MS 548.

This proposal is intended to cover mining operations for approximately the next 10 years (to 2020) and yield approximately 46 million tonnes (Mt) of ore. An additional 440 ha of disturbance, on top of the existing 1273 ha of disturbance, would be required taking the total disturbance area to approximately 1713 ha.

Ore would be sourced predominantly from multiple open cut pits, with some underground mining. Ore would be processed at the existing Lefroy Mill with some low-grade ore to be treated at the existing St Ives Heap Leach. Tailings disposal would be managed through a tailings storage facility that is already in use. However, SIGM is currently in the process of commissioning a new tailings facility through the Department of Mines and Petroleum (DMP) and Department of Environment and Conservation (DEC) approvals parallel to the EPA assessment of the Beyond 2010 proposal.

Process water is sourced from the Mt Morgan Borefield and managed under current Groundwater Licence No. 59222 issued by the Department of Water.

Dewatering of mining pits is generally undertaken through sumps within open pits or in underground operations. All mine dewater is ultimately discharged to the lake surface.
SIGM also intends to carry out exploration on its leases surrounding the proposal area to identify further development options.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Section 4 of the PER (SIGM, 2010).

**Table 1: Summary of key proposal characteristics**

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
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<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>Area of disturbance</td>
<td>Up to 1713 ha (including 1273 ha of existing disturbance)</td>
</tr>
<tr>
<td>Area of direct riparian zone disturbance</td>
<td>Up to 90 ha (including 77 ha of existing disturbance)</td>
</tr>
<tr>
<td>Height of waste rock dumps</td>
<td>Up to 40 metres</td>
</tr>
<tr>
<td>Volume of waste rock used for backfilling</td>
<td>A minimum of approximately 95 million tonnes</td>
</tr>
<tr>
<td>Mining method</td>
<td>Open pit using conventional techniques, with some underground mining likely to be conducted at some deposits</td>
</tr>
<tr>
<td>Dewatering volume and discharge to Lake Lefroy</td>
<td>Up to 30 GL per annum (GL/a) whole of lake discharge</td>
</tr>
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Since release of the PER, one modification to the proposal has been made by the proponent. This change is a minor redrawing of the project area boundary to include two areas that were proposed for disturbance as part of the Beyond 2010 proposal but not shown in the figures of the PER as being within the project area. The environmental impacts of disturbing these areas were considered as part of the assessment process, including within the surface water impact study that was carried out for the proposal. The change has the effect of increasing the existing disturbance in the project area to 1273 ha, which is an extra 13 ha over the figure shown in the PER.

The potential impacts of the proposal initially predicted by the proponent in the PER document (SIGM 2010) and their proposed management are summarised in Table E-3 (Executive Summary) of the proponent's document.
Figure 1 Regional setting
Figure 2 Project footprint and location of key components – mine disturbance
Figure 3  Project footprint and location of key components – dewatering points
3. Key environmental factors and principles

Section 44 of the EP Act requires the EPA to report to the Minister for Environment on the key environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the key factors selected for detailed evaluation in this report is summarised in Appendix 3. The reader is referred to Appendix 3 for the evaluation of factors not discussed below. A number of these factors, such as noise and Aboriginal heritage, are relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

It is the EPA’s opinion that the following key environmental factors for the proposal require detailed evaluation in this report:

(a) surface water discharge; and
(b) mine closure and rehabilitation.

The above key factors were identified from the EPA’s consideration and review of all environmental factors generated from the Public Environmental Review document and the submissions received, in conjunction with the proposal characteristics.

Details on the key environmental factors and their assessment are contained in Sections 3.1 and 3.2. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

The following principles were considered by the EPA in relation to the proposal:

(a) the precautionary principle;
(b) the principle of intergenerational equity;
(c) the principle of conservation of biological diversity and ecological integrity;
(d) principles relating to the improved valuation, pricing and incentive mechanisms; and
(e) the principle of waste minimisation.
3.1 Surface water discharge

Description

SIGM are required to dewater the mines to maintain safe and dry conditions. Dewatering is currently undertaken utilising sumps to aid sediment settlement and capture of hydrocarbons. From the sumps the water is discharged to the lake surface from seven different discharge points.

The expansion of existing pits and development of new pits will require an increase in the dewatering discharge limit for the project from 20 GL/a to 30 GL/a. The actual annual dewatering discharge level has been below the licensed amount with the highest annual discharge to date being 12.7 GL. The maximum predicted annual discharge for the Beyond 2010 proposal is 26 GL/a, with the 30 GL approval being sought as a contingency should a larger volume of dewatering be required, such as a large than normal groundwater recharge event occurring.

The proposal is to continue using existing discharge points to limit the zone of influence of the discharge to areas on the lake surface that have already been impacted by mining operations. One new discharge point is proposed for the Santa Ana pit. The locations of the existing dewatering discharge points and the two options for the new discharge point are shown in Figure 3.

The change in dewatering volume will require a change to Environmental Licence 4570/10 issued by the DEC and GWL62505(6) issued by the DoW. SIGM have already applied to the DoW for an increase in its licence entitlement.

The potential impacts of the increased dewatering discharge are a larger portion of the riparian zone being inundated with hypersaline water, and the change in surface water and sediment quality as a result of increased salt loads and heavy metals in the dewatering discharge.

Inundation

As part of the PER, SIGM commissioned the development of a model to determine the likely surface water impacts of mining on Lake Lefroy. The model was used to predict the water levels in the lake from different dewatering and rainfall scenarios and consequently the level of inundation of the riparian zone.

The model predicted that the riparian zone at Lake Lefroy is naturally subject to flooding during large rainfall events. However, the modelling shows that mining activity on the lake will lead to an increased area of inundation following a 1 in 100 year Average Recurrence Interval (ARI) rainfall event.

The model shows that during a 1 in 100 year ARI rainfall event (140 mm in 72 hours) an additional 3% of the riparian zone will become inundated above what is naturally inundated during a 1 in 100 year event without 30 GL of
dewatering discharge. The total area of inundation is predicted to be 4.6% (161 ha) of the riparian zone. The modelling also predicts that the area inundated will be underwater for between 94 and 347 days, which is an increase of between 27 to 31% over the existing conditions with the current disturbance footprint and discharge levels.

The predicted increase in water levels in the lake is more the result of the larger disturbance footprint from the Beyond 2010 proposal reducing the storage capacity of the lake than due to the increased volume of dewatering discharge. This is because the surface disturbance (mining areas) on the lake will be surrounded by a bund effectively reducing the surface area of the lake and its storage volume.

The small playas and clay pans that surround Lake Lefroy are separated from the lake by a series of dunes. The surface water impact study indicates that if the flood levels in the lake increase as predicted due to the Beyond 2010 proposal, there are 19 locations where this dune system may be breached and the playas and clay pans would be inundated with hypersaline water.

The modelling utilised ground-truthed riparian zone elevation data and lake bathymetry as well as a desktop assessment, which increases the confidence that the predicted area of riparian zone inundation is representative of the likely impacts.

**Water quality**

The dewatering discharge tends to have elevated levels of heavy metals reflecting the geology of the aquifer from which the groundwater is drawn. Sampling has shown that existing SIGM operations have contributed to increased heavy metal levels in the surface water and the sediment around the discharge points.

Water quality testing in 2009 showed that levels of most heavy metals tested were higher at discharge sites compared with reference sites, with cobalt, copper, lead and nickel exceeding ANZECC trigger values at the 80% species protection level. Sampling of sediment at existing discharge points has shown increases in the concentration of arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, vanadium and zinc.

The increase in heavy metal levels is expected to continue as a result of the proposal. Monitoring suggests that the increases are confined to areas around the discharge points as the heavy metals are absorbed and immobilised in the sediment.

The potential environmental impacts from the dewatering discharge are to:

- riparian flora and vegetation;
- aquatic flora;
- aquatic invertebrate fauna; and
• terrestrial fauna.

Riparian flora and vegetation

Since 1996, there have been several surveys of the riparian vegetation around Lake Lefroy, including a number that were commissioned for the purpose of this assessment, the most recent of which were carried out in 2010. SIGM has carried out its recent surveying in accordance with EPA Guidance Statement No. 51 (EPA 2004a) and has focussed on identifying information gaps about the conservation values and cumulative impacts of operations on the health of riparian vegetation and flora.

Lake Lefroy is low lying and devoid of vegetation except for the riparian zone and natural islands on the lake. The vegetation around the shoreline is dominated by samphires, with some species growing a few centimetres above the lake margin. Vegetation in this area is periodically inundated with water. Samphires are also found on the aeolian plateaus and dunes surrounding the lake. Other dominant vegetation species found in the aeolian dunes are the shrubs Tecticornia, Frankeria and Darwinia sp.. The vegetation composition of the riparian zone is typical of the region.

Desktop searches identified the potential for Priority Flora and Declared Rare Flora (DRF) to occur within the riparian zone of Lake Lefroy. Previous surveys carried out identified populations of DRF on SIGM southern leases. Botanica Consulting (2010) undertook an assessment of the priority species listed in previous surveys. The assessment concluded that priority species identified in previous surveys had either been incorrectly identified or are no longer listed as priority species. Therefore, no Priority Flora or DRF species are in the area of disturbance proposed for the Beyond 2010 proposal.

The surveys carried out on behalf of SIGM also considered riparian vegetation health. Botanica Consulting (2010) concluded that in most sampling locations the vegetation health was very good, with one of the ten sample points having good vegetation health and another showing poor vegetation health. These two points are associated with disturbance from existing mining operations.

Some of the older surveys carried out do not provide reliable data on vegetation health due to their sporadic nature and differing methodologies. The Botanica Consulting survey is proposed to be used as baseline data for assessing riparian vegetation health over the course of the project.

Vegetation that is inundated with hypersaline water for more than 20 days is unlikely to survive (SIGM, 2010). The modelling carried out by SIGM predicts that the period of inundation following a 1:100 rainfall event is between 94 and 347 days, which significantly exceeds the 20 days. The result is that vegetation will be lost in the 4.6% of the riparian zone predicted to be inundated if the project is at its maximum disturbance footprint; dewatering discharge is 30 GL and a 1:100 rainfall event occurs. This amounts to 161 ha of riparian zone area.
The project proposes some direct disturbance of the riparian zone for the Pistol Club pit, Neptune pit and Thunderer cutback. The project will result in the clearing of an additional 13 ha of the riparian zone, bringing the total riparian zone disturbance to 90 ha, which represents approximately 2.55% of the total riparian zone area.

Survey work has shown that there is no Declared Rare or Priority flora species in the Pistol Club or Neptune disturbances areas or any listed Threatened or Priority Ecological Communities.

The original 2000 project was predicted to disturb 2.4 ha of playas and ephemeral pools adjacent to Lake Lefroy. The development of the Thunderer deposit resulted in the actual disturbance of playa habitat being 10.9 ha. The Beyond 2010 proposal proposes no further disturbance of the adjacent pools and playas through the construction of new pits.

Aquatic flora

Surveys conducted for the original Lake Lefroy assessment (EPA Assess. No. 1250) determined that the salt encrusted region of the lake has low levels of aquatic life. Aquatic flora found on the lake is in the form of halotolerant species of diatoms, cyanobacteria and algae (Dalcon Environmental, 2010).

Sampling carried out by the proponent shows that species richness for aquatic flora is higher at reference sampling sites compared with discharge sampling sites indicating some impacts of dewatering discharge activities on aquatic flora communities. The sampling has shown that algal species richness is impacted, with diatoms and cyanobacteria richness not appearing to be affected. These impacts are expected to continue as a result of the increased dewatering discharge proposed.

The distribution of aquatic flora naturally varies across the lake surface as the whole lake doesn’t completely fill with water during most fill events. The part of the lake’s surface that becomes flooded varies between the different fill events.

Cyanobacteria, diatoms and *Schizothrix* spp. (algal mats) are found in the playas and clay pans adjacent to Lake Lefroy. The algal mats rely on a freshwater flush to undergo germination. Inundation of the playas and clay pans with hypersaline water during a flood event or from dewatering discharge would prevent this freshwater flush from occurring and therefore germination by the *Schizothrix*. The algal mats have an important role in the ecology of the playas and clay pans as a primary producer. Any impacts to the algal mats from mining could be considered significant from an ecological perspective.

Aquatic invertebrate fauna

A number of studies on the invertebrate fauna of Lake Lefroy have been carried out, including those done as part of 2000 EPA assessment of the
mine. In 2009, SIGM commissioned a study to investigate the richness and abundance of aquatic invertebrate communities at Lake Lefroy and to attribute the impacts of mining operations on these assemblages.

Aquatic invertebrate fauna abundance in Lake Lefroy is naturally low and comprises halotolerant species due to the thick salt crust found on the lake’s surface.

Resting stages of macroinvertebrates found on the lake were collected and cultured from discharge and reference sites. None of the specimens collected were found to be viable, which is consistent with the assertion that the lack of a freshwater phase limits the ecological function of the lake (Dalcon Environmental, 2010).

Cysts of some species found on the lake are unlikely to hatch due to the absence of a freshwater stage on Lake Lefroy. These species rely on the freshwater stages in the playas and clay pans surrounding the lake to break cyst dormancy. The playas and clay pans play a vital role in "seeding" Lake Lefroy with aquatic life during a fill event.

Terrestrial fauna

Lake Lefroy is not generally considered a breeding area for migratory birds due to the absence of a freshwater phase (Dames and Moore, 1999), however, migratory birds have been observed in the area. A desktop study has identified a number of migratory birds protected under the Environment Protection and Biodiversity Conservation Act 1999 that would utilise the playas and clay pans after a major cyclonic event. Due to the migratory nature of these birds and the availability of habitat outside the area of inundation, these species are not expected to be impacted by the project.

A terrestrial vertebrate fauna survey was carried out in 2010 consistent with EPA Guidance Statement No. 56 (EPA 2004b). Results from this survey indicate that existing mining operations are having a negative impact on species diversity at sites that had been directly disturbed by mining activities when compared with reference sampling sites, but there was no significant impact on species diversity at dewatering discharge points compared to reference sites.

It is anticipated that there will be some loss of terrestrial fauna as a result of this proposal particularly through direct mortality during clearing and operations, and inundation of the riparian zone. Bolam’s mouse is the only non-bird species of conservation significance recorded in the project area. Bolam’s mouse is considered locally significant because its habitat is restricted to salt lake vegetation. Surveys have not recorded the presence of this mouse in areas proposed for disturbance within the project area.

It is the proponent’s proposition that areas of fauna habitat that have been disturbed do not represent unique or significant habitat and are all
represented elsewhere around Lake Lefroy. Future areas proposed for clearing are also common and well represented habitats.

**Monitoring and Management Measures**

The proponent has proposed to monitor and manage the impacts of the discharge on surface water by:

- Continuation of riparian vegetation health monitoring program with up to three additional monitoring sites added in the southern part of lake that were identified as being potentially inundated during a 1:100 year ARI rainfall event.
- Installation of crest gauges at five locations to record rainfall events. The crest gauges will provide information on surface water levels and salinity, including movement and salinity of flood water. The information obtained from the gauges will be used to provide feedback for modelled data. The exact location of the crest gauges is to be confirmed as part of the plan being developed for ongoing monitoring of the project.
- Expanding existing invertebrate richness and diversity monitoring to include a further three sites in the southern part of the lake that have been identified as being potentially being inundated during a 1:100 year ARI rainfall event. These are the same sites as those proposed for increased riparian vegetation health monitoring.
- Using existing dewatering discharge points (except for one new point) to limit the zone of influence of the dewatering to areas already impacted.
- Implementing measures to promote settlement of sediments out of discharge water prior to it being released to the lake surface.
- Establishing a monitoring program to track heavy metals in the sediment including developing response trigger values for metal levels at reference points outside the current zone of influence of discharge.

**Submissions**

The DEC noted the high level of consultation carried out by the proponent during the assessment process in regards to biodiversity conservation and considers the risk to biodiversity conservation values is adequately addressed in the PER.

**Assessment**

The EPA’s environmental objectives for this factor are to:

- Maintain the integrity, functions and environmental values of the lake.
- Maintain the quality of surface water so that existing and potential uses, including ecosystem maintenance, are protected.
The EPA notes that there will be some impact to terrestrial fauna from this proposal. The DEC has advised that the risk to biodiversity conservation values is adequately addressed. The potential impact on terrestrial fauna is not considered to compromise the EPA objective of conservation of biological diversity due to the availability of similar habitat outside the project footprint and the likely absence of species of conservation significance.

The EPA concurs with the proponent’s conclusion that the hypersaline nature of Lake Lefroy and the absence of a freshwater phase following large rainfall events results in the lake’s surface having low levels of aquatic life. The EPA also notes that the playas and clay pans adjacent to Lake Lefroy are an important part of the lake’s ecosystem in that they provide habitat for species that require a freshwater phase as part of their lifecycle and seed Lake Lefroy with aquatic biota.

The EPA considers that the surface water modelling was carried out with sufficient rigour such that there is a high degree of confidence that the actual area of impact on the riparian zone from inundation will not exceed the predicted area of impact.

The total area of riparian zone potentially disturbed is up to 118.25 ha, being 13 ha of direct disturbance and 106 ha of indirect disturbance through inundation. The area to be disturbed does not contain any Threatened Ecological Communities or Declared Rare Flora. The EPA considers that the direct loss of riparian vegetation from clearing and the loss of riparian vegetation and a freshwater phase in the playas and clay pans through inundation will not significantly impact on the ecological function of the lake as a whole. The areas disturbed represent a small portion of the total riparian zone of Lake Lefroy with the majority of playas and clay pans that fringe the lake not being disturbed by this proposal.

From a cumulative perspective the impact to the riparian zone from existing and future operations will be up to 5.55% of the total riparian zone area of Lake Lefroy.

The EPA considers that monitoring of the playas and clay pans adjacent to Lake Lefroy that may be inundated for riparian vegetation health; surface water and sediment quality; aquatic flora and fauna populations and terrestrial fauna populations, is important to manage the impacts of the project and has recommended a condition to ensure this occurs.

The EPA notes that monitoring to date has shown no observed impacts from the existing dewatering discharge on the aquatic invertebrate fauna in adjacent playas and clay pans.

The increased surface water discharge of up to 30 GL per annum will increase salinity and heavy metal levels on the lake surface. The main area of impact from surface water discharge will be to the Lake Lefroy surface as the heavy metals will generally be immobilised in the sediment. The EPA agrees with the proponent’s conclusion that the environmental values of the lake’s surface
are predominantly influenced by the hypersaline nature of the environment and the absence of a freshwater phase during fill events.

The use of existing dewatering discharge points will limit the impacts of the discharge to those areas already impacted by existing mining operations. The EPA notes that the new discharge point proposed for the Santa Ana pit would be located away from the riparian zone.

The proponent has made a commitment to monitor aquatic biota in the surrounding playas and clay pans during fill events of not less than a 1:20 year magnitude. The EPA considers the commitment to develop a monitoring program for the playas and clay pans is an important part of managing the impacts of the proposal. In view of this, the EPA has recommended a condition to ensure this monitoring occurs.

Given the limited aquatic biota on Lake Lefroy due to the hypersaline conditions, the availability of riparian zone and playa and clay pan habitat outside the modelled area of inundation and the proponent’s proposed management actions, the EPA considers that the surface water discharge is unlikely to significantly impact on the biological diversity and ecological integrity of Lake Lefroy and its surrounds.

**Summary**

Having particular regard to the:

(a) absence of species of conservation significance and the limited aquatic life of the lake’s surface due to the hypersaline nature of Lake Lefroy;

(b) existence of playa and clay pan habitat outside the project area;

(c) predictions from surface water impact modelling; and

(d) potential for DEC to regulate issues in relation to the quality of water discharge, under Part V of the EP Act,

it is the EPA’s opinion that the EPA’s environmental objectives for this factor can be met subject to implementation of the recommended conditions to monitor and manage surface water discharge.

**3.2 Mine closure and rehabilitation**

**Description**

Lake Lefroy is one of the elongated, medium sized salt lakes that occur in chains on the Yilgarn Craton. Lake Lefroy contains numerous natural islands as well as open pit voids, waste dumps and infrastructure from previous mining operations. The lake is bisected by a causeway that was constructed in 1968.
Parts of the lake bed have been disturbed by historical and current mining operations. Over its ten-year mine life the Beyond 2010 proposal would disturb up to a further 440 ha above what was approved to be disturbed for the St Ives mine in the 2000 assessment. The disturbance is for the purpose of mining pits, waste rock dumps, access roads. The additional disturbance would bring the total area disturbed up to 1713 ha.

Rehabilitation was one of the relevant environmental factors discussed in the EPA Report No. 976 with backfilling of voids the primary issue. SIGM has committed to examine opportunities for backfilling of voids.

**Waste Rock Dumps**

The commitment in EPA assessment No. 1250 to rehabilitate waste rock dumps to islands with the same ecological function and landform as undisturbed islands on Lake Lefroy has not been met to date due to three main reasons:

- Given the geological age of the islands, the rehabilitation of the waste dumps could not achieve an outcome similar to the natural islands within an appropriate timeframe.
- The natural features of the islands include features that are not stable and would not comply with DMP guidelines for rehabilitation, such as for steep slopes and erosional properties.
- Topsoil in the area closer to the lake surface is likely to become sterilised due to interaction with hypersaline water and spray. Alternative topsoil sources have been examined, however research trials have failed to identify lake sediments as a growth medium, and harvesting topsoil from land based operations is considered unsustainable.

The proponent acknowledges that the commitment to mimic the naturally occurring islands has not proved possible (Botanica Consulting, 2010).

There have been varying degrees of success of revegetation efforts so far. SIGM lake-based rehabilitation of Mars and Revenge although still young has shown some progress in terms of revegetation. Revegetation efforts have not been successful on Redoubtable, Intrepid or South Delta waste rock dump. Revegetation success at Lake Lefroy is dependent on the availability of topsoil to which a seed mix can be added to encourage vegetation to establish on the dumps. The quantity of topsoil available for rehabilitation of the waste rock dumps has tended to be limited.

There has been some acidic seepage from a waste rock dump associated with pre 2000 mining. Remedial work has been carried out on the dump and acidic seepage is no longer being observed. This highlights the potential for acidic seepage to occur at SIGM and the need to ensure measures are in place to manage potentially acid forming material in the waste rock.
SIGM has established that its overriding closure objective for waste rock dumps is the creation of safe, stable, non-polluting landforms. SIGM believe that by achieving these overriding, non-biotic, objectives the site is set up for the natural successional development of biotic conditions appropriate to the location and level of historical activity. The existing waste rock dumps have been constructed to a height that is significantly higher than the natural islands on Lake Lefroy.

The availability of topsoil to use during rehabilitation of the Beyond 2010 proposal is limited (Botanica Consulting, 2010). Where topsoil, dune sands, or other appropriate growth medium is available the establishment of self-sustaining vegetation to enhance the natural succession will also be a secondary objective. The proposal is to place the topsoil or dune sands in small areas across the waste rock dump to act as a ‘seed bank’ to aid the natural succession of vegetation.

SIGM has indicated that it does not intend to progress with its commitment to rehabilitate the waste rock dumps to mimic the islands. SIGM have instead made the commitment to rehabilitate the waste rock dumps so that they are safe, stable, and non-polluting and have an ecosystem appropriate to the area of disturbance.

SIGM will also progressively reclaim sections of the causeway system across Lake Lefroy as they are no longer required for exploration, development or production purposes. SIGM’s current approach to managing sections of the causeway used for exploration purposes is to ensure that there is no net increase in the footprint of the causeway.

Mine Voids

SIGM has indicated it would backfill pit voids where it is economically viable and there is sufficient overburden waste available for use to backfill to lake level. SIGM have established a number of internal economic and mine planning criteria for determining if it is viable to backfill pits. Under current mine planning for the Beyond 2010 proposal, there is approximately 95 million tonnes of waste rock for which disposal to waste rock dumps has not be accounted for. This overt strategy by SIGM not to account for the 95 million tonnes means the waste rock will need to be disposed of via backfilling of mine voids.

SIGM has proposed that final voids that are left open will be surrounded with abandonment bunds to restrict access as required under the Mining Act 1978 and will be allowed to flood back to the natural groundwater table level after salvageable equipment and infrastructure have been removed.

Open pit voids from existing operations have rapidly filled with water back to the natural groundwater level once dewatering has ceased. Over time the salinity levels in open voids are expected to slowly increase above the background levels found in Lake Lefroy (Johnson and Wright, 2003).
As the groundwater is hypersaline and has limited beneficial uses, any salinity increase in the final void will have no adverse impact on groundwater suitability (Johnson and Wright, 2003).

**Mine Closure Plan**

SIGM prepared a Draft Mine Closure Plan (DMCP) in June 2008 which outlines the planning process (i.e. standards and obligations, objectives, issue identification) and includes information for major components of the operation including, programs, investigations etc required to address knowledge gaps. The DMCP is an evolving document which is regularly updated by SIGM.


**Submissions**

There were no submissions in response to this factor.

**Assessment**

The EPA’s environmental objectives for this factor are to:

- ensure that closure and rehabilitation achieves stable, non polluting and functioning landforms which are consistent with surrounding landscape and other environmental values;

- ensure that self-sustaining native vegetation communities are returned after mining, which in species composition and ecological function are close as possible to naturally occurring analogue sites; and

- ensure that mining is planned and carried out so as to ensure a sustainable mine closure outcome is achieved, consistent with mining industry best practice as set out in the Department of Mines and Petroleum and Environmental Protection Authority *Guidelines for Preparing Mine Closure Plans*, 2011.

The EPA notes that the proponent prepared a draft mine closure plan in 2008 which is in accordance with the Australian and New Zealand Minerals and Energy Council/Minerals Council of Australia (ANZMEC/MCA) (2000) *Strategic Framework for Mine Closure*. The EPA also notes that the closure plan has been provided to the DMP and the DEC for review and comment. The DMCP was prepared before the DMP/EPA *Guidelines for Preparing Mine...*
Closure Plans were released in 2011. Subsequent reviews of the DMCP will bring it in line with these guidelines.

The EPA notes that the proponent has maximised the use of existing disturbed areas to limit the amount of area required to be rehabilitated. It is also noted that the the proposal area specifically excludes islands on Lake Lefroy that have not already been disturbed by mining and that the proponent commits to not disturbing any islands that remain undisturbed.

The EPA acknowledges that the proponent has committed to progressive backfilling, rehabilitation and post-closure monitoring. The EPA notes that the proponent has developed a set of conceptual closure objectives which would be revised and made more specific to the closure issues associated with the proposal over the life of the project.

It is also acknowledged that the availability of topsoil is a limiting factor in achieving successful revegetation of rehabilitated areas. It is recognised that sourcing topsoil from areas outside the project area is not considered sustainable and trials to utilise other growth mediums such as lake sediments have had limited success. The EPA further notes that this will mean that waste rock dumps will be constructed to be safe, stable and non-polluting but will have limited topsoil applied and will rely on the long-term process of natural succession to restore some ecosystem function.

During the assessment the proponent has indicated current mine planning has resulted in approximately 95 million tonnes of waste for which disposal to a waste rock dump is currently not considered. The intention of the proponent is that this waste be used to backfill pits. It is the EPA’s expectation that this 95 million tonnes is used for backfilling. If the proponent cannot meet the EPA’s expectation of backfilling, the proponent should refer the change to the EPA for assessment.

The number of pits backfilled to date has been less than the number envisaged during the 2000 EPA assessment process. The proponent’s commitment to submit a three-year rolling plan as part of its annual environmental reporting that identifies opportunities to progressively backfill mine pits is supported. The EPA considers that the proponent must realistically strive to backfill the maximum number of voids possible. In this regard, it should be noted that the proposal specifies the maximum area open within the project area and the height of any waste dumps. This also serves to ensure that backfilling occurs during implementation of the proposal.

In view of the statutory requirements of the Mining Act 1978, the EPA is satisfied that rehabilitation, and mine closure and decommissioning can be managed by the DMP consistent with the DMP/EPA Guidelines for Preparing Mine Closure Plans.

The EPA considers that over a long-term timeframe its objectives for this factor can be met.
Summary

Having particular regard to the:

(a) SIGM Lake Based Operations Closure Plan;
(b) the commitment to backfill voids; and
(c) closure and rehabilitation being managed by the DMP in accordance with the requirements of the *Mining Act 1978*,

it is the EPA’s opinion that its environmental objectives for this factor can be managed.

3.3 Environmental principles

In preparing this report and recommendations, the EPA has had regard for the object and principles contained in s4A of the EP Act. Appendix 3 contains a summary of the EPA’s consideration of the principles.

4. Conditions

Section 44 of the EP Act requires the EPA to report to the Minister for Environment on the key environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

4.1 Recommended conditions

Having considered the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by St Ives Gold Mining Company Pty Limited to develop further lake based gold mining developments at Lake Lefroy, is approved for implementation.

These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) development of a monitoring program, particularly to monitor any impacts on the riparian zone of Lake Lefroy and the playas and clay pans that are adjacent to the lake;
(b) monitoring the area of inundation of the lake following large rainfall events;
(c) using data collected during monitoring to verify the predicted area of impact from the surface water model developed by the proponent;
(d) determining management measures and plans to implement the measures should the actual area of inundation exceed the predicted area of impact; and

(e) avoidance of an increased zone of influence on surface water and sediment quality from heavy metals discharged during dewatering.

It should be noted that other regulatory mechanisms relevant to the proposal are:

- **Rights in Water and Irrigation Act 1914** – licence for abstraction (dewatering);
- **Wildlife Conservation Act 1950** – licence to handle and remove native fauna from construction areas;
- **Part V of the Environmental Protection Act 1986** – various Works Approvals and an operating Licence are required for construction and operation of the St Ives gold mine;
- **Mining Act 1978** – the mining proposal requires approval by the DMP.
- **Explosive and Dangerous Goods Act 1961** – dangerous goods licence;
- **Dangerous Goods Safety Act 2004** – licence for the storage, handling and transport of dangerous goods;
- **Environmental Protection (Noise) Regulations 1997** – for construction and operational noise; and
- **Aboriginal Heritage Act 1972** – to protect Aboriginal Heritage sites

### 4.2 Consultation

In developing these conditions, the EPA consulted with the proponent and the departments of Environment and Conservation, Water, and Mines and Petroleum in respect of matters of fact and matters of technical or implementation significance. Minor changes, which did not change the intent or scope, were made to conditions 4-6, 6-2 and 7-1 to 7-3. A minor change was made to the key characteristics of the proposal, being the rounding up of the direct riparian zone disturbance from 89.25 ha to 90 ha.

### 5. Other advice

The assessment highlights that there is potential for a build up of heavy metals at the site of dewatering discharges. The EPA recommends that the DEC amend Environmental Licence L4570/1988/11 that covers the dewatering discharge to include heavy metals so it can be demonstrated discharges are consistent with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australia and New Zealand Environment and Conservation Council, 2000).

It should be noted that the project area for the Beyond 2010 proposal incorporates those areas managed under the existing MS 548. The
recommended Ministerial conditions for this proposal are consistent with the requirements of the existing Ministerial Statement. The EPA is aware however, that the previous Ministerial Statement contains a series of commitments that may no longer be relevant. The EPA would support a Section 46 change to implementation conditions to ensure that a single contemporary and consolidated Ministerial Statement applies across the proposal area.

Recommendations

The EPA submits the following recommendations to the Minister for Environment:

1. That the Minister notes that the proposal being assessed is for further development of gold mining operations at Lake Lefroy and discharge of water to the lake;

2. That the Minister considers the report on the key environmental factors and principles as set out in Section 3;

3. That the Minister notes that the EPA has concluded that it is likely that the EPA’s objectives would be achieved provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4 and summarised in Section 4;

4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report; and

5. That the Minister supports a section 46 change to Ministerial Statement 548 under the Environmental Protection Act so that a single ministerial statement applies across the proposal area.
Appendix 1

List of submitters
Organisations:
Department of Indigenous Affairs
Department of Environment and Conservation
Department of Water

Individuals:
One public submission
Appendix 2

References


Appendix 3

Summary of identification of key environmental factors and principles
<table>
<thead>
<tr>
<th>Preliminary Environmental Factors</th>
<th>Proposal Characteristics</th>
<th>Government Agency and Public Comments</th>
<th>Identification of Key Environmental Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BIOPHYSICAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acid drainage</td>
<td>Lake Lefroy has a number of existing waste rock dumps. Ore mined to date has generally not been associated with acid generating material. The highest risk material is found in the overburden associated with mine development. The proponent has an existing database of acid rock drainage characterisation test work for lake-based mining areas. Using the information in this database the proponent has completed a general assessment of the potential for acid generating wastes to be present. This information indicates the likelihood of potentially acid forming (PAF) waste to be encountered and will be used in waste rock disposal planning when determining measures to manage PAF material.</td>
<td>No submissions were received</td>
<td>Not considered to be a key environmental factor Can be managed by the Department of Mines and Petroleum through the mine closure and rehabilitation plan required to be prepared by the proponent under the Mining Act 1978.</td>
</tr>
<tr>
<td>Surface water hydrology and bathymetry</td>
<td>Lake Lefroy is a highly salinised lake system. The lake has a thick halite salt crust which prevents Lake Lefroy from experiencing a freshwater phase, like other salt lakes in the region, after significant rainfall events. The lake bed is flat and corresponds with the capillary fringe of the groundwater table. Increased dewatering discharge and disturbance of the lake surface as a result of the proposal has the potential to alter the hydrology of the lake, including</td>
<td>No submissions were received</td>
<td>Considered to be a relevant environmental factor and discussed under Section 3.1 – Surface water discharge.</td>
</tr>
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</table>
increased inundation of the riparian zone.

Modelling by the proponent indicates that if the proposal was implemented the area of riparian zone inundation will be 3.0% greater than what is naturally inundated during a 1 in 100 year rainfall event, which represents approximately 106ha of the riparian zone. The riparian zone will also be inundated with hypersaline water for longer periods than what would occur under natural conditions, creating further adverse impacts.

The potential impacts of riparian zone inundation are loss of riparian vegetation and loss of ecosystem function in the small playas and clay pans surrounding Lake Lefroy. These playas and clay pans currently experience the freshwater phase that Lake Lefroy does not undergo following larger rainfall events. The playas and clay pans will be inundated with hypersaline water if the rise in the lake water level is sufficient to break through the dune system that fringes Lake Lefroy.

Modelling by the proponent shows that the natural inundation period of the riparian zone from a 1:100 year rainfall event is between 74 and 265 days depending on evaporative conditions. The Beyond 2010 proposal if executed in full is predicted to increase the period of inundation by 27 to 31%.

| Surface water quality | Surface water at Lake Lefroy is hypersaline, with salinity levels up to 569,000 mg/L being recorded. The surface water has a dominant sodium chloride signature and is neutral to weakly acidic. High | No submissions were received | Considered to be a relevant environmental factor and discussed under Section 3.1 – Surface water discharge |
background levels of some heavy metals can be found.

The increased dewatering discharge will lead to localised increases in the salt and sediment load on the lake surface.

Discharge from existing operations at Lake Lefroy have resulted in increased levels of heavy metals in surface water around the discharge points due to the hydro chemical properties of the groundwater being discharged.

Water quality testing in 2009 showed that levels of most heavy metals tested were higher at discharge sites compared to reference sites, with cobalt, copper, lead and nickel exceeding the Australian and New Zealand Guidelines for Fresh and Marine Water Quality trigger values at the 80% species protection level.

This increase in heavy metals is expected to continue due to the further dewatering discharge. Although monitoring suggests that the increase are confined to areas around the discharge as the heavy metals tend to get absorbed and immobilised in the sediment at the discharge sites (see sediment quality below).

Avifauna that come into contact with the surface water are the biota considered most susceptible to increased heavy metal concentrations. Lake Lefroy is not generally considered a breeding area for migratory birds due to the absence of a freshwater phase which limits the potential impact on avifauna, however
**Groundwater**

A series of palaeochannels in-filled with fine to coarse-grained sand forms the most significant aquifer of the Lefroy Palaeodrainage system in the Lake Lefroy area. Groundwater occurs within fractures in the palaeochannel sediments and bedrock. On a regional scale, groundwater discharges to the Lake Lefroy system.

The Lefroy Palaeodrainage system and its underlying fractured rock aquifers form a complex series of groundwater flow paths, which experience recharge and loss from hydraulic interconnections as well as rainfall, runoff and evaporation.

Groundwater in the project area is hypersaline and ranges from 274,000 mg/L TDS to 423,000 mg/L TDS.

**Department of Water**

The proposal is located in the Goldfields Groundwater Area which is proclaimed under the Rights in Water and Irrigation Act. There may be a requirement to obtain a licence for the use of groundwater, or to modify an existing licence.

**Not considered to be a key environmental factor**

The increased take of abstraction of groundwater is not considered to cause significant environmental issues as the highly saline water does not support any groundwater dependent ecosystems and it has few beneficial uses.

The environmental impacts to the riparian zone and surface water quality from discharge of the groundwater to the lake surface are potentially
The beneficial uses of the groundwater in the area are thought to be limited because of its hypersaline nature. In addition, no groundwater-dependent ecosystems have been identified that will be impacted by the abstraction of water.

Groundwater is currently abstracted under a licence issued by the Department of Water pursuant to the *Rights in Water and Irrigation Act 1914*. An increase in licensed volume from 24.3 GL per annum to 30 GL per annum would be required to meet dewatering requirements for the proposal.

The Department of Water is waiting on the results of the EPA assessment of this proposal before deciding whether to increase the allocation limit to 30 GL.

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**Sediment quality**

The sediment of Lake Lefroy is similar to that of other salt lakes in Western Australia, in that it has an alkaline pH, high salinity and is dominated by sodium and chloride. The quality of sediment varies across the Lake Lefroy surface and is influenced by the geology, geography and stage of the hydrocycle during sampling. The sediment quality is also affected by existing dewatering discharge.

The high salinity of the lake promotes settlement of sediment that has become suspended in the water column, facilitating the relatively quick movement of heavy metals in the surface water into the sediment.

Sampling carried out by SIGM shows that the sediment at Lake Lefroy exhibits similar heavy metals levels to

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Not considered to be a key environmental factor

The PER outlines a number of management measures to limit the increase of heavy metals in sediments. They are:

- Use existing discharge points to limit distribution of heavy metals to areas already impacted.
- Implement sediment reduction measures prior to discharging water to the lake surface.
- Develop a sediment...
the surface water. The sediment at dewatering discharge locations exhibits elevated heavy metals concentrations, according to the quality of groundwater discharge.

There is expected to be further localised increases in sediment loads at discharge points due to an increase in the volume of water being discharged.

Heavy metal concentrations at discharge points are expected to increase above background levels if dewatering discharge continues. Sampling at existing discharge points has shown increases in the concentration of arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, vanadium and zinc in the sediment.

The impacts of the increase salt, heavy metal and sediment loads will be localised in nature and be in areas of low biotic diversity and abundance.

| Flora and vegetation | The proposal has the potential to impact on halotolerant aquatic flora and vegetation in the riparian zone.  

*Aquatic flora*

Aquatic flora found on Lake Lefroy is in the form of halotolerant species of diatoms, cyanobacteria and algae. Microflora are usually the only primary producers in nutrient poor environments like salt lakes and therefore provide an important function to the ecology. |
| Department of Environment and Conservation  
For matters related to biodiversity conservation, the DEC commended the proponent for the level of consultation conducted during the assessment process and considers that the risk to monitoring program that monitors the zone of influence of elevated heavy metals and response triggers based on ANZECC water quality guidelines.  
The EPA considers that the potential impacts of increased heavy metals in the sediment are minimal due to a lack of environmental values in the sediment.  
The impact of higher heavy metal concentrations in the surface water itself (i.e. before the metals settle out into the sediment) is considered to be a key environmental issue and discussed in Section 3.1 – Surface water discharge. |
| Considered to be a key environmental factor and discussed in Section 3.1 – Surface water discharge. |
Sampling carried out by the proponent shows that species richness for aquatic flora is higher at reference sampling sites compared with dewatering discharge sampling sites indicating some impacts of dewatering activities on aquatic flora communities. The sampling has shown that the impacts are on algal species of microflora, with diatoms and cyanobacteria richness not appearing to be affected. These impacts are expected to continue as a result of the increased dewatering proposed.

The distribution of aquatic flora varies across the lake surface as the section of the surface that floods varies between the different fill events.

*Schizothrix* algal mats are found in the playas and clay pans surrounding Lake Lefroy, and are an integral part of the ecosystem. The algal mats rely on a freshwater phase following rainfall as the freshwater flush triggers germination.

This proposal commits to no direct disturbance of these playas and clay pans, however there is potential for indirect disturbance due to inundation of hypersaline water preventing a freshwater phase in the playas and clay pans.

*Riparian vegetation*

Lake Lefroy is low lying and devoid of vegetation except biodiversity conservation values is adequately addressed.
for the riparian zone. The vegetation around the shoreline is dominated by samphires, with some species growing a few centimetres above the lake margin. Vegetation in this area is periodically inundated with water from the lake. Samphires are also found on the Aeolian plateaus and dunes surrounding the lake. Other dominant vegetation species found in the Aeolian dunes are the shrubs Tecticornia, Frankeria and Darwinia sp..

Further from the lake, *Eucalyptus* woodland and *Acacia* and *Allocasuarina* thickets dominate the woodlands surrounding the riparian zone.

The proposal will have direct impacts on the riparian zone through the clearing of 13 ha of riparian vegetation for the development of the Pistol Club Pit, Neptune Pit and Thunderer Cutback. This represents 0.35% of the total riparian zone of Lake Lefroy. When combined with approved clearing carried out as part of the 2000-2010 project, the total area of the riparian zone disturbed will be 90 ha or 2.55% of the riparian zone. There has been no Declared Rare or Priority flora species recorded in the Pistol Club or Neptune disturbance areas or any listed Threatened Ecological Communities or Priority Ecological Communities.

Increased dewatering discharge may cause impacts by inundating the riparian zone. Modelling carried out by SIGM predicts that 3% more of the total riparian vegetation will be inundated due to the combined effects of the dewatering discharge, increased
disturbance footprint and a 1:100 year flood event, compared with inundation of 1.6% due to just a 1:100 year flood event i.e. total inundation will be 4.6% of the riparian zone, which equates to 106 ha.

Vegetation that is inundated with hypersaline water for more than 20 days is unlikely to survive. Based on the modelling provided by SIGM, the area inundated will be underwater for between 94 and 347 days, meaning the vegetation in the 4.6% of the riparian zone that is inundated will be lost if the project is at its maximum disturbance footprint, dewatering discharge is 30 GL and a 1:100 rainfall event occurs.

| Aquatic invertebrate fauna | The disturbance of the lake bed and an increase in dewatering discharge has the potential to impact on the aquatic invertebrate fauna of Lake Lefroy. A number of studies on the invertebrate fauna of Lake Lefroy have been carried, including those done as part of 2000 EPA assessment of the mine and its ongoing operation. In 2009 SIGM commissioned a study to investigate the richness and abundance of aquatic invertebrate communities at Lake Lefroy and to attribute and impacts of mining operations on these assemblages. Aquatic invertebrate fauna abundance in Lake Lefroy is naturally low and is limited to halotolerant species due to the thick salt crust found on the lake’s surface. No impacts from dewatering discharge on aquatic macroinvertebrate resting stages have been observed | Department of Environment and Conservation

For matters related to biodiversity conservation, the DEC commended the proponent for the level of consultation conducted during the assessment process and considers that the risk to biodiversity conservation values is adequately addressed. | The impacts to aquatic invertebrate fauna from dewatering discharge on Lake Lefroy itself is not considered to be a key environmental factor. Impacts to aquatic invertebrate fauna on Lake Lefroy are expected to be minimal due to the low abundance and absence of freshwater phase on the lake. The proponent has committed to monitoring aquatic invertebrate fauna following a 1:20 year rainfall event (defined as 100mm in a 72 hour period) to determine if this low abundance continues as expected. |
Cysts of some species found on the lake are unlikely to hatch due to the absence of a freshwater stage on Lake Lefroy. These species rely on the freshwater stages in the playas and clay pans surrounding the lake to break cyst dormancy. SIGM were approved to disturb 2.4 ha of playas and clay pans during the 2000 EPA assessment.

The surrounding playas and clay pans are considered a much more viable and valuable habitat for aquatic invertebrate fauna.

No further direct disturbance of the playas and clay pans is proposed as part of the Beyond 2010 proposal.

The impacts from dewatering discharge on aquatic invertebrate fauna communities in the playas and clay pans surrounding Lake Lefroy are considered to be a key environmental factor and discussed in Section 3.1 – Surface water discharge.

<table>
<thead>
<tr>
<th>Terrestrial fauna</th>
<th>Terrestrial vertebrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>A survey targeted at the riparian zone and habitat was commissioned for this assessment as disturbance of the terrestrial environment as part of this project is confined to the riparian zone.</td>
<td></td>
</tr>
<tr>
<td>Six conservation significant species were recorded in the project area. Five of which were birds and one a mammal.</td>
<td></td>
</tr>
</tbody>
</table>

Department of Environment and Conservation

For matters related to biodiversity conservation, the DEC commended the proponent for the level of consultation conducted during the assessment process and considers that the risk to

Not considered to be a key environmental factor

The riparian zone of Lake Lefroy is similar to that of other saline lakes in the region, and exhibits typical terrestrial invertebrate fauna composition, with no short range endemics, Priority Ecological Communities or
The bird species identified were the Rainbow Bee-eater (*Merops ornatus*); the Shy Heathwren (*Calamanthus (Hylacola) cautus whitlocki*); the Crested Bellbird (southern sp.) (*Oreocia gutturalis gutturalis*); the Scarlet-chested Parrot (*Neophema splendid*); and the Redthroat (*Sericornis brunneus*). The mammal was Bolam’s Mouse (*Pseudomys bolami*).

The Rainbow Bee-eater is listed as migratory and protected under the *Environment Protection and Biodiversity Conservation Act 1999*. The proposal was referred to the then Department of Environment, Water, Heritage and the Arts (now the Department of Sustainability, Environment, Water, Population and Communities) under this act. DEHWA determined that the proposal does not constitute a controlled action and does not require further assessment or approvals under the EPBC Act.

Fauna habitat in the area has been disturbed by existing mining operations and recreational activities around the lake.

The proponent has committed to managing the terrestrial vertebrate fauna by minimising areas to be cleared and using existence disturbance footprints were possible; carrying out targeted searches of the riparian zone before clearing to identify sedentary species for relocation and clearing Pistol Club pit area between February and October to minimise the potential for impacting on breeding and nesting Rainbow Bee-

<table>
<thead>
<tr>
<th>biodiversity conservation values</th>
<th>adequately addressed.</th>
</tr>
</thead>
</table>

**Threatened Ecological Communities** identified. As such whilst an impact may occur, it does not compromise the EPA objective for biodiversity protection given the lack of endemic environmental values in the existing environment and the available remnant habitat in the Goldfields.

The proponent has committed to carrying out a targeted search of the riparian zone to identify sedentary vertebrate fauna species for relocation prior to clearing.

Terrestrial fauna habitat has been disturbed by previous mining activity. As there is alternative habitat outside the project area the impacts are not considered to be significant.
Terrestrial Invertebrates

Survey work carried out over a number of years has identified 387 species of terrestrial invertebrates within the riparian zone. None of these species identified were listed as threatened under the *Wildlife Conservation Act 1950*.

Surveys carried out in 1999 and 2009 indicate that dewatering discharge has had no apparent impacts on terrestrial invertebrate assemblages. Discharge and reference (control) sampling sites showed no statistical difference in abundance, richness and composition of terrestrial invertebrate fauna. There were differences between all sites with respect to species richness and abundance, regardless of if they were reference or discharge sites.

<table>
<thead>
<tr>
<th>Subterranean fauna</th>
<th>Department of Environment and Conservation</th>
<th>Not considered to be a key environmental factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>A desktop assessment for the proposal indicated that the likelihood of stygofauna being present in the project area was rare to nil due to the salinity being above 170,000 mg/L. The presence of stygofauna in such high salinities is considered unlikely. The island structures of Lake Lefroy provide potential habitat for troglofauna communities at Lake Lefroy. SIGM has committed to not disturb any islands that aren’t already disturbed which will protect any troglofauna habitat.</td>
<td>For matters related to biodiversity conservation, the DEC commended the proponent for the level of consultation conducted during the assessment process and considers that the risk to biodiversity conservation values is adequately addressed.</td>
<td></td>
</tr>
</tbody>
</table>
Lake Lefroy is one of the elongated, medium sized salt lakes that occur in chains on the Yilgarn Craton. Lake Lefroy contains numerous natural islands as well as open pit voids, waste dumps and infrastructure from previous mining operations. The lake is bisected by a causeway that was constructed in 1968.

Mining developments on and around the lake have the potential to disturb the hydrological and ecological processes and shoreline areas.

This proposal will include the modification of landforms on the lake. However, SIGM has committed to not disturb any islands that are currently undisturbed.

Rehabilitation was one of the relevant environmental factors discussed in the EPA Report No. 976 with backfilling of voids the primary issue. SIGM has committed to examine opportunities for backfilling of voids as part of this assessment and for future closure planning.

SIGM prepared a Draft Mine Closure Plan (DMCP) in June 2008. SIGM have committed to providing an updated closure plan for review by the DEC, DMP and EPA. The current DMCP was prepared before the development of the EPA/DMP Guidelines for the Preparation of Mine Closure Plans.

In 2000, SIGM committed to rehabilitating waste rocks dumps to a state that mimics the ecosystem of the

<table>
<thead>
<tr>
<th><strong>Mine closure and rehabilitation</strong></th>
<th><strong>No submissions were received</strong></th>
<th><strong>Considered to be a key environmental factor and discussed in Section 3.2 – Mine closure and rehabilitation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Lefroy is one of the elongated, medium sized salt lakes that occur in chains on the Yilgarn Craton. Lake Lefroy contains numerous natural islands as well as open pit voids, waste dumps and infrastructure from previous mining operations. The lake is bisected by a causeway that was constructed in 1968. Mining developments on and around the lake have the potential to disturb the hydrological and ecological processes and shoreline areas. This proposal will include the modification of landforms on the lake. However, SIGM has committed to not disturb any islands that are currently undisturbed. Rehabilitation was one of the relevant environmental factors discussed in the EPA Report No. 976 with backfilling of voids the primary issue. SIGM has committed to examine opportunities for backfilling of voids as part of this assessment and for future closure planning. SIGM prepared a Draft Mine Closure Plan (DMCP) in June 2008. SIGM have committed to providing an updated closure plan for review by the DEC, DMP and EPA. The current DMCP was prepared before the development of the EPA/DMP Guidelines for the Preparation of Mine Closure Plans. In 2000, SIGM committed to rehabilitating waste rocks dumps to a state that mimics the ecosystem of the</td>
<td>No submissions were received</td>
<td>Considered to be a key environmental factor and discussed in Section 3.2 – Mine closure and rehabilitation</td>
</tr>
</tbody>
</table>
natural islands. Attempts to do this to date have not been successful, and will never be, due to a number of reasons detailed in the PER document.

SIGM have committed to rehabilitating waste rock dumps to a state that is safe, stable, and non-polluting and has an ecosystem appropriate to the area of disturbance, but does not mimic the ecosystem of the islands. The waste rock dumps would be left in a state that encourages natural succession of the ecosystem.

SIGM will also provide a 3 year rolling plan to the EPA as part of its annual reporting commitments which will include the details of further rehabilitation planning, including the backfilling of pit voids.

<table>
<thead>
<tr>
<th>POLLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noise and vibration</strong></td>
</tr>
<tr>
<td>The development of the Pistol Club pit 1.6 kilometres south of Kambalda East has the potential for increased noise levels at residential properties in Kambalda East and the camping grounds at the Kambalda Trotting Club.</td>
</tr>
<tr>
<td>SIGM commissioned modelling of the impacts of noise during the construction and mining phases of the Pistol Club pit.</td>
</tr>
<tr>
<td>The modelling predicts that overburden removal during construction of the mine will not be able to meet night time regulatory noise limits and during certain wind conditions daytime and evening mining will not be able to meet noise limits.</td>
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</table>
The acoustic modelling carried out by SIGM indicates that night time mining at Pistol Club may not be able to meet the 35 dB(A) regulatory noise limit. (1-2 dB above the limit).

Different locations for the Pistol Club pit waste rock stockpile were considered in the modelling to determine any potential increase in noise buffering effects from different locations.

SIGM has committed to developing a noise management plan in consultation with the Shire of Coolgardie and Kambalda residents that ensures compliance with noise regulations.

- That the proponent should submit a noise management plan with respect to the construction phase of the proposal. Final approval of the noise management plan would be at the discretion of the Shire of Coolgardie.

- That the proponent provides more information with the respect to the practicality of the recommended/proposed noise control measures for predicted exceedences of assigned levels under model scenario 2.

Pistol Club pit
- noise control measures on fleet machinery operating in Pistol Club pit.

The EPA considers that this factor can be managed under the *Environmental Protection (Noise) Regulations 1997.*

| Contaminated sites | In 2007, SIGM reported one known and 20 suspected contaminated sites to DEC. The known contaminated site is an uncapped tailings storage facility at the Paris mine site, which is a historical mine site not operated by SIGM. The number of contaminated sites could increase due to the accumulation of heavy metals in sediments at dewatering discharge locations and hydrocarbon contamination through the continued use of workshop and refuelling areas located on raised pads on the lake surface. SIGM's closure plan is to remediate contaminated sites | No submissions were received |

*Not considered to be a key environmental factor*  
The EPA considers that this factor can be managed under the *Contaminated Sites Act 2003* and through the draft mine closure plan.
on the lake surface as well as those at land based operations.

<table>
<thead>
<tr>
<th>Greenhouse gas emissions</th>
<th>In Financial Year 2009 SIGM reported emissions of 265,000 tonnes of CO₂ equivalent. SIGM predicts it will continue to emit similar emission levels per year throughout the project.</th>
<th>No submissions were received</th>
<th>Not considered to be a key environmental factor</th>
</tr>
</thead>
</table>
| Air quality             | Current air emissions within the Lake Lefroy area are primarily from SIGM existing operations and other mining operations located on and near the lake. SIGM operations also contribute to dust in the area.  
This proposal is for the use of the existing power plant and processing facilities at Lake Lefroy so the air quality impacts as approved under the 2000 assessment (EPA Assessment No. 1250) would be expected to continue. 

The Kambalda Nickel Concentrator operated by BHP Billiton contributes to an altered ambient air quality at Kambalda East. 

Development of the Pistol Club pit is expected to create dust from blasting and haulage that could impact on the Kambalda township. SIGM would need to manage the dust to minimise impacts on the township. | No submissions were received | Not considered to be a key environmental factor | Can be managed through existing operational licences under the *Environmental Protection Act 1986 (WA)* |

**SOCIAL SURROUNDINGS**

| Aboriginal heritage | The Ngadju and Widji groups have registered native title claims over parts or all of the SIGM leases.  
In the last 3 years SIGM has conducted two ethnographic and archaeological surveys with these groups to help identify areas of heritage value in the | Department of Indigenous Affairs | Not considered to be a key environmental factor | Can be managed under the *Aboriginal Heritage Act 1972 (WA)* |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------------|---------------------------------------------------------------|
The surveys were conducted in accordance with the requirements of the *Aboriginal Heritage Act 1972* and EPA Guidance Statement No. 41.

These surveys focussed on the areas of riparian zone proposed for disturbance, the lake and the islands within the lake.

Preliminary surveys on land based sites have also been carried out at the proposed Pistol Club mine; at the existing Argo discharge and hydroslide; at the existing Leviathan discharge area and the proposed Thunderer/Neptune mine expansion.

No heritage sites have been identified in the project area. However, the Pistol Club development requires further in depth survey prior to commencing clearing for this operation.

The Department of Indigenous Affairs has advised SIGM that the Central West Goldfields and the Kalamaia Kabu(d)jn Peoples may have relevant cultural knowledge of the land surrounding Lake Lefroy. SIGM has commenced engagement with these groups.

The DIA commented that SIGM had demonstrated awareness of the section 18 process and is satisfied that if SIGM meets its commitments relating to Aboriginal heritage made in the PER that it will be able to effectively manage Aboriginal heritage within its area of operations and surrounds.

<table>
<thead>
<tr>
<th>Australian and European heritage</th>
<th>There are no Australian or European heritage sites within the project area. Red Hill and the Kambalda township are the nearest sites with potential heritage value.</th>
<th>No submissions were received</th>
<th>Not considered to be a key environmental factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourism, recreation and</td>
<td>Recreational and tourist activities carried out on and around Lake Lefroy include motorbike riding, hiking,</td>
<td>No submissions were received</td>
<td>Not considered to be a key environmental factor</td>
</tr>
<tr>
<td>surrounding land use</td>
<td>land sailing and photography. These activities tend not to be controlled and have caused impacts to some areas of the riparian zone of the lake. Due to the size of the lake and the access restrictions in place for active mining areas, these activities have tended to occur away from the mining areas.</td>
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<td></td>
</tr>
<tr>
<td>Public health and safety</td>
<td>The proposal is in an existing mining area and public health and safety control measures are in place according to the relevant regulatory requirements. The Lake Lefroy causeway is the main access to the site and is as a point to restrict access by the public. SIGM has held community forums to keep the local community members abreast of any safety issues and will continue to do so. Public access to Pistol Club pit via roads near the Kambalda Trotting Club may be possible. Exclusion bunds, fences and signage will be erected to prevent public access to mining areas. The Red Hill walk trail would be closed for short periods during blasting as part of the blast exclusion zone due to the risk of fly rock and debris causing injury or death. A detailed public safety plan needs to be prepared by the proponent that addresses this.</td>
<td>Public One submitter was concerned that the project would disturb radioactive material that was buried on the lake by Western Mining Corporation.</td>
<td>Not considered to be a key environmental factor Discussions between the proponent and the submitter confirmed that the location of the buried material is not within the lake but is in Ngalbain Location 68 which is outside the area subject to this assessment. The EPA considers that safety issues can be managed under the Mines Safety and Inspection Act 1995 (WA).</td>
</tr>
<tr>
<td>Visual amenity</td>
<td>The natural landscape of Lake Lefroy has been significantly altered by existing and historical mining operations, impacting on the visual amenity of the area.</td>
<td>No submissions were received</td>
<td>Not considered to be a key environmental factor</td>
</tr>
</tbody>
</table>
The disturbance is expected to align with the central corridor of the existing disturbance and Lake Lefroy and have minimal additional impacts to the visual amenity of Lake Lefroy.

The Pistol Club pit will impact on the visual amenity of the Red Hill area. There are existing mining operations in this area including a nickel mine operated by Consolidated Minerals Limited.

<table>
<thead>
<tr>
<th>PRINCIPLES</th>
<th>Principle</th>
<th>Relevant</th>
<th>If yes, Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The precautionary principle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk-weighted consequences of various options.</td>
<td>Yes</td>
<td>In considering this principle, the EPA notes the following: • Investigations of the biological and physical environments provided background information to assess risks and identify measures to avoid or minimise impacts. • The assessment of the adequacy of these impacts and management is provided in Section 3 of this report. • Conditions have been recommended where considered necessary.</td>
<td></td>
</tr>
<tr>
<td>2. The principle of intergenerational equity</td>
<td></td>
<td></td>
<td>Rehabilitation of waste rock dumps to an ecosystem function</td>
</tr>
</tbody>
</table>

The present generation should ensure that the
health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.

| Conservation of biological diversity and ecological integrity should be a fundamental consideration. | Yes | In considering this principle, the EPA notes the following:  
• Scientific studies have contributed to the understanding and management of impacts of mining operations on biodiversity and ecological integrity of the area.  
• The above impacts have been assessed and provided in Section 3 of this report. |

| 3. The principle of the conservation of biological diversity and ecological integrity | | |

| 4. Principles relating to improved valuation, pricing and incentive mechanisms | Yes | The proposal would require decommissioning and rehabilitation. The proponent should bear the cost of any potential pollution, containment, monitoring, management, mine closure and rehabilitation. |

| (1) Environmental factors should be included in the valuation of assets and services. | | |
| (2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. | | |
| (3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use | | |
of natural resources and assets and the ultimate disposal of any waste.

(4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximize benefits and/or minimize costs to develop their own solution and responses to environmental problems.

5. The principle of waste minimisation

| All reasonable and practicable measures should be taken to minimize the generation of waste and its discharge into the environment. | In considering this principle, the EPA notes the following:  
• The proposal would generate waste rock.  
• Geotechnical investigations indicate that there is a negligible potential for Acid Rock Drainage to occur;  
• Saline water would be discharged to the lake’s surface. |
Appendix 4

Identified Decision-making Authorities
and
Recommended Environmental Conditions
Identified Decision-making Authorities

Section 44(2) of the *Environmental Protection Act 1986* (EP Act) specifies that the EPA’s report must set out (if it recommends that implementation be allowed) the conditions and procedures, if any, to which implementation should be subject. This Appendix contains the EPA’s recommended conditions and procedures.

Section 45(1) requires the Minister for Environment to consult with decision-making authorities, and if possible, agree on whether or not the proposal may be implemented, and if so, to what conditions and procedures, if any, that implementation should be subject.

The following decision-making authorities have been identified for this consultation:

<table>
<thead>
<tr>
<th>Decision-making Authority</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Minister for Water</td>
<td>Rights in Water and Irrigation Act - water abstraction licence</td>
</tr>
<tr>
<td>2. Minister for Indigenous Affairs</td>
<td>Aboriginal Heritage Act – section 18 clearances</td>
</tr>
<tr>
<td>3. Minister for Mines and Petroleum</td>
<td>Mining Act – mining approvals</td>
</tr>
<tr>
<td>4. Department of Environment and Conservation</td>
<td>Works Approval and Licence under part V of the Environmental Protection Act</td>
</tr>
<tr>
<td>5. Department of Mines and Petroleum</td>
<td>Mining Act – mining approvals</td>
</tr>
<tr>
<td>6. Shire of Coolgardie</td>
<td>• Planning approval</td>
</tr>
<tr>
<td></td>
<td>• Noise management plan approval</td>
</tr>
</tbody>
</table>

Note: In this instance, agreement is only required with DMA #1 - 3 since these DMAs are Ministers.
RECOMMENDED ENVIRONMENTAL CONDITIONS

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF THE
ENVIRONMENTAL PROTECTION ACT 1986)

GOLD MINE DEVELOPMENTS ON LAKE LEFROY

Proposal: The proposal is to expand existing open-cut and underground gold mining developments within a defined project area on the surface of Lake Lefroy, approximately 20 kilometres south east of Kambalda. The proposal includes the discharge of dewatering to the lake’s surface and the construction of associated mining infrastructure (including open pits and waste rock dumps).

The proposal is further documented in schedule 1 of this statement.

Proponent: St Ives Gold Mining Company Pty Limited

Proponent Address: PO Box 359,
KAMBALDA WEST WA 6444

Assessment Number: 1809

Previous Assessment Number: 1250

Report of the Environmental Protection Authority: Report 1411

Previous Report of the Environmental Protection Authority: Report 976

Previous Statement Number: 548 (Published on 13 July 2000)

The proposal referred to in the above report of the Environmental Protection Authority may be implemented. The implementation of that proposal is subject to the following conditions and procedures:
1 Proposal Implementation

1-1 The proponent shall implement the proposal as documented and described in schedule 1 of this statement subject to the conditions and procedures of this statement.

2 Proponent Nomination and Contact Details

2-1 The proponent for the time being nominated by the Minister for Environment under sections 38(6) or 38(7) of the Environmental Protection Act 1986 is responsible for the implementation of the proposal.

2-2 The proponent shall notify the Chief Executive Officer of the Office of the Environmental Protection Authority of any change of the name and address of the proponent for the serving of notices or other correspondence within 30 days of such change.

3 Time Limit of Authorisation

3-1 The authorisation to implement the proposal to expand existing open-cut and underground gold mining developments within a defined project area on the surface of Lake Lefroy, approximately 20 kilometres south east of Kambalda provided for in this statement shall lapse and be void five years after the date of this statement if the proposal to which this statement relates is not substantially commenced.

3-2 The proponent shall provide the Chief Executive Officer of the Office of the Environmental Protection Authority with written evidence which demonstrates that the proposal has substantially commenced on or before the expiration of five years from the date of this statement.

4 Compliance Reporting

4-1 The proponent shall prepare and maintain a compliance assessment plan to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority.

4-2 The proponent shall submit to the Chief Executive Officer of the Office of the Environmental Protection Authority the compliance assessment plan required by condition 4-1 at least six months prior to the first compliance report required by condition 4-6, or prior to implementation, whichever is sooner.

The compliance assessment plan shall indicate:

1 the frequency of compliance reporting;
2 the approach and timing of compliance assessments;
3 the retention of compliance assessments;
4 the method of reporting of potential non-compliances and corrective actions taken;
5 the table of contents of compliance assessment reports; and
6 public availability of compliance assessment reports.

4-3 The proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 4-1.

4-4 The proponent shall retain reports of all compliance assessments described in the compliance assessment plan required by condition 4-1 and shall make those reports available when requested by the Chief Executive Officer of the Office of the Environmental Protection Authority.

4-5 The proponent shall advise the Chief Executive Officer of the Office of the Environmental Protection Authority of any potential non-compliance within seven days of that non-compliance being known.

4-6 The proponent shall submit to the Chief Executive Officer of the Office of the Environmental Protection Authority the first compliance assessment report by 31st March 2012 (to cover the period 1st July 2010 to 31st December 2011) and then annually by the 31st March each year to cover the previous 12 month calendar year period.

The compliance assessment report shall:

1 be endorsed by the proponent’s General Manager or a person delegated to sign on the General Manager’s behalf;
2 include a statement as to whether the proponent has complied with the conditions;
3 identify all potential non-compliances and describe corrective and preventative actions taken;
4 be made publicly available in accordance with the approved compliance assessment plan; and
5 indicate any proposed changes to the compliance assessment plan required by condition 4-1.

5 Environmental Monitoring

5-1 The proponent shall monitor:
1 Riparian vegetation health at discharge and reference sites.
2 Surface water quality at discharge sites and points throughout the lake including the playas and clay pans adjacent to Lake Lefroy.
3 Sediment quality at discharge sites, including levels of heavy metals.
4 Aquatic flora and fauna following a 1:20 year (100mm in 72 hours) rainfall event or greater; and
5 Terrestrial fauna populations.

to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority.

5-2 The monitoring required under condition 5-1, shall be carried out in such a way that it allows confirmation that the observed impacts from the proposal documented in schedule 1 are not greater than those predicted in the Public Environmental Review for the proposal, which is titled Gold Mining Developments on Lake Lefroy Beyond 2010 (dated the 3rd of December 2010).

5-3 The proponent shall submit annually, as part of the compliance plan, the results of the monitoring required by condition 5-1 to the Chief Executive Officer of the Office of the Environmental Protection Authority.

5-4 The proponent shall make the results of monitoring required by condition 5-1 publicly available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

5-5 Should the monitoring carried out under condition 5-1 indicate that the environmental impacts of the project are greater than those predicted in the Public Environmental Review the proponent will develop and implement a management plan to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority that details how the impacts will be reduced or mitigated and any remedial work required.

6 Surface Water Discharge

6-1 The proponent shall use the existing and one of the proposed new Santa Ana dewatering discharge points as shown in Figure 3 of this statement.

6-2 The proponent shall visually monitor and record the size of the area of inundation of the Lake Lefroy riparian zone following rainfall of 100mm or greater in any 72 hour period being recorded at two points
in the Lake Lefroy catchment as agreed to with the Chief Executive Officer of the Office of the Environmental Protection Authority.

6-3 Should the area of inundation exceed that predicted in the surface water model presented in the Public Environmental Review the proponent shall:

1. report such findings to the Chief Executive Officer of the Office of the Environmental Protection Authority within 7 days of the exceedance being identified;

2. determine actions in consultation with the Department of Environment and Conservation to be taken to prevent future exceedences and to remediate any impact resulting from the exceedance;

3. submit actions to be taken to the Chief Executive Officer of the Office of the Environmental Protection Authority within 21 days of reporting the exceedance; and

4. implement actions identified above upon approval of the Chief Executive Officer of the Office of the Environmental Protection Authority.

6-4 The proponent shall make the results of monitoring required by condition 6-2 publicly available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

6-5 The proponent shall make the records of the area of inundation monitoring available on request of the Chief Executive Officer of the Office of the Environmental Protection Authority.

6-6 The proponent shall use the actual area of inundation data gathered under monitoring for condition 6-2 to verify the surface water model presented in the Public Environmental Review within 3 months of the relevant rainfall event.

6-7 Should the verification carried out under condition 6-5 show that the model is not accurate the proponent shall recalibrate the surface water model presented in the Public Environmental Review.

6-8 On completing any work required under conditions 6-5 and 6-6, the proponent shall provide a report to the Chief Executive Officer of the Environmental Protection Authority detailing the results of the verification and the recalibration and the environmental implications of changes to the model for Lake Lefroy.
Notes

1. Where a condition states “on advice of the Office of the Environmental Protection Authority”, the Office of the Environmental Protection Authority will provide that advice to the proponent.

2. The Office of the Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment and Conservation.

3. The Minister for Environment will determine any dispute between the proponent and the Office of the Environmental Protection Authority over the fulfilment of the requirements of the conditions.

4. Mine closure and rehabilitation will be managed by the Department of Mines and Petroleum under the statutory requirements of Mining Act 1978.

5. The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the Environmental Protection Act 1986.
The Proposal (Assessment No. 1809)

The proposal is to expand existing open-pit and underground gold mining operations within a defined project area on Lake Lefroy, 20 kilometres south east of Kambalda, and includes dewatering discharge to the lake surface.

The proposal is described in the following document – *Gold Mining Developments on Lake Lefroy – Beyond 2010: Public Environmental Review*, December 2010.

Table 1: Summary of Key Proposal Characteristics

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Area of disturbance</td>
<td>Up to 1713 ha (including 1273 ha of existing disturbance)</td>
</tr>
<tr>
<td>Area of direct riparian zone disturbance</td>
<td>Up to 90 ha (including 77 ha of existing disturbance)</td>
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<tr>
<td>Height of waste rock dumps</td>
<td>Up to 40 metres</td>
</tr>
<tr>
<td>Volume of waste rock used for backfilling</td>
<td>A minimum of approximately 95 million tonnes</td>
</tr>
<tr>
<td>Mining method</td>
<td>Open pit using conventional techniques, with some underground mining likely to be conducted at some deposits</td>
</tr>
<tr>
<td>Dewatering volume and discharge to Lake Lefroy</td>
<td>Up to 30GL per annum (GL/a) whole of lake discharge</td>
</tr>
</tbody>
</table>

Figures

Figure 1 Regional location of mine site (see Figure 1 above).
Figure 2 Project footprint and location of key components – mine disturbance (see Figure 2 above).
Figure 3 Project footprint and location of key components – dewatering points (see Figure 3 above).
Appendix 5

Summary of Submissions and Proponent's Response to Submissions