Tropicana Gold Project

Tropicana Joint Venture

Report and recommendations of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia

Report 1361
July 2010

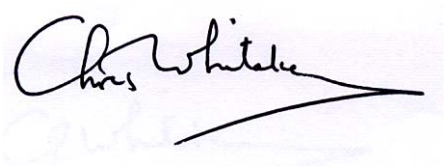
Environmental Impact Assessment Process Timelines

Date	Progress stages	Time (weeks)
7/07/08	Level of Assessment set (date appeals process completed)	
28/09/09	Proponent Document Released for Public Comment	64
24/11/09	Public Comment Period Closed	8
23/02/10	Proponent Response to Submissions and an additional eleven Biodiversity Reports received	13
16/04/10	DMA advice on additional Biodiversity Reports and clarification on matters received from Proponent	5
14/07/10	EPA report to the Minister for Environment	13*
19/07/10	Publication of EPA report	1
2/08/10	Close of appeals period	2

STATEMENT ON TIMELINESS

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

*** In this case, the Environmental Protection Authority did not meet its agreed timeline objective of 10 weeks for the completion of the assessment and provision of a recommendation to the Minister. However, the timeline did include the additional and recently introduced step of consultation with the proponent and a key decision-making authority on the draft conditions which had a target timeline of 2 weeks.**



Dr Chris Whitaker
Deputy Chairman
14 July 2010

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Summary and recommendations

This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for Environment on the proposal to develop and operate an open-cut gold mine with infrastructure and utilities located approximately 330 kilometres (km) east northeast of Kalgoorlie and 200 km east of Laverton by Tropicana Joint Venture.

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 *Environmental Protection Act 1986.*

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) flora and vegetation;

(b) terrestrial fauna;

(c) subterranean fauna;

(d) groundwater quality; and

(e) rehabilitation and mine closure.

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 relating to improved valuation, pricing and incentive mechanisms; and

(e) The principle of waste minimisation.

Conclusion

The EPA has considered the proposal by Tropicana Joint Venture to develop and operate an open-cut gold mine with infrastructure and utilities located approximately 330 km east northeast of Kalgoorlie and 200 km east of Laverton.

Flora and Vegetation - The proposal requires the clearing of up to 3,440 hectares (ha) of vegetation. No Threatened Ecological Communities or Declared Rare Flora would be impacted. The TJV has adopted a precautionary approach in the absence of detailed information on a potential Priority Ecological Community to minimise impacts. Some Priority Flora species are expected to be directly affected by the Project, however all of these taxa are found outside the project footprint and the EPA considers that the impact to Priority Flora to be acceptable.

Terrestrial Fauna - The EPA notes that a number of conservation significant fauna have been recorded in the proposal area. The EPA considers that the proposal is unlikely to have significant impacts on Schedule 1 terrestrial fauna species including the Southern Marsupial Mole, the Sandhill Dunnart and the Malleefowl.

The Short Range Endemic species *Kwonkan* sp. 2 has not been identified outside the Project footprint, however the EPA considers there is sufficient evidence that its habitat extends beyond the boundaries of the proposed disturbance footprint. The proponent intends to undertake annual monitoring of the known habitat of *Aganippe* sp. 4 and the presumed habitat of *Kwonkan* sp. 2 to provide information on the indirect impacts from mine activities on SRE invertebrate fauna and to ensure the species are not subject to indirect impacts beyond the mine's footprint.

Subterranean Fauna - No stygofauna have been identified in the project area. Four species of troglofauna were found including a bristletail and centipede which were found only within the project footprint. A subsequent habitat assessment found suitable habitat outside the footprint and suggested that the troglofauna community was likely to have a distribution that extends beyond the footprint. The EPA considers that subterranean fauna would not be significantly impacted.

Groundwater Quality – the EPA notes that there is limited beneficial use for groundwater in the area. The EPA has recommended a condition requiring the proponent to ensure that any discharge of water from the tailings storage facility and waste material landforms is monitored, managed, and treated if necessary to ensure that water quality is maintained.

Rehabilitation and Mine Closure - Sustainable closure and rehabilitation present challenges in the project area since there is a general lack of information on appropriate and successful rehabilitation techniques and protocols. The EPA considers the Conceptual Mine Closure and Rehabilitation Strategy to be adequate. The TJV is committed to undertaking research to support the rehabilitation work and understands the restoration requirements. The TJV intends to progressively rehabilitate the Project area and to ensure that the rehabilitation outcomes are managed in accordance with agreed closure strategies. The EPA has recommended a condition requiring a final strategy at least 5 years prior to mine completion.

Proposed Offsets - The TJV has proposed direct and contributing offsets. The biodiversity offset package focuses on the residual environmental impacts such as impacts to threatened species habitats that remain after implementation of the mitigation hierarchy. The Great Victoria Desert Trust (the Trust) forms the

centrepiece of the proposed offsets. The TJV proposes that the Trust would be used to facilitate biological research to improve knowledge of the conservation significant taxa directly affected by the Project. A direct offset to restore and rehabilitate degraded areas outside of the Project's disturbance area is also proposed. Areas to be rehabilitated would be agreed with stakeholders and would total at least 100 hectares.

The EPA has concluded that it is unlikely that the EPA's objectives would be compromised, 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 to develop and operate an open-cut gold mine with infrastructure and utilities;
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 unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments; and
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

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 the Tropicana Joint Venture to develop and operate an open-cut gold mine with infrastructure and utilities is approved for implementation. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) flora and vegetation;

(b) terrestrial fauna;

(c) subterranean fauna;

(d) groundwater quality;

(e) rehabilitation; and

(f) mine closure.

Contents

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 Tropicana Joint Venture (TJV) to develop and operate an open-cut mine and infrastructure located on the western edge of the Great Victoria Desert (GVD) biogeographic region (Figure 1).

The proponent is seeking approval for the Tropicana Gold Project (TGP) to construct and operate an open-cut gold mine, process facilities, materials handling facilities, utilities and other general infrastructure facilities (Figure 2).

The level of assessment of the proposal was set at Public Environmental Review (PER) with an eight week public review period under the Western Australian (WA) *Environmental Protection Act 1986* (EP Act). The public review period commenced on 28 September 2009 and closed on 24 November 2009.

The Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) have confirmed the proposal is a controlled action under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* due to the presence of listed species such as the Marsupial Mole, Sandhill Dunnart and Malleefowl. Commonwealth assessment will occur via the Bilateral Agreement between WA and the Commonwealth.

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 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 TGP is located approximately 330 km east northeast of Kalgoorlie and 200 km east of Laverton. Figure 1 shows the regional location of the TGP and the project footprint and layout is shown in Figure 2.

The proposal is described in detail in Section 2 of the PER document (360 environmental, September 2009). The main components include:

- mining of up to 75 million tonnes per annum (Mtpa) of gold-bearing ore and waste from the Tropicana and Havana deposits, with an estimated viable resource of 5.01 million ounces;
- disposal of up to 800 million tonnes (Mt) of waste material in adjacent waste material landforms;
- a processing plant (Carbon in Leach) with a processing rate of up to 7 Mtpa of primary ore;

- disposal of up to 7 Mtpa of tailings in a two-cell paddock tailings storage facility with possible in-pit deposition;
- water to be sourced from the borefield approximately 50 km from the processing plant and pumped via a bunded (or buried) pipeline;
- infrastructure corridors (mine access road from the Operational Area to Kalgoorlie, communications corridor); and
- a power station of up to 40 megawatts total installed capacity.

The main characteristics of the proposal are summarised in Table 1 below.

Table 1: Summary of key proposal characteristics

Element	Description
General	
Project life	Approximately 15 years of mining; total Project duration up to 25 years (including post closure monitoring)
Mining and Processing	
Mining rate (resource and waste rock)	Up to 75 million tonnes per annum
Stripping ratio	8:1
Number of pits	Up to 4
Open pit void/s	Not more than 400 hectares
Maximum length of pit/s	6 kilometres (if pits combine)
Maximum width of pit	1.5 kilometres
Overburden and waste	Not more than 800 million tonnes
Waste landform	Not more than 1,200 hectares. Maximum height 375 mRL. Slope with maximum angle of 15 degrees
Water supply	Up to 7 gigalitres per annum.
Dewatering rate	1,000 – 5,000 kilolitres per day
Infrastructure	
Mine access road	Pinjin Option – 370 kilometres (~210 kilometres of road construction)
Communications	Fibre Optic or Microwave via either Pinjin or Tropicana Transline Corridor
Aerodrome	All weather strip 2.4 kilometres long
Power supply	Onsite power station with an installed capacity of up to 40 megawatts
Water pipeline	Approximately 50 kilometres in length from the borefield (located north northwest of the Operational Area) to the process plant.
Tailings Storage Facility	Up to 7 million tonnes per annum; two-cell paddock tailings storage facility with possible in-pit deposition. Maximum height of 372 mRL. Approximately 1330 metres wide by 1850 metres.
Disturbance Areas	
Areas of disturbance	Total disturbance during project not more than 3,440 hectares comprising: • operational area – 2,570 hectares. • water supply area – 200 hectares. • infrastructure areas – 670 ha.

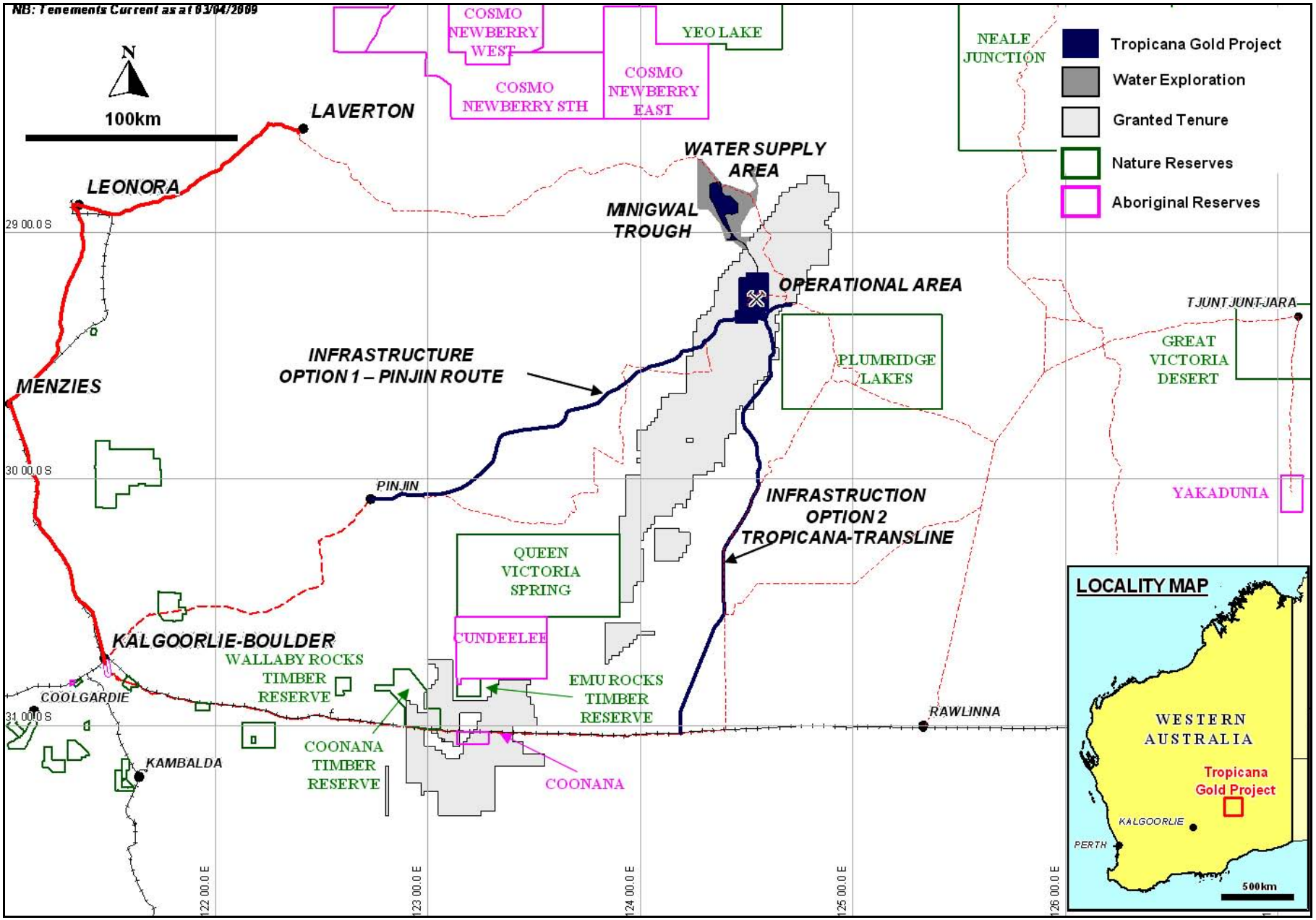

Figure 1: Regional location of mine site

The potential impacts of the proposal predicted by the proponent and the proposed management are summarised in Table 7.2 of the proponent's PER document (AngloGold Ashanti Australia, 2009).

Since release of the PER (September 2009), no modifications to the proposal have been made by the proponent. Since the PER's publication, the TJV has completed a number of supplementary surveys for flora, terrestrial and subterranean fauna, and provided information on monitoring and offsets. Additional information has been provided on:

Flora and Vegetation

- A report from Botanic Gardens and Parks Authority Science (November 2009) on molecular assessment of the identity of regenerating mallees on the Tropicana Pinjin Infrastructure Corridor. This report concluded that no Declared Rare Flora (DRF) *Eucalyptus articulata* was identified through DNA sequence analysis and fingerprinting on the burnt sections of the Pinjin Corridor.
- An addendum by MBS Environmental (January 2010) to the MBS Environmental (September 2009) report provided with the PER. The addendum outlined the findings of the additional work undertaken to further establish the distribution of conservation significant flora in the broader Project area. This included additional survey work, updated distribution records and a recalculation of the percentages of conservation significant flora species potentially impacted by the TGP proposal.
- TGP – Conservation Significance Review by Department of Environment and Conservation (DEC) (February 2010). Due to the surveys undertaken for the Project five Priority Flora have been removed from the DEC Priority Flora list and two Priority 2 species have been downgraded to Priority 4 status.

Fauna

- Southern Marsupial Mole *Notoryctes typhlops* Habitat fragmentation review by Joe Beshemesh (November 2009). This additional review concluded that the loss of 15 km of sand dunes from the project would be concomitant with the loss of marsupial moles and their habitat in this area. However, this loss is not likely to threaten the conservation of the species either locally or globally.
- Assessment of habitat availability for the Sandhill Dunnart *Sminthopsis psammophila* in Western Australia (WA) by Sue Churchill (December 2009). This additional work was undertaken to assess the availability of potentially suitable Sandhill Dunnart habitat within the Project area. The report concluded that although adjacent to large areas of Prime habitat, the majority of the proposed Operational footprint is situated in habitat considered Marginal for Sandhill Dunnarts, that is, they may occasionally use this habitat for movement and foraging however would not live or breed in it.
- Sandhill Dunnart *Sminthopsis psammophila* population genetics between South Australia and Western Australia by Gaikhorst et al (undated). The study concluded that little differentiation is shown between these populations.
- Additional Sandhill Dunnart *Sminthopsis psammophila* habitat assessment by GHD (January 2010).
- Additional Report for TJV on Second Round Sandhill Dunnart Surveys of the Proposed Operational Area and Infrastructure Corridor by GHD and Sue Churchill (February 2010). Additional trapping for Sandhill Dunnarts was undertaken in November 2009. Areas trapped were identified by Sue Churchill using survey recommendations from DEC. An additional 3510 trap nights were conducted with no Sandhill Dunnarts recorded.

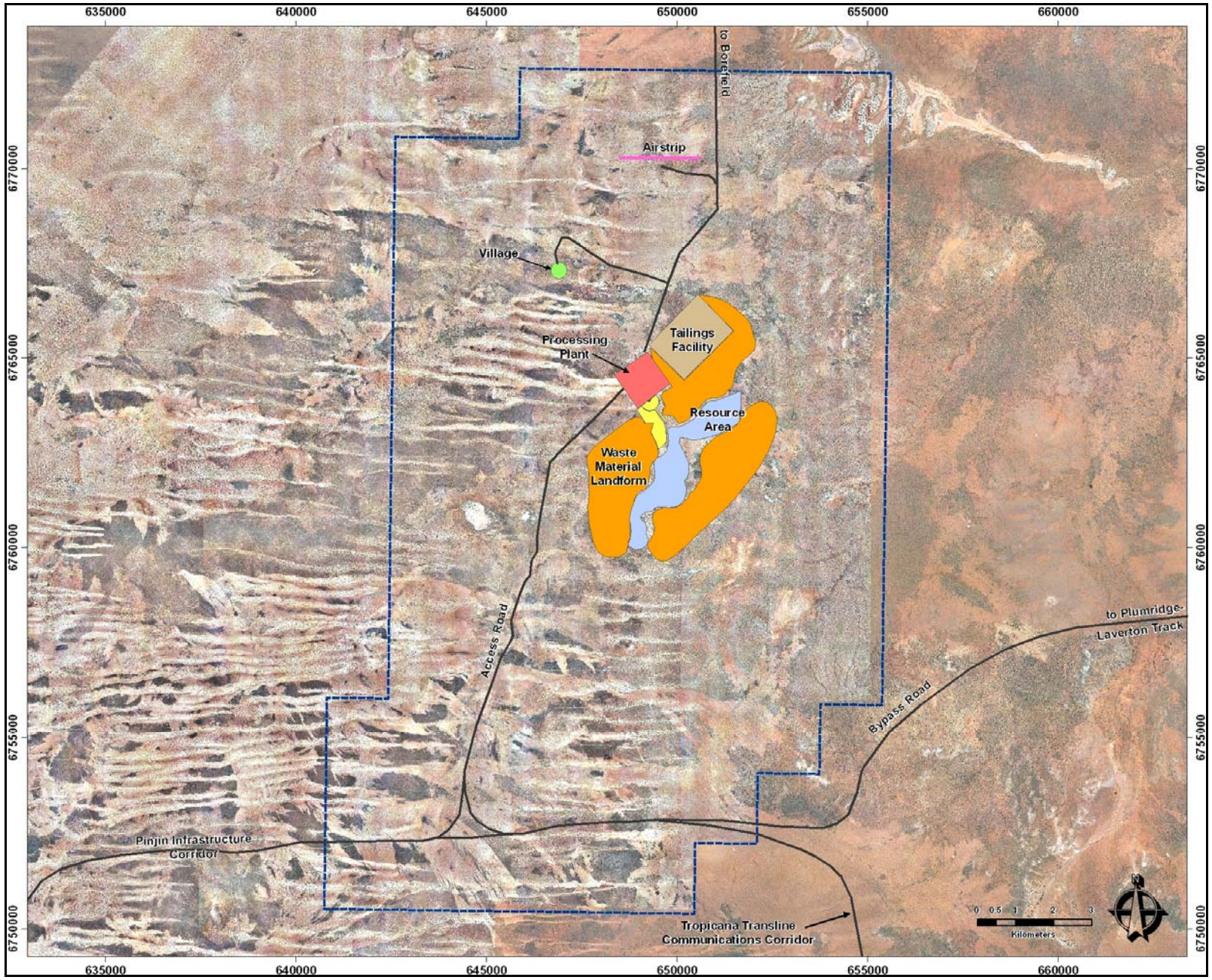

Figure 2: Project footprint and layout of key components

- Additional information on Mygalomorph Spiders by *ecologia* Environment (December 2009). The aim of this further work was to attempt to locate *Kwonkan* sp. 2 and *Aganippe* sp. 4 and assess habitat. A broadened DNA study on all collected specimens of the genus *Aganippe* and *Anidiops* was also conducted. A monitoring programme is also provided.

Subterranean Fauna

- Troglofauna Records and Troglobitic Habitat at Tropicana Gold Project, *ecologia* Environment (February 2010). Additional information provided on two additional troglofauna surveys undertaken outside the Operational footprint. The addition of Phase 6 and 7 troglofauna surveys takes the total sample size to 411 with 14 individuals belonging to four definitive troglobitic species, of which two are known only from the Project footprint. An assessment of suitable troglobitic habitat is provided with this report.
- Biodiversity of the two-pronged bristletails (Diplura) in WA as revealed from recent mining projects by Dr. Marcus Koch (December 2009).

Monitoring Program

- An Environmental Monitoring Strategy was provided in February 2010.

Offsets

- A Draft Biodiversity and Greenhouse Offset Strategy was provided in February 2010.

3. Key environmental factors and principles

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for Environment on the 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 Waste Material 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) Flora and Vegetation;

(b) Terrestrial Fauna and Habitat;

(c) Subterranean Fauna;

(d) Groundwater Quality; and

(e) Rehabilitation and Mine Closure.

The above key factors were identified from the EPA's consideration and review of all environmental factors generated from the PER 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 - 3.5. The description of each factor shows why it is relevant to the proposal and how it would 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 the conservation of biological diversity and ecological integrity;

(d) Principles relating to improved valuation, pricing and incentive mechanisms; and

(e) The principle of waste minimisation.

In preparing this report and recommendations, the EPA has had regard for the object and principles contained in s4A of the *Environmental Protection Act (1986).* Appendix 3 contains a summary of the EPA's consideration of the principles.

3.1 Flora and Vegetation

Description

The proposal has the potential to impact on flora and vegetation by direct loss due to clearing for the mine site and infrastructure, and indirect loss due to dust deposition, spread of weeds and fire. The proposal would require the clearing of 3,440 ha of native vegetation.

The operational area and proposed infrastructure corridors are situated in the Helms Botanical District near the border of the Great Victoria Desert (GVD), the Nullarbor Plain within the Eremaean Botanical Province, and the Austin Botanical District of the Eremaean Province (Beard, 1990). The vegetation of the Helms Botanical District is very consistent and characterised by tree steppe of *Eucalyptyptus gongylocarpa* and *Triodia Basedowii*. Overall, the sandy areas are a mosaic of tree and shrub communities; *Eucalyptyptus gongylocarpa* is dominant in the dune systems where it occurs locally between the dunes (Beard, 1990).

Prior to the commissioning of baseline surveys for the Project, there was limited baseline environmental knowledge available for the proposed impact zones. Most historical surveys in the region have either occurred in the nearby Nature Reserves or at a large scale. The TJV commissioned extensive environmental surveys from 2006 onwards to allow context for the data being collected on the proposed Project area. Detailed vegetation maps were developed for approximately 230 000 ha of native vegetation. In addition, the TJV has (and continues to) participate in regional studies in conjunction with the Department of Environment and Conservation (DEC) and local interest groups to assist in reducing the knowledge gap in the region. Table 2 outlines the flora and vegetation surveys undertaken for the Project.

Table 2: Flora and vegetation surveys Tropicana Gold Project.

Title of Report	Consultant	Dates undertaken	Survey Target
Tropicana Project Project Area Threatened Flora Assessment	*ecologia* Environment	3 field trips: 2007 – end 2008	Level 2 Flora Survey
Tropicana Gold Project Flora and Vegetation Assessment of the proposed Operational area and its Surroundings	*ecologia* Environment	8 – 17 Nov 2006, 8 – 15 Jun and 2 – 16 Jul 2007	Level 2 Baseline Flora and Vegetation Survey
Tropicana Gold Project: Tropicana – Transline Infrastructure Corridor: Vegetation and Flora Survey	*ecologia* Environment	13 – 22 Jul and 20 – 24 Aug 2007	Level 1 Flora and Vegetation Survey
Flora and Vegetation Survey of Proposed Mine Access Road and Infrastructure Corridor – Pinjin Option L31/57, L39/185, Tropicana Mine – Pinjin Station	Mattiske Consulting	3 field trips: 2 – 7 Dec 2007; 9 – 15 Mar 2008; and 6 – 9 May 2008	Level 2 Flora and Vegetation Survey
Tropicana Gold Project Minigwal Trough Water Supply Area and Pipeline Corridor Vegetation and Flora Survey	Botanica Consulting	7 – 15 Nov and 10 – 12 Dec 2008	Level 2 Flora and Vegetation Survey
Threatened Flora Survey for Regional Context, Tropicana JV and Adjacent Nature Reserves	AngloGold Ashanti	7 – 11 Dec and 14 – 18 Dec 2008, 16 – 18 Jan 2009	Level 1 Flora Survey
Threatened Species Assessment of areas adjacent to the Tropicana Gold Project	Mattiske Consulting	5 – 8 May and 16 – 19 Jun 2008	Level 2 Flora Survey
Additional Conservation Significant Species Survey – Pinjin Corridor and potential PECs in the Tropicana-Transline Corridor.	Mattiske Consulting	2 – 5 Oct 2009	Level 2 Flora Survey

All surveys were designed to meet the requirements of *EPA Guidance Statement 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact in Western Australia.*

None of the vegetation communities identified across the Operational Area, Pinjin Infrastructure Corridor, Tropicana-Transline Corridor or Water Supply Area are listed as Threatened Ecological Communities (TECs) under either State *Wildlife Conservation Act 1950* (WC Act) or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) legislation.

The Priority Ecological Community (PEC) Yellow Sandplains Community of the GVD potentially crosses the Pinjin Infrastructure Corridor and the Tropicana-Transline Corridor. This PEC has recently been listed by DEC and at present, detailed descriptions and regional mapping are not available. The TJV has adopted a precautionary approach in the absence of detailed information and has minimised impacts on the PEC through practical avoidance of known locations and planning of infrastructure placement. Table 3 summarises the direct impact within communities found on yellow and yellow-orange sand within the potential PEC along the Pinjin Corridor. These communities support either a Declared Rare Flora (DRF) species (S11) or other conservation interest species (S9) or because of limited distribution. Impacts to the PEC on the Tropicana-Transline Corridor are expected to be minimal due to limited clearing.

Table 3: Impact to communities found on yellow and yellow-orange sand within the potential PEC, Pinjin Corridor.

Vegetation Community	Yellow and yellow-orange sand within survey area (ha)	Yellow and yellow-orange sand within proposed corridor (ha)	Percentage impacted by proposed corridor
E4	1170.70	62.97	5.38
S5	771.62	32.34	4.19
S8	168.09	16.27	9.68
S9	204.83	12.17	5.94
S11	69.12	0.00	0.00
Total	**2384.36**	**123.75**	**5.19**

The percentage impact to communities of conservation interest (which are locally less common) in the Operational Area includes:

- mixed eucalypt woodlands over mixed open shrubs and *Triodia basedowii:* 5.5 percent;
- minor clay pan: Scattered *Acacia nyssophyllal Grevilea sarissa* over open herbs and grasses: 1.4 per cent; and
- dunes: Scattered *Eucalyptus gongylocarpa* over mixed shrubs and *Triodia desertorum* or *T. basedowii*: 0.15 per cent.

The percentage disturbance to communities of conservation interest within the Pinjin Infrastructure Corridor and the Tropicana-Transline Communications Corridor ranges from:

- 0.38 – 14 per cent within the Pinjin Infrastructure Corridor;
- 0.14 – 0.27 per cent within the Tropicana-Transline Infrastructure Corridor.

These communities are not restricted to the Project area.

Desktop searches of the DEC Threatened and Priority Species Database, EPBC Act Protected Matters Database and flora and vegetation surveys identified that 54 species of conservation significance may be present in the TGP area. Flora and vegetation surveys undertaken over the 230 000 ha survey area identified 21 conservation significant flora species.

One DRF species, *Conospermum toddii* (Victoria Desert Smokebush), which is listed as Endangered under the EPBC Act and Schedule 1 under the WC Act, was located during the surveys but would not be impacted by the Project. During surveys, 20 Priority Flora were recorded, of which 13 Priority Flora are to be directly impacted by the Project.

The DEC advised that due to the survey efforts of the TJV five Priority Flora have been removed from the list as survey data shows that they are widespread. Two Priority 2 species and one Priority 3 species have been downgraded to Priority 4 status. Species under Priority 4 are not currently threatened by any identifiable factors, and therefore are on the list for monitoring purposes only.

Five of the Priority Flora recorded within the Project survey area would have greater than 4.9 per cent of the known populations removed by the Project. These species are:

- *Acacia eremophila* var. *variabilis* P3 (4.9 per cent);
- *Eucalyptus pimpiniana* P3 (9.3 per cent);

- *Acacia eremophila* numerous nerved variant P3 (10 per cent);
- *Dicrastylis cundeeleensis* P4 (26.8 per cent) - This is likely to be an artefact of the surveys undertaken as the species has been recorded in four vegetation communities in the Operational Area and four different communities in the Pinjin Corridor. This species was only included on the DEC Priority list in 2008 as Priority 3 status and has been downgraded to a Priority 4 status due to survey work for the Project area; and
- *Daviesia purpurascens* P4 (94 per cent) - local population is largely within the proposed footprint. However on a regional scale, the impact is 2.4 per cent of known populations.

Indirect Impacts - The TGP has the potential to cause indirect impacts to vegetation health. Indirect impacts can include; competition from increased weed numbers, dust deposition on vegetation (affecting photosynthesis and plant respiration), and altered water and fire regimes.

The proponent has proposed measures to mitigate impacts to flora and vegetation (360 environmental, 2009) which include:

- implementation of the Threatened Species and Communities Management Strategy;
- clearing areas only when required and where necessary;
- no DRF (*Conospermum toddii*) population to be removed or impacted by the Project;
- development of ex situ seed banking for DRF and Priority Flora;
- progressive rehabilitation;
- monitoring, management and eradication of weeds;
- fire management;
- implementing dust control strategies;
- feral animal control and supporting regional feral animal programs;
- monitoring vegetation and vegetation stress; and
- contingency actions when required.

Submissions

Key comments in submissions focused on:

- the need to avoid defined conservation significant species and communities; and
- a buffer, in which flora may decline to pre-defined limits should be delineated around areas approved for disturbance and a monitoring program should be put in place and provide for adaptive management.

Assessment

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

- protect DRF, Priority Flora and other species of conservation significance, consistent with the provisions of the *Wildlife Conservation Act 1950*; and
- maintain the abundance, diversity, geographic distribution and productivity of flora and species and ecosystem levels trough the avoidance or management of adverse impacts and improvement of knowledge.

The DEWHA and the DEC advised that the information provided by the TJV to address flora and vegetation impacts is adequate. The flora and vegetation surveys

comply with EPA Guidance Statement No. 51 (EPA 2004) and the EPA considers the surveys are adequate for environmental impact assessment. The EPA commends the TJV on the extensive biological survey program undertaken to date and the ongoing support for regional studies to assist in reducing the knowledge gap in the region.

The EPA notes that the recently listed Priority 3 Yellow Sandplains Community PEC of the GVD potentially crosses the Pinjin Infrastructure Corridor and the Tropicana-Transline Corridor. The EPA also notes that although large areas of this PEC appear to occur to the east and north of the Pinjin Corridor and to the west of the Tropicana-Transline Corridor (360 environmental, 2009), further details about the extent and location are still unknown, partly due to a lack of state-wide mapping of the PEC and the lack of formal description of the community. The EPA notes that the TJV has adopted a precautionary approach in the absence of detailed information and has minimised impacts on the potential PEC through practical avoidance of known locations and planning of infrastructure placement. As this PEC supports high numbers of conservation significant flora and fauna in the region, the EPA notes that this approach would also reduce impact to species that utilise dune habitats.

The EPA notes that while some Priority Flora would be directly impacted by the proposal, the proponent has altered the proposal layout to minimise these impacts, and avoid impacts to Priority 1 or Priority 2 species. The EPA notes that all of these species occur outside the Project area.

Indirect Impacts - The EPA notes that the area has low levels of weed invasion and that the TJV intends to manage weeds through mapping, maintaining a weed inventory, regular site inspections, and implementing weed hygiene practices throughout the life of mine. The EPA considers that these actions are appropriate to reduce the spread of weeds.

The EPA notes that the TJV has developed an Environmental Monitoring Strategy which includes the provision of a monitoring protocol designed to assess the indirect impacts on flora and vegetation resulting from the Project. The proposed monitoring strategy would establish monitoring sites within a proposed 200 m buffer zone around the disturbance footprint within the Operational Area, and within 100 m of the disturbance footprint of the Mine Access Road and Water Supply Area. Reference monitoring sites would also be established to enable the TJV to determine if changes in environmental values are attributable to the project or natural variances.

The TJV proposes to establish trigger levels to detect decline in vegetation health. If the impact sites show a 25 per cent (or greater) deviation from the reference sites in more than one monitored parameter, the TJV would investigate the cause. If the cause can be attributed to Project activities, new management measures would be developed and implemented. The EPA considers that the above monitoring should be required as a condition of approval, and has recommended a condition (condition 5).

The EPA considers that the specific management and monitoring strategies provided in the Threatened Species and Communities Management Strategy should be required as a condition of approval. This strategy should be revised as new information becomes available in consultation with DEC. As such, the EPA has recommended a condition (condition 6).

Offsets - To mitigate the residual impacts to Priority Flora and the potential PEC through unavoidable clearing, the TJV has proposed offsets for the Project. The cornerstone of the Project offsets package is the establishment of a Great Victoria Desert Trust to facilitate research into rehabilitation (that is relevant beyond the boundaries of the Project such as understanding dune restoration requirements, the ecophysiology of framework species such as Spinifex and seed bank handling), environmental education and on-ground conservation work that would benefit the wider GVD region during and after the life of the Project.

A direct offset to restore and rehabilitate degraded areas outside of the Project's disturbance area is also proposed. Areas to be rehabilitated would be agreed with stakeholders and would total at least 100 hectares. This may include: rehabilitation of surplus tracks in the region, particularly those in Nature Reserves; and rehabilitation of disturbed areas with State Reserves located within the GVD. These rehabilitation activities can assist in reducing access into the region and by improving habitat for conservation significant species such as the Sandhill Dunnart.

Summary

Having particular regard to the:

(f) no loss of TECs or impact to DRF species;

(g) the proponent's actions to mitigate impacts to Priority Flora;

(h) the recommended condition requiring the monitoring of vegetation health; and

(i) the recommended condition requiring implementation of the TGP Threatened Species and Communities Management Strategy (July 2009),

the EPA considers the issue of Flora and Vegetation has been adequately addressed and the proposal can meet the EPA's objectives for this factor subject to implementation of the recommended condition.

3.2 Terrestrial Fauna

Description

The construction and operation of the TGP has the potential to directly impact terrestrial fauna through vegetation clearing, vehicle strike and entrapment in open trenches and mine tailings. There is also potential for the proposal to indirectly impact fauna through loss of habitat, dust deposition, changed fire regimes, noise and vibration and increased predation.

Desktop searches of the DEC Threatened and Priority Species Database and the EPBC Act Protected Matters Database identified 32 conservation significant fauna species potentially present in the survey areas (including those presumed to be extinct in the local area). Field surveys identified 11 of these species as being present in the Project area. Table 4 outlines the fauna surveys undertaken project wide.

Table 4: Fauna surveys Tropicana Gold Project.

Title of Report	Consultant	Dates undertaken	Survey Target
Tropicana Gold Project Vertebrate Fauna Assessment – Operational Area	*ecologia* Environment	Nov 2006, Mar 2007, Mar 2008	Level 2 Vertebrate Fauna Survey of the Tropicana Lease, Targeted Mole Survey
Tropicana Gold Project Tropicana-Transline Infrastructure Corridor Fauna Survey	*ecologia* Environment	23 Jul – 3 Aug 2007	Level 1 Fauna Survey Access Road
A Level 1 Survey of the Vertebrate Fauna for the Proposed Tropicana – Pinjin Access Track	Ninox Wildlife Consulting	2 – 7 Dec 2007 and 10 – 15 Mar 2008	Level 1 Fauna Survey of the Access Road
Marsupial Mole Survey: Proposed Access Road Route Tropicana Gold Project	URS	22 – 28 Nov 2007, 4 – 10 Mar 2008 and 22 – 29 Apr 2008	Level 2 Fauna Survey of the Access Road
Malleefowl and Mulgara Survey Tropicana Gold Project	URS	Apr and Aug 2008	Level 2 Fauna Survey of the Pinjin Access Road
Tropicana Gold Project Sandhill Dunnart Survey of the Proposed Project Area, Access Road and Public Bypass	Gaikhorst and Lambert	5 – 14 Mar 2008, 21 – 28 May 2008	Level 2 Fauna Survey
Tropicana TJV Minigwal Sub Basin Water Area and Pipeline Corridor Level 1 Fauna Survey	*ecologia* Environment	11 – 25 Mar 2008	Level 1 Fauna Survey
Survey of the Underground Signs of Marsupial Moles in the WA Great Victoria Desert	Beshemesh and Schulz	28 Apr – 14 May 2008	Level 1 Fauna Survey
Sandhill Dunnart Surveys of the Proposed Operational Area and Infrastructure Corridor	GHD and Sue Churchill	16 – 26 November 2009	
Tropicana Gold Project Putative SRE Invertebrate Survey Report	*ecologia* Environment	Sept – Oct 2006	
Tropicana Gold Project Putative SRE Survey Report Addendum Phase 5 Additional Survey Results	*ecologia* Environment	Apr – Sept 2008	
Tropicana Gold Project Targeted Mygalomorph Survey and DNA Study	*ecologia* Environment	Mar and May 2009	

All surveys were designed to meet the requirements of *EPA Guidance Statement 56 Terrestrial Fauna Surveys for Environmental Impact in Western Australia.*

To supplement the main fauna surveys a number of targeted cryptic species surveys were undertaken. The TJV took the approach that if potentially suitable habitat was present, then the species may be present, despite the lack of captures.

Southern Marsupial Mole - (*Notoryctes typhlops*) is listed as Endangered under the EPBC Act and Schedule 1 under the WC Act. Little is known about the habitat preference of the Marsupial Mole, however they are most recorded in arid regions in areas such as sand dunes associated with various acacias and shrubs (Beshemesh, 2008). Estimations of total population sizes are difficult to ascertain, but recent

studies indicate Southern Marsupial Moles may be more common and widespread than previously thought in the GVD (Beshemesh, 2008).

The TJV commissioned targeted studies to provide new information on the presence, distribution and abundance of the Southern Marsupial Mole in the WA section of the GVD. Survey methods used by *ecologia* Environment were devised following consultation with Dr Joe Beshemesh from Monash University (specialist zoologist) and review of the Manual for Marsupial Mole Survey and Monitoring by Trenches (Beshemesh, 2005). Standard practice is to use indirect methods of assessment including searching for their holes and examining predator scats.

In the Operational Area, 139 mole holes were reported from two surveys. Of these 42 were located in areas of proposed infrastructure development with three fresh, 12 recent, 19 oldish and 8 old. Mole presence was significantly correlated with dunes, yellow or yellow-red sand, and loose sand. In the Pinjin Corridor survey area, ten mole holes were recorded from six sites. Of these, three occurred within 50 m of the proposed road alignment. All three holes were classified as old to very old. In the Tropicana-Transline Corridor survey area, 26 mole holes from six sites were identified. Of these, one hole was within 50 m of the proposed corridor alignment and this was classified as old.

The results of the regional survey commissioned by the TJV has determined that the species is widespread in the GVD and probably more common than previous records suggest. A survey of the WA GVD indicated that mole hole abundance was similar to that recorded in the South Australian (SA) GVD and averaged more than three recognisable mole holes per vertical square metre on the crests and slopes of the dune fields surveyed (Beshemesh and Schulz 2008). Studies were unable to estimate the population size as the rates of decay and creation of mole holes is still uncertain (Beshemesh and Schulz 2008).

The main threats to the Southern Marsupial Mole from the Project include the direct loss of individuals and habitat and also fragmentation of the local population.

The proposed Operational Area and Infrastructure Corridors have been designed to avoid disturbance to continuous sand dunes where Marsupial Mole may occur. Such habitat occurs west of the Resource Area and would not be impacted by the Proposal. Clearing within the resource area would remove localised mole habitat. The Project area would impact approximately 15 km of dunes that represent Southern Marsupial Mole habitat (*ecologia* Environment, 2009).

Sandhill Dunnart - (*Sminthopsis psammophila*) is listed as endangered under the EPBC Act and Schedule 1 under the WC Act.

The Sandhill Dunnart is known from under 100 specimens since being described in 1894. It has been recorded in the Northern Territory, SA and WA. There have been few studies into their distribution, abundance, ecology and conservation biology (Gaikhorst Lambert, 2008). Sandhill Dunnarts have been captured in Queen Victoria Springs Nature Reserve and near Mulga Rock in the GVD. Historical Sandhill Dunnart captures within the greater Tropicana tenements were made by Gaikhorst and

Lambert between 2001 and 2008 when 12 animals were captured at seven sites, with a further five animals being caught just outside the tenement area (MBS, 2009).

This species is found in a variety of sandy habitats, usually with sand dunes and an understorey of *Triodia* spp. Hummock grassland. Although no detailed habitat assessment has been made for the Sandhill Dunnart there appear to be large areas of potentially suitable habitat types throughout the southern GVD (Churchill, 2009).

The surveys commissioned by the TJV did not record any Sandhill Dunnarts, however previous surveys recorded an individual approximately 50 km south west of the Operational Area and potentially suitable habitat occurs in the Operational Area and adjacent to the Pinjin Corridor.

It is possible that under the right conditions Sandhill Dunnarts may migrate into the Project area, provided suitable unburnt habitat is available (AngloGold Ashanti, 2009). For this reason, routing of infrastructure corridors would occur away from habitat suitable for this species where practicable (AngloGold Ashanti, 2009). The TJV has also committed to avoiding areas of Spinifex which have been unburnt for between eight and 38 years which may provide potential habitat for Sandhill Dunnarts.

Malleefowl - (*Leipoa ocellata*) is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. Birds Australia has no modern records for Malleefowl in the vicinity of the Project area however an individual bird was sighted south of Plumridge Lakes Nature Reserve in 2007 indicating that Malleefowl are likely to be present within the Operational Area in areas of suitable habitat.

Three surveys commissioned by the TJV identified twelve inactive Malleefowl mounds located in the Operational Area and its surrounds. One Malleefowl was observed along the proposed Pinjin Corridor approximately 600 m from the track at the southern end. One active mound and four inactive mounds were surveyed along the Pinjin Corridor, as well as numerous fresh tracks. Eight inactive Malleefowl mounds were identified along the Tropicana-Transline Corridor, and a fresh set of Malleefowl tracks were observed.

The clearing of Malleefowl nesting mounds that may be reused is a potential threat as is clearing of any patches of dense vegetation that they may inhabit. Vehicle collisions, fire and predation are also threats to this species.

The Project area has been modified to avoid direct impacts to all Malleefowl mounds except one inactive mound located within the Operational Area. The Project would avoid most of the known nesting habitat of the Malleefowl such as mallee thickets and patches of old Spinifex that form small discrete habitats. Clearing would not be undertaken during the Malleefowl nesting period (August to December).

Other species of conservation interest – species expected or identified in the Project area from surveys are discussed below.

The Rainbow Bee-eater (*Merops ornatus*), the Fork-tailed Swift (*Apus pacificus*), the Wood Sandpiper (*Tringa glareola*) and the Common Greenshank (*Tringa nebularia*)

are listed as Migratory under the EPBC Act. Due to their migratory nature and widespread habitat availability outside of the Project footprint, these species are not expected to be impacted by the Project.

The Greater Stick Nest Rat (*Leporillus sp.*) is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. A number of abandoned Stick-nest Rat nests were observed within small caves and overhangs in breakaway areas in the Operational Area. The nests observed were all old, inactive and in the process of decay.

The Peregrine Falcon (*Falco peregrinus*) listed as Schedule 4 under the WC Act was sighted in the vicinity of the Operational area. Due to the widespread distribution of this species and the extent of suitable habitat outside of the Project area, impacts are expected to be negligible.

The Brush-tailed Mulgara (*Dasycercus blythi*) is listed as Priority 4-DEC. Surveys commissioned by the TJV did not record any Mulgara, although suitable habitat was identified and a potential burrow was found in one section of the Pinjin Corridor however no footprints were noted. The proposed Operational Area contains significant amounts of hummock grasslands that are considered to be suitable Mulgara habitat, however the habitat is mostly patchy and the percentage ground cover and maturity of habitat is highly variable. Five areas of suitable habitat were identified along the Tropicana-Transline Corridor and one area approximately 1 km from the Pinjin Corridor. Routing of infrastructure corridors would avoid suitable habitat for this species.

The Australian Bustard (*Ardeotis australis*) listed as Priority 4-DEC was sighted during surveys in the Operational area and Pinjin Corridor. A nest and egg was recorded, 50 m from the proposed Pinjin Corridor. Tracks were observed on the Tropicana-Transline Corridor and water borefield and pipeline corridor. The Crested Bellbird (*Oreoica gutturalis*) listed as Priority 4-DEC was sighted along the Pinjin Infrastructure Corridor. Due to the extent of suitable habitat outside the study area, wide distribution and nomadic nature of both the Australian Bustard and Crested Bellbird, there is expected to be minimal impact on these species.

The TJV proposed management focuses firstly on avoiding impacts to fauna and fauna habitat through site selection and secondly on managing and mitigating unavoidable impacts. The Construction Environmental Management Strategy (CEMS), the Operational Environmental Management Strategy and the Threatened Species and Communities Management Strategy would be implemented to manage and mitigate impacts to terrestrial fauna. The CEMS also details fauna management strategies for native fauna that may become trapped in open trenches. These strategy documents focus on the environmental outcomes rather than specific controls that would be adopted, to enable the TJV to adapt as new information or practises are developed.

Short Range Endemic Fauna - *Ecologia* Environment was commissioned to undertake an assessment of the potential occurrence of Short Range Endemic (SRE) invertebrate fauna within the Operational Area. Surveys were undertaken in September – October

2006 and May – September 2008. In addition to this work a DNA project to further investigate the taxonomy of particular species was undertaken.

Forty three invertebrate taxa were identified in the Operational Area and its surrounds, of which 17 are considered to be of conservation significance. None of the species are currently listed as protected species, their conservation significance results from the fact that they are all new to science and/or belong to a genera composed predominantly of SRE species. The species were predominantly Mygalomorph spiders. One species, *Kwonkan* sp. 2, has been located only within the Project footprint. The waste material landform was redesigned to avoid the only known sampling location of *Aganippe* sp. 4 and it is now 800 m from the footprint.

Submissions

Key comments in submissions:

- information is outstanding for the Southern Marsupial Mole and Sandhill Dunnart;
- the DEC advised that the information available on *Kwonkan* sp. 2 habitat and *Aganippe* sp. 7 was insufficient to adequately determine risk from this proposal; and
- the SRE fauna community requires monitoring and adaptive management for protection.

Assessment

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

- protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950*;
- protect fauna listed on the Protect fauna listed on the Schedules of the *Environment Protection and Biodiversity Conservation Act 1999*; and
- maintain the abundance, species diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impact and improvement in knowledge.

Terrestrial Fauna - The EPA notes that the fauna surveys conducted for the TGP comply with EPA Guidance Statement No. 56 (EPA 2004) and considers them adequate for environmental impact assessment. The EPA acknowledges that limited historical survey work exists for the Project area and that extensive surveys have been undertaken for the Project.

An additional report by Joe Beshemesh was submitted by the proponent in November 2009 which provided his professional opinion on the effects of the Project on the Marsupial Mole population. Beshemesh concluded that it was unlikely that the loss of Marsupial Mole habitat and individuals due to the Project construction and operations would significantly threaten the larger population. Beshemesh noted that substantial habitat (estimated at approximately 14, 000 km of dune) existed north of the Project area and that the 15 km of dunes that may be impacted by the Project represents less than 0.1 per cent of this habitat and less than 0.01 per cent of available habitat for the Southern Marsupial Mole in the GVD. Beshemesh added that there is nothing to suggest that the Project area provides an important link to surrounding areas and populations.

The EPA notes the above advice and the management measures which include avoidance of continuous sand dune habitat where Marsupial Moles are likely to occur and preservation of Marsupial Mole habitat to the west of the Resource Area.

Due to large areas of sand dunes located in the region, the EPA considers that direct impacts to the regional populations of Southern Marsupial Mole are unlikely to be significant.

Additional survey work and information on habitat availability for the Sandhill Dunnart was provided post the PER document along with additional information regarding the genetic differentiation between Sandhill Dunnarts collected in WA and SA. Three field trips were conducted to specifically target Sandhill Dunnart comprising 5,856 trap nights over two seasons. The DEC advised that survey efforts for Sandhill Dunnarts are adequate.

An assessment of potential habitat for the Sandhill Dunnart in the Operational Area and Pinjin Corridor was undertaken by Sue Churchill (specialist wildlife consultant) in December 2009 and provided to the EPA. The EPA notes that this work found that the majority of the proposed disturbance footprint within the Operational Area is situated in habitat considered Marginal for Sandhill Dunnarts, that is, they may use this habitat for movement between Prime or Likely habitats, or for foraging if appropriate cover is present however would not often live in it. Churchill's report indicates that there are patches of vegetation that may be Prime or Likely habitat along the Pinjin Corridor, however some of these have been severely burned in the last few years making them unsuitable for at least the next decade.

The EPA notes that in order to minimise impacts to the Sandhill Dunnart, the TJV has designed the Pinjin Corridor to bypass the majority of yellow dune systems which are considered to constitute Prime or Likely Sandhill Dunnart habitat. Disturbance to potential habitats has also been minimised by avoiding Spinifex areas which have been unburnt for approximately eight to 38 years. The EPA notes that the Prime habitat present to the west and south west of the Operational Area would be avoided.

The EPA notes the proponent's efforts to minimise direct impacts to Malleefowl through project design. The EPA acknowledges that the infrastructure corridors would avoid direct impacts to Malleefowl with only relatively small areas of vegetation to be cleared in these areas. The EPA considers that the direct impacts to the Malleefowl (clearing of 1 inactive mound in the Operational Area) to be acceptable.

The EPA notes that a number of other conservation significant species were identified in the TGP surveys and have the potential to occur in the Project area. The EPA considers that the risks to threatened species have been minimised through the management strategies to be implemented by the proponent outlined in the TGP Threatened Species and Communities Management Strategy.

To ensure that fauna is not unduly impacted during pipeline construction, the EPA has recommended a condition requiring the clearing of fauna from open trenches (condition 7).

Short Range Endemic Fauna - The DEC requested further information on *Kwonkan* sp. 2 and *Aganippe* sp. 7 to allow adequate determination of risk to these species from the proposal.

The TJV commissioned further survey work (September 2009) with the aim of collecting the potential SRE species *Kwonkan* sp. 2 and *Aganippe* sp. and describing in more detail the habitat preferences and distribution of these species. This work included a broadened DNA study of all GVD specimens of the genera *Aganippe* and *Anidiops.* No further *Kwonkan* sp. 2 or *Aganippe* sp. specimens were recorded.

A habitat assessment for *Kwonkan* sp. 2 was also undertaken. Three habitat types were identified as potentially suitable for *Kwonkan* sp. 2. Two occurred both inside and outside the disturbance footprint and one fully outside the footprint. None of these habitats were classified as 'island habitats'. The habitats identified were fully overlapping with the habitat of *Kwonkan* sp. 1 and partially overlapping with *Aganippe* sp. 2/7 and a new species, *Swolnpes darwini*. Given this similarity, the proponent considers that the spatial distribution of *Kwonkan* sp. 2 is most likely to follow similar patterns of these other species.

Twelve specimens of *Aganippe* sp. 2/7 were collected in the surveys. On a large scale, the species was found in two distinct vegetation units and on small scale (within the two vegetation units) the species were associated with pockets of four habitat types. Habitat assessment undertaken by the TJV showed that these pocket habitats extended a minimum of 12 km beyond the proposed footprint suggesting that the preferred habitat of this species is well represented outside the Project area.

Based on the findings of these studies the TJV has developed a monitoring program to ensure indirect impacts on potential SREs are minimised. The monitoring procedure consists of conducting:

- annual census of all Mygalomorph burrows present;
- vegetation monitoring; and
- ground cover monitoring.

The EPA acknowledges the survey work undertaken for SRE species including the supplementary survey and habitat assessment commissioned to address DEC's concerns regarding *Kwonkan* sp. 2 and *Aganippe* sp. 7. The EPA, on the advice of DEC, considers survey work undertaken by the proponent for SRE species in the Project area to be adequate. The EPA acknowledges this survey work has addressed critical gaps in knowledge of such poorly surveyed species.

The EPA notes that although *Kwonkan* sp. 2 has not been identified outside the Project footprint it is likely that its habitat extends beyond the boundaries of the proposed disturbance footprint.

The EPA recognises that the proponent intends to undertake annual monitoring of the known habitat of *Aganippe* sp. 4 and the presumed habitat of *Kwonkan* sp. 2 to provide information on the indirect impacts from mine activities on SRE invertebrate fauna and to ensure the species are not subject to indirect impacts beyond the mine's footprint.

The EPA supports the undertaking of such a monitoring program to provide information on indirect impacts from mine activities and implement adaptive management of operations to minimise impacts on these species, on the advice of and in agreement with DEC. This monitoring is detailed in the Tropicana Gold Project Threatened Species Management Strategy (2009). The EPA recommends a condition (condition 7) be imposed which requires the TJV to implement the Tropicana Gold Project Threatened Species Management Strategy (2009).

Summary

Having particular regard to:

(a) the habitat information for threatened species and SRE;

(b) recommended condition requiring implementation of the TGP Threatened Species and Communities Management Strategy (July 2009); and

(c) recommended condition requiring management measures to reduce the potential impacts on fauna from open pipeline trenches,

the EPA considers the issue of Fauna has been adequately addressed and the proposal can meet the EPA's objectives for this factor subject to implementation of the recommended conditions.

3.3 Subterranean Fauna

Description

The construction and operation of the TGP has the potential to directly impact subterranean fauna through direct species and habitat removal, substrate or surface water contamination, groundwater drawdown, and vibration. There is also potential for the proposal to indirectly impact subterranean fauna through physical alterations such as changes to temperature, humidity and availability of organic matter.

Desktop assessments for the Operational Area and Water Supply Area suggested that the likelihood of stygofauna being present was low. Follow up sampling programs were commissioned to test these conclusions. Field sampling confirmed that both areas had highly saline groundwater and no stygofauna were located.

Desktop assessments for troglofauna suggested that based on the geology of the Operational Area, it was not prospective for troglofauna as there was no evidence for cavities or voids in the weathered material site above the basement rock. Despite this a phased sampling regime was commissioned by the TJV in both dry and wet seasons. Table 5 outlines the subterranean fauna surveys undertaken.

All surveys were designed to meet the requirements of *EPA Guidance Statement 54 Sampling of Subterranean Fauna in Groundwater and Caves, and EPA Draft Guidance Statement 54a Sampling Methods and Survey Consideration for Subterranean Fauna in Western Australia.* Sampling was performed both inside and outside the zone of proposed disturbance footprint.

Table 5: Subterranean fauna surveys Tropicana Gold Project.

Title of Report	Consultant	Dates undertaken
Tropicana Gold Project Stygofauna Survey Report	*ecologia* Environment	Sept, Nov 2007, Apr-May 2008
Tropicana Gold Project Troglofauna Survey Report	*ecologia* Environment	Sept – Nov 2007, Apr – Jun 2008, Aug – Oct 2008, Oct – Dec 2008
Tropicana Gold Project Troglofauna Survey Report Addendum Phase 5	*ecologia* Environment	
Tropicana Gold Project: Review of Local and Regional Regolith Types and Distribution as Potential Troglofauna Habitat	Louisa Lawrence and Associates	July 2009
Tropicana Gold Project Stygofauna Survey Minigwal Water Supply Area	Subterranean Ecology	Jan 2009
Tropicana Gold Project Troglofauna Surveys Phase 6 and 7	*ecologia* Environment	

Troglobitic species belonging to the following three families were recorded over 5 phases of sampling included in the PER report:

- Isopoda (slater);
- Diplura (bristletail); and
- Chilopoda (centipede).

Two species of troglofauna (a bristletail and a centipede) have been identified only within the proposed disturbance footprint.

Submissions

Key comments in submissions:

- the DEC had concerns over the methodology and adequacy of troglofauna data to determine risk to the species.

Assessment

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

- protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950*;
- protect fauna listed on the Schedules of the *Environment Protection and Biodiversity Conservation Act 1999*; and
- maintain the abundance, species diversity, geographic distribution and productivity of fauna at species and ecosystem levels through appropriate research including sampling, identification and documentation.

In response to the DEC concerns over the methodology used in the troglofauna surveys, the TJV commissioned two additional rounds of sampling and undertook fourteen regolith cross sections across the Operational Area in order to describe the potential distribution of potential habitat for troglofauna. The new surveys recorded a number of additional occurrences of the Isopod plus a fourth species of troglofauna (a cockroach) identified both inside and outside the proposed disturbance area. No new occurrences of the bristletail or the centipede were recorded.

A total sample size of 411 was achieved in the seven phases, produced 14 individuals belonging to four definitive troglobitic species, of which two predatory species (the

bristletail and the centipede) remain known only from within the Operational footprint. The proponent infers that such trapping results suggested that the troglobitic community within the region is sparse, or that the current trapping methods for troglofauna sampling have low trapping rates.

Fourteen regolith cross sections were compiled across the Operational Area. Six of these sections are located in areas where troglofauna have been collected, each contained regions presumed 'prime habitat' (porous strata located above the water table). Assessment identified that these strata are extensive, and are linked by 'bridge' strata to other areas of 'prime' habitat.

An extrapolation of the suitable geological strata resulted in an estimate of 16,670 ha of troglofauna habitat within the TGP. The overall impact of the footprint on the troglofauna community within Operational Area is estimated at 10 per cent (*ecologia* Environment, 2010).

The EPA considers the sampling effort undertaken to be adequate. The EPA notes that results gained from the sampling efforts suggest that the troglobitic community located within the Operational Area is sparse or that the current trapping methods used in WA for troglofauna sampling have low trapping rates in lateritic environments (like those observed within the GVD).

The EPA, with the advice of DEC, considers it likely that suitable habitat connectivity exists along the channel-fill sediments, supplemented by gravel, silcrete, ferricrete and calcrete strata 'bridges' above, and upper and lower saprolites below. The troglobitic community is expected to be distributed along these geological units. The EPA notes that the troglobitic habitat is likely to extend beyond the TGP Operational Area and suitable habitat may be widespread across lateralised weathered environments observed over significant areas in Australia. The EPA considers that it is likely that all species identified through the surveys would occur in the remaining habitat outside the impact footprint.

The EPA notes that the subterranean surveys for the Project area have identified troglobitic species within an area/environment that conventional desktop assessment classified as having a low probability of harbouring troglofauna. Guidance Statement 54A (EPA 2007) does not identify this area as one of high risk for troglofauna.

Based on the results of the troglofauna sampling undertaken for the Project area, *ecologia* Environment have provided recommendations to improve trapping efficiency and effectiveness based on knowledge and experience gained from the Tropicana surveys. The EPA will give consideration to these recommendations when reviewing EPA Guidance Statement No. 54a Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia.

Summary

Having particular regard to the:

- the likelihood that troglofauna habitat extends beyond the Project area; and
- management measures to be implemented by the proponent to minimise potential impacts to troglobitic species and troglofauna habitat,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objectives for this factor.

3.4 Groundwater Quality

Description

There is potential for groundwater to be impacted through: unsustainable abstraction, discharge of excess water, contamination from chemicals, leachate from the tailings storage facility/waste material landforms, and acid and metalliferous drainage.

Groundwater recharge is estimated at 0.5 per cent of annual rainfall. Consequently salinities are high ranging from 15,000 to 30,000 milligrams per litre (mg/L) Total Dissolved Salts (TDS) and up to 100,000 mg/L TDS several kilometres north of the mine.

Water supply - Process water would be predominantly saline raw water from the borefield (Minigwal Trough) approximately 50 km away. Water would be pumped via a bunded or buried pipeline. Seven gigalitres per annum (14 megalitres per day) would be required during full production. Hydrogeological modelling (Pennington Scott, 2009A) indicates that the aquifer is sufficient to meet the TGP's water requirements without causing unacceptable environmental or social impacts. An estimated 40 production bores would be required, drilled to 350 m. A Reverse Osmosis plant would produce higher quality water for potable water supplies.

Pit dewatering - Groundwater would be impacted by dewatering to allow mining below the water table. All water produced from dewatering would be utilised in the processing facility for dust suppression. There would be no discharge of pit water to the environment.

A numerical groundwater model of the Operational Area was constructed using the FEFLOW finite element code (Pennington Scott, 2009B) to simulate abstraction rates and changes to groundwater levels and flow paths associated with mine dewatering activities and TSF water management.

A 15 year modelling scenario, representing the cessation of mining, predicts that a drawdown cone of up to 50 m is likely to occur within a 1 km radius of the void, 10 m within about 1.5 km and result in a drawdown cone of up to 1 m over a distance of about 4 km to the south and southwest, equating to a total impacted area of 25 km^2. Figure 3 shows the drawdown contour impacts over the Operational Area. Much of this area lies beneath the proposed waste dumps and other disturbed mine areas. The greatest drawdowns, of up to 50 m would occur within about 1 km of the eastern wall of the pit. Being located in a remote region of the GVD, there are no dwellings or stock and domestic bores within 200 km of the Operational Area, and therefore the TGP drawdown would not adversely impact other water users.

The proponent states that the drawdowns are not predicted to have an impact on vegetation as there is unlikely to be any groundwater dependence in the region as the depth to groundwater over the impacted area is greater than the rooting depth of local vegetation. The water table is approximately 17–35 m between dunes and approximately 45–55 m under sand dunes. While there are some vegetation species

that are known to have tap roots that could conceivably reach the water table, the saline to hypersaline quality of the groundwater precludes usage by most plants apart from halophytes. No deep rooted halophytic vegetation has been identified in the Operational Area (Pennington Scott, 2009B).

During the clearing phase the proponent proposes to collect soil and moisture data and photograph and record the root profiles for key tree and shrub species. The TJV would monitor the drawdown effect over the life of the TGP via observation bores.

At the completion of mining, all pit dewatering would cease and groundwater would seep back into the pit voids. The pit voids are predicted to form groundwater sinks whereby evaporation would exceed the rate of groundwater inflow. Pit void modelling (Pennington Scott, 2009B) predicts that salts derived from rainfall and groundwater influx would steadily accumulate and be concentrated in the void water through continuous evaporation, turning the voids hypersaline within approximately 50 years. Density differences may drive this highly saline pit water into groundwater directly beneath the voids should fissures be present in the pit base.

Tailings Storage Facility – The TSF would be lined with a combination of High Density Poly Ethylene (HDPE) and compacted clay liner. A tailings underdrainage system would direct water to a sump where it would be pumped to a supernatant pond, then central decant, before being returned to the plant. The design includes a TSF seepage recovery system of interception bores.

Drainage management within the TSF has been modelled (Knight Piesold, 2009) and under worst case conditions where faulting provides a direct, high permeability connection between the TSF and the pit, the maximum influx that could occur is the entire TSF leakage volume of 1000 kL/day. This would increase the long-term pit influx by about 20 per cent of the baseline. Seepage rates under normal operating conditions with the proposed liner and underdrainage system are estimated to be below the guideline limit of 1 kL/ha/day as set by the Department of Water (DOW).

The TSF would be managed to meet the requirement of the International Cyanide Management Code. As part of the code the tailings storage facility would be monitored for levels of Weak Acid Dissociable (WAD) Cyanide. The proponent's Tailings Environmental Management Strategy incorporates cyanide monitoring procedures and management strategies. The preferred management option is to actively control cyanide levels at the 'carbon in leach' circuit to maintain residual WAD cyanide in tailings bleed water at an acceptable level. If required, a cyanide destruction facility would be designed to reduce WAD cyanide in the tailings bleed water. The intention would be to treat only sufficient bleed water to ensure that the total standing bleed water at the TSF is below 50 mg/L.

The TSF would be fenced to prevent cyanide impacts to wildlife and includes a water recovery system to limit the amount of free water stored on the facility. The facility would be monitored daily and any observed fauna deaths would be recorded as an incident and investigated.

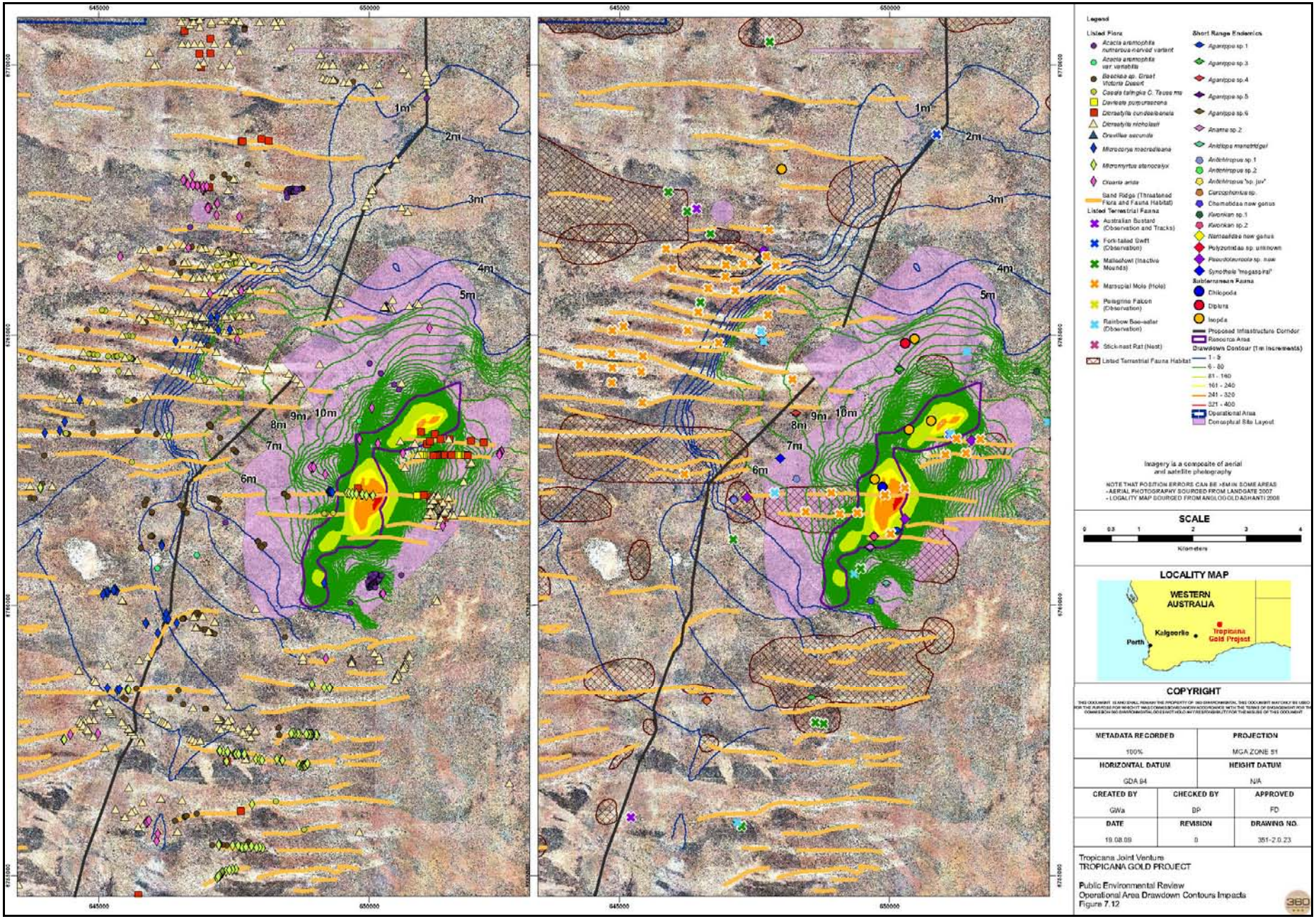

Figure 3: Operation area drawdown contours impacts

Waste Material Landforms - There is a potential impact for the waste material landform to generate acid rock drainage, release of heavy metals and the release of sediments in surface run-off. Geochemical characterisation (including static and kinetic testing) of samples from the Project area (SRK, 2009) has shown that the majority of the waste material (70 – 75 per cent) can be expected to be non acid forming. Approximately 8 per cent of the waste material could be expected to be potentially acid forming, although this could be as high as 15 per cent. This material is associated with a small number of rock types. A further 10 to 22 per cent of the waste material is classified as uncertain.

The TJV propose to prevent acid migration and formation by co-dumping with non-acid forming waste during operation. The co-dumping strategy is based on the inherent acid neutralising capacity observed in the non-acid forming material during the testing program. A layer of approximately 10 m depth of non-acid forming waste would be placed as the final layer on each waste landform to provide a barrier between the co-dumped waste and the topsoil to prevent access by the roots of surface vegetation.

Modelling undertaken on the reconstructed landform suggests that rainfall infiltration following a typical or an extreme event would remain within the 10 m layer of inert material, further reducing the potential for metallic or contaminated seepage from the waste landforms. The waste landforms would also be surrounded by a toe drain to prevent sediment generated from the structures from dispersing into the surrounding landscape.

Submissions

Key comments in submissions focused on:

- concern regarding impacts of groundwater drawdown on dunes, vegetation and water holes;
- further information required on the geochemical constituents of the tailings such as heavy metal, pH, salinity and leaching characteristics; and
- management measures to ensure that wildlife are not impacted if WAD cyanide levels are above 50 mg/L.

Assessment

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

- maintain the quality of groundwater so that existing and potential users, including ecosystem maintenance, are protected;
- ensure that activities which could affect the quantity of groundwater are appropriately controlled;
- maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance, are protected; and
- ensure that the beneficial uses of groundwater can be maintained.

The EPA notes the beneficial use of ground water in the area is limited. The EPA notes that predicted drawdowns are not expected to impact vegetation since the linkage between surface and the deep aquifers is minimal due to clay levels and the depth to groundwater over the impacted area is greater than rooting depth of local vegetation.

The EPA notes that the standing water levels in the pit voids at the cessation of mining are predicted to be hypersaline. The voids would be a closed water system. The EPA therefore considers that it is unlikely that the pit voids would impact groundwater quality.

The proponent's proposed measures to minimise the generation of acid rock drainage and release of heavy metals in surface run-off from the waste material landforms to the environment are noted. The Department of Mines and Petroleum (DMP) supports the design of the integrated TSF and waste dump design as it provides advantages in rehabilitation that other options do not. The EPA notes that the detailed design of the TSF and waste material landforms would be vetted by technical specialists of the DMP and the Department of State Development (DSD) prior to construction.

The TSF design uses best practice technology and includes a HDPE and low permeability clay liner and underdrainage system. The EPA notes that impacts from seepage from the TSF are expected to be negligible and therefore it is unlikely that groundwater quality would be affected. However, the EPA recommends that a condition (condition 9) be imposed on the proponent to ensure that any discharge of water from the TSF and waste material landforms is monitored, managed, and treated if necessary to ensure that surface and groundwater quality are maintained.

Summary

Having particular regard to the:

(a) limited beneficial uses of groundwater in the area;

(b) hydrogeological modelling;

(c) best practice design of the TSF, and the detailed design of the TSF and waste material landforms to be vetted by DMP; and

(d) recommended condition on discharge of water,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objectives for this factor subject to implementation of the recommended condition.

3.5 Rehabilitation and Closure

Description

The TGP is expected to have a 15 year mine life and result in the disturbance of 3,440 ha and require rehabilitation of 3,040 ha (mine void would not be rehabilitated). The proponent's post operational aim is to: establish a sustainable native ecosystem that is as similar to the pre-existing ecosystem as can be achieved within the limits of recognised good practice rehabilitation methods and the post mining environment.

The potential risks associated with rehabilitation and closure include: failure to establish a safe non-polluting landform; failure to establish self-sustaining vegetative cover; rehabilitation falls short of agreed completion criteria; erosion; contamination and altered groundwater and surface water regimes.

The TJV has developed a Conceptual Closure and Rehabilitation Strategy which provides a framework for managing closure and rehabilitation requirements over the life of the Project. The Conceptual Closure and Rehabilitation Strategy would be updated over the life of the Project to ensure that it reflects the changes to the Project status, research outcomes and Stakeholder expectations. TJV intends to manage rehabilitation progressively, and to ensure that the rehabilitation outcomes are in accordance with agreed closure strategies.

The TJV considers that backfilling the pit(s) with waste materials would result in the sterilisation of underground resources that may become viable in the future. Notwithstanding this, the TJV has stated that it would use its best endeavours to identify opportunities to backfill some areas of the pit(s).

Modelling (Pennington Scott, 2009B) predicts that the pit void(s) would act as groundwater sinks over time since evaporation would exceed the rate of groundwater inflow. The fresh rock in the Havana and Tropicana voids exhibits virtually nonexistent permeability and throughflow; therefore, these voids would effectively be closed water systems. Water filled voids after closure could attract both native and feral animal populations, however given the high salinity of groundwater influx to the pit, the proponent expects that the water would be too saline to support native or feral fauna from the onset. An abandonment bund would be constructed around the perimeter of the pit outside of the zone of geotechnical instability and all access ramps would be blocked off. The bund would be at least two metres high and five metres wide at the base, consistent with statutory requirements.

The waste material landforms would not exceed 375 mRL. This is lower than the surrounding natural landforms. Waste landform slopes would be continuous at a maximum angle of 15 degrees. This is a similar slope angle to sand dunes in the area. The waste landforms would be surrounded by a toe drain to prevent sediment generated from the structures dispersing into the surrounding landscape. Surface runoff from the landforms would either evaporate or be diverted to the pit void where it would mix with void water.

Benign capping material for the TSF would be obtained from the adjacent waste landform or the pit. This capping material would prevent salinisation of the growth medium, and roots from the re-established vegetation accessing the saline tailings and water infiltration into the tailings post closure.

The post closure landforms would be covered with topsoil as a growing media. Research would determine what depth of growing medium is required to support the new ecosystem and whether an impervious layer below the medium is required to support dune vegetation. Cover material would be carefully selected to be able to support vegetation and would not contain material that is dispersive, acidic or saline. At a minimum, one metre of growth medium would be applied. An estimated volume of 17 Million cubic metres (Mm^3) of growth medium is required, the calculated approximate volume of available growth medium is 18 Mm^3 providing sufficient competent material (AngloGold Ashanti, 2009). Water erosion modelling undertaken (Landloch, 2009B) has confirmed that a landform (that is 40 m high on 14 degree gradient) covered by a sandy growth medium would be stable and have an extremely

small potential for run-off induced erosion. The waste landform crests may be vulnerable to wind erosion and investigations (Landloch, 2009C) show a growth media consisting of a mix of sand and gravel/rock would be required to minimise wind erosion.

The TJV acknowledges challenges would be faced in rehabilitating the Project area. There is a general lack of information on appropriate and successful rehabilitation techniques and protocols for similar environments in Australia. There is also the lack of an appropriate analogue site. The TJV proposes to undertake an adaptive strategy to rehabilitation which would include securing baseline data, adapting leading practice from other sites for the local conditions and conducting research into areas of remaining uncertainty.

The TJV would implement a Rehabilitation Research Program over the life of the Project. A research program would support the rehabilitation work and is aimed to understand the restoration requirements for the local area, the ecophysiology of framework species, seed bank handling, seed catchment, broadcasting, germination and propagation. The TJV is collaborating with external parties such as the Botanic Gardens and Parks Authority and other specialist organisations to ensure the knowledge required to achieve successful rehabilitation is attained.

The proponent has identified a number of rehabilitation management measures typically employed to re-establish a vegetative ecosystem:

- re-introduce plant species and soil biota by careful handling of topsoils;
- effective seed management and direct seeding;
- growing cuttings for planting out;
- direct transplanting;
- employing micro-propagation methods to multiply plants; and
- creating habitat for fauna re-colonisation.

Monitoring would be undertaken to ensure successful establishment of vegetation in rehabilitated areas. Remote sensing and visual assessments would be used to assess factors such as soil condition, vegetation stability, invasive species and compliance with closure criteria.

Submissions

Key comments in submissions focused on:

- minimising the impacts of an increase in fauna and introduced animals attracted to the post-mining water-filled void;
- research into rehabilitation for the area should be undertaken; and
- progressive backfilling for the pit(s) by mine overburden and waste from the processing plant should be considered.

Assessment

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

- ensure that mining is planned and carried out so to ensure a sustainable mine closure outcome is achieved, consistent with mining industry best practice as set out in the Australia and New Zealand Minerals and Energy Council/ Minerals Council of Australia, 2000, *Strategic Framework for Mine Closure*;

- ensure that self-sustaining native vegetation communities are returned after mining, which in species composition and ecological function are as close to possible to naturally occurring analogue sites; and
- ensure that final mine pit lakes do not cause significant environmental impacts through groundwater pollution or by attracting wildlife, birds or stock which may be harmed by contact with contaminated water, or, if the water is of good quality, by attracting increased numbers of grazing and predatory animals which may consequently impact on the ecology of the surrounding area.

A Conceptual Closure and Rehabilitation Strategy was provided which provides a framework for managing closure and rehabilitation requirements over the life of the Project. The EPA acknowledges that the proponent has committed to progressive rehabilitation and to plan for closure and rehabilitation, commencing from the early stages of project development, which would be further defined through stakeholder consultation, detailed engineering design and various studies.

The pit voids are not proposed to be backfilled. However the EPA encourages the TJV to use its best endeavours to identify opportunities to backfill some areas of the pit voids as this strategy would ultimately reduce the overall Project footprint.

The EPA supports the inclusion of a Rehabilitation Research Strategy to assist in addressing unanswered questions and plans/strategies for the forced or unexpected early closure of the Project.

To ensure the long-term success of mine closure and rehabilitation the EPA recommends a condition (condition 10) that requires rehabilitation to achieve specific outcomes to ensure that, at closure, the tailings storage facility, waste material landforms and other disturbed areas are left in a safe, stable and non-polluting condition.

The EPA has also recommended a condition (condition 11) which requires the proponent to prepare a Final Closure and Decommissioning Plan at least 5 years prior to the final completion of mining. This requirement is consistent with Australian and international mining industry best practice for sustainable mine closure.

Summary

Having particular regard to the:

(a) the TJV's Conceptual Closure and Rehabilitation Strategy;

(b) design and rehabilitation of the TSF and waste material landforms; and

(c) recommended conditions on rehabilitation and closure,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objectives for this factor subject to implementation of the recommended condition.

4 Conditions

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for Environment on the 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 TJV to construct and operate the TGP is approved for implementation.

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

(a) flora and vegetation;

(b) fauna;

(c) groundwater quality;

(d) rehabilitation; and

(e) mine closure.

In developing these conditions, the EPA consulted with the proponent and the Department of Environment and Conservation in respect to matters of fact and matters of technical or implementation significance. Minor changes, which did not change the intent or scope, were made to conditions 5, 7, 8 and 9.

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 trapped 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 TGP;
- *Mining Act 1978* – the mining proposal requires approval by the DMP.

5. Recommendations

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

1. That the Minister notes that the proposal being assessed is to develop and operate an open-cut gold mine with infrastructure and utilities;
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 unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4; and
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

Appendix 1

List of submitters

Government Departments:
Department of Environment and Conservation
Department of the Environment, Water, Heritage and the Arts
Department of Indigenous Affairs
Department of Mines and Petroleum
Department of Water
Shire of Laverton
Department of Health

Non-governmental Organisations:
Central Desert Native Title Services
Wildflower Society

Appendix 2

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Appendix 3

Summary of identification of key environmental factors and principles

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
BIOPHYSICAL			
Flora and vegetation	A total of 3,440 ha would be disturbed by the proposal, this includes: • 2,570 ha for the operational area; • 200 ha for the water supply area; and • 670 ha for infrastructure areas. The project area is situated in the Helms Botanical District, near the border of the GVD and the Nullabor Plain, with the Eremaean Botanical Province. A limited number of previous surveys have been undertaken in the region around the Operational Area. Most have either occurred in the nearby nature reserves or at a large scale. WA Herbarium and DEC Flora database identified the potential for two DRF to occur along the Pinjin Corridor (Victoria Desert Smokebush *Conospermum toddii* and Ponton Creek Mallee *Eucalyptus articulata*). Level 1 and 2 surveys were undertaken across the project area in accordance with EPA Guidance Statement 51. The broader survey area covered 230,000 ha. The project footprint by comparison equates to 3,440 ha. A total of 445 taxa were recorded within the survey area. None of the vegetation communities identified in the Operational Area, Pinjin Infrastructure Corridor, Tropicana-Transline Corridor or Water Supply Area are listed as Threatened Ecological Communities. However, communities within or adjacent to the survey areas around the Operational Area and both Infrastructure Corridors show possible similarities with the 'Yellow sandplain communities of the Great Victoria Desert' which has recently been listed as a Priority 3 Priority Ecological Community. At present, detailed descriptions and regional mapping for this PEC are not available. *C. toddii* was located during the surveys, however all known locations of *C. toddii* are located outside of the proposed impact areas. Twenty Priority Flora were recorded across the combined survey areas; most are located outside of the disturbance areas. Fifteen Priority Flora were recorded in the project footprint. 13 would be directly impacted.	<u>Government Organisations</u> • The proponent mitigates or offsets the residual impacts on Priority Flora. • That the basis for extrapolations to estimate Priority Flora be provided to DEC for review. • The potential for indirect impacts on flora and vegetation has not been addressed. This could be done by delineating buffer areas where indirect impacts are expected, identifying thresholds of change and monitoring these accordingly. • That the proponent commits to not exceeding the stated limits of disturbance on vegetation communities S8, ExL.t2H and S4. • A buffer, in which flora and vegetation may decline to pre-defined limits, be delineated around areas approved for disturbance. • That conditions are applied that stipulate trigger levels which specify the measurable level of decline/impact for flora and vegetation within the predetermined buffer area before contingency measures are applied to avert further decline/impact. The proponent should develop a monitoring program applicable to the buffer area. This program should also include reference sites, and provide for adaptive management where the measurable change has reached identified trigger levels. That a condition be developed which requires the proponent to report annually on the findings of the monitoring program. • The proponent needs to define the proposed locations and footprints of outstanding areas and provide commitments to avoid defined conservation significant species and communities.	**Considered to be a relevant environmental factor**
Terrestrial Fauna	The habitats within the Project support a range of fauna species, including several that are endemic to the region and/or listed for protection under State and Federal conservation legislation.	<u>Government Organisations</u> • The assessment on risk of isolation and fragmentation of marsupial mole habitat (connectivity of dunes) is incomplete. That	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	Limited previous fauna surveys have been undertaken in Great Victoria Desert. Data from two previous studies in Plumridge Lakes (Burbidge *et al*, 1976) and Mulga Rock (Matinick and Associates Pty Ltd) have been considered in the PER. Vertebrate fauna surveys were undertaken over the Operational Area, Infrastructure Corridors and Water Supply Area including targeted surveys for conservation significant species. No mammalian species of conservation interest were captured during the surveys however the surveys did identify signs of Southern Marsupial Mole (*Notoryctes typhlops*) holes and habitat suitable for the Sandhill Dunnart (*Sminthopsis psammophila*) and Mulgara (*Dasycercus blythi).* Evidence of bird species of conservation interest (or potential habitat) was recorded during surveys including Malleefowl (*Leipoa ocellata*), Peregrine Falcon (*Falco peregrinus*), Australian Bustard (*Ardeotis australis*), Rainbow Bee-eater (*Merops ornatus*), Fork-tailed Swift (*Apus pacifus*), Wood Sandpiper (*Tringa glareola*), Common Greenshank (*Tringa nebularia*) and Crested Bellbird (*Oreoica gutturalis*). Areas of high value vertebrate fauna habitat were identified and mapped within the survey areas e.g. sand dunes, mature Spinifex and dense Mulga. Impacts to these habitats would be avoided where possible. <u>Short Range Endemic Fauna</u> Surveys identified several species that are new to science. All but one of the species were identified outside the impact area. *Kwonkan* sp. 2 has not been located outside of the footprint and would be fully impacted by the proposal. Habitat assessment has indicated that the preferred habitat of Kwonkan is predicted to extend beyond the impact footprint.	the proponent provides the marsupial mole habitat fragmentation addendum to DEC for review and comment. • That the proponent provides the following information to DEC for review and comment: - Local conservation status of the sandhill dunnart habitat paper; - Results and analysis of sandhill dunnart sampling (survey work) undertaken by Glen Gaikhorst. • That the proponent develops a monitoring program to provide information on the indirect impacts from mine activities on SRE invertebrate fauna, and implements adaptive management measures to minimize the impacts on these species, on the advice of, and in agreement with, DEC. • That the proponent provides the Kwonkan sp. 2 habitat risk assessment addendum to DEC for review and comment. • That the proponent provides information on the size of the Aganippe sp. 7 populations outside the impact footprint addendum for DEC review and comment. • For some species of conservation significance (particularly the marsupial mole, sandhill dunnart and SRE invertebrate fauna), the impact of the proposal is potentially significant and specific programs and strategies need to be developed in consultation with DEC and these strategies should be made a condition of approval.	**Considered to be a relevant environmental factor**
Subterranean Fauna	Desktop assessments for the Operational Area and Water Supply Area suggested that the likelihood of Stygofauna being present was low. Follow up sampling programs were commissioned to test these conclusions. Field sampling confirmed that both areas had highly saline groundwater and no stygofauna were located. Sampling for Troglofauna in the Operational Area recorded three families: • Isopoda (slater); • Diplura (bristletail); • Chilopoda (centipede).	<u>Government Organisations</u> • That the proponent provides the following information to DEC for review and comment as required: - results and analysis of troglofauna sampling (survey work) that is currently being undertaken; - prospective troglofauna habitat risk assessment addendum.	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	The bristletail and the centipede have only been located in the disturbance footprint. Work on habitat distribution for troglofauna has demonstrated that the habitat for the bristletail and centipede is likely to be present in the wider area.		**Considered to be a relevant environmental factor**
Surface Water	Surface drainage is a minor feature in the majority of the GVD. The majority of the drainage catchment is upstream of the Operational Area and the Infrastructure Corridors. Two broad, low relief drainage lines occur on either side of the Resource Area. These drainage lines flow in a north-easterly direction, with an outflow into an unnamed salt lake/clay pan ~ 9km north. Drainage into these catchments flows NE to the southern reaches of Lake Rason system (a large intermittently filled saline wetland with regional significance located 50 km north). The proposed Pinjin Infrastructure Corridor includes the upgrading of three ephemeral waterway crossings. The regional geology is predominantly Aeolian sands with high infiltration capacity, interspersed with areas of colluvial sands. As a result, stormwater runoff rates and volumes are generally low. Surface run-off generated by major storm or cyclonic events may carry sediments from the waste landform and/or permeate into the potentially acid forming waste, potentially impacting flora, fauna and the rehabilitation program if not managed properly.	<u>Government Organisations</u> • Would holding ponds/evaporation ponds be required for excess amounts of water or is it anticipated that given the limited water resource for the project that the water would be quickly utilized at a fast turn over rate? • Surface drainage along the proposed roads is discussed in the PER but how would surface drainage be addressed around other areas of the project? • Is there potential for water starvation due to a 'shadow' effect from large infrastructure, e.g. TSF and plant, in terms of sheet flows?	A surface water management concept has been developed to manage diversion of stormwater from above the site and retention of site generated stormwater onsite through the creation of a gravity drainage network and storages. Infrastructure corridors have been designed to minimise drainage crossing of major water features and avoid listed flora species. Culverts and floodways to minimise disruption to natural flow paths, downstream runoff shadowing and upstream ponding would be implemented. Pipelines would be bunded or buried. The EPA considers that this factor can be appropriately managed under Part V of the EPA Act. **Not considered to be a relevant environmental factor**
Groundwater	<u>Water supply</u> Processing water would be predominantly saline, raw water from the borefield (Minigwal Trough) approximately 50 km away. Water would be pumped via a bunded or buried pipeline 7Mm3/per annum (14 ML/day per day) would be required during full production. Hydrogeological modelling estimates that 40 production bores would be required. A Reverse Osmosis plant would produce higher quality water for potable water supplies. <u>Groundwater and dewatering</u> Groundwater recharge is estimated at 0.5% of annual rainfall. Consequently salinities are high ranging from 15,000 to 30,000 mg/L TDS and up to 100,000 several km north of the mine. Pit dewatering is required as the proposed pits extend below the groundwater table. All water produced from dewatering would be utilised in the processing facility for dust suppression. There would be no discharge of pit water to the environment. Dewatering would consist of pumping from several advance dewatering bores, in-pit sumps and horizontal seep wells.	<u>Government Organisations</u> • Proponent would need to address the following: - Compliance with Australian Drinking Water Guidelines 2004; - Establishment of drinking water quality reporting procedures with Department of Health; - Establishment of a Drinking Water Quality Management Plan; - Mine sites and Exploration Camps Drinking Water Quality Compliance Requirements; - Observing Guidelines for the Bulk Cartage of Drinking Water if potable water is to be transported around the extensive land holdings. • Tailings would be thickened, what are the expected solids? • Has the root zone depth in the area of the proposed TSF been determined? Nearby	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	At the end of mining, drawdowns of 1m would not extend more than 4km from the mining area, equating to a total impacted area of 25 km^2. The area impacted by more than 10m of drawdown would be confined to less than a 1.5km radius from the mining area. Much of this area lies beneath the proposed waste dumps and other disturbed mine areas. The greatest drawdowns, of up to 50m would occur within about 1km of the eastern wall of the pit. Being located in a remote region of the Great Victoria Desert, there are no dwellings or stock and domestic bores within 200 kilometres of the Operational Area, and therefore the TGP drawdown would not adversely impact other water users. The drawdowns are also not predicted to have an impact on vegetation as there is unlikely to be any groundwater dependence in the region as the depth to groundwater over the impacted area is greater than the rooting depth of local vegetation. Water table is 17 – 35m between dunes and 45 – 55 m under sand dunes. While there are some vegetation species that are known to have tap roots that could conceivably reach the water table, the saline to hypersaline quality of the groundwater precludes usage by most plants apart from halophytes. No deep rooted halophytic vegetation has been identified in the Operational Area. <u>Tailings storage facility</u> Additional impacts to groundwater arising from the proposal include contamination of groundwater by hydrocarbon or chemical spills, TSF leachate and waste rock stockpiles. TSF seepage modelling has been undertaken. Seepage rates under normal operating conditions with the proposed liner and underdrainage system are estimated to be below the guideline limit of 1 kL/ha/day as set by DOW. The TSF facility is located in close proximity to a higher permeability sub-surface drainage zone and the open pit. The open pit would be dewatered to facilitate mining and water in the HPS drainage zone would be utilised as a water resource for the operation. It is anticipated that both of these features would influence the direction and rate of TSF seepage. It is recognised that potential seepage from the TSF and run-off from the WML would be low due to low rainfall and high evaporation rates. However, in the event of major storm or cyclonic event, the TSF may overflow and cyanide and heavy metal-rich water spread across the adjoining waste dump and surrounding land. The TSF would be managed to meet the requirement of the International Cyanide Management Code. As part of the code the TSF would be monitored for levels of Weak Acid Dissociable Cyanide (WAD). The Tailings Environmental Management Strategy	native vegetation being impacted by groundwater mounding would be a factor needing operational protection. • The baseline contents of the major geochemical constituents have not been included, what are the expected heavy metal, pH and salinity of the tailings including the leaching characteristics? • Bore monitoring stations would be constructed downsteam. Would upstream bores be included? • The DEC would need confirmation at works approval stage that the TSF pipeline be welded to Australian Standards and that the containment system would also include catchment pits in the event of a large pipeline spill. • The TSF would be designed to retain a 1 in 100 year 72 hour rainfall event, what has this capacity been calculated as? The DEC would require demonstration that a 0.3 freeboard is adequate during the works approval process. • Apart from cyanide and hydrocarbons what other chemicals would be stored on site and in what quantities and would they be stored to the same standard?	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	incorporates cyanide monitoring procedures and management strategies. *Potentially Acid Forming Minerals* The potential for waste material generated through the mining process to generate acid has been assessed by SRK, Landloch and Soil Water Consultants. Geochemical characterisation (including static and kinetic testing) of samples from the project area undertaken has shown that the majority of the waste material (70 – 75%) can be expected to be non acid forming (NAF). Approximately 8% of the waste material could be expected to be potentially acid forming, although this could be as high as 15%. This material is associated with a small number of rock types. A further 10% to 22% of the waste material is classified as uncertain Generation of acid run-off is unlikely, due to the high total alkalinity of waste generated and the design of the waste material landforms. Soil Water Consultants demonstrated that there is negligible risk of groundwater contamination from metalliferous seepage from the long-term storage of environmentally hazardous waste material (such as PAF) given the proposed management strategies planned for the Project.		**Considered to be a relevant environmental factor**
Geology/hydrogeology	Multi-element analysis of surface soil samples and near surface soil samples was undertaken to provide a baseline for metal concentrations occurring naturally in the surrounding environment. Metal levels were assessed against the Australian Institute of Mining and Metallurgy (AIMM) average crustal abundance values. Average concentrations for the majority of elements fall below average crustal abundance levels, with the exception of arsenic, mercury, strontium and tellurium, although individual concentrations of a number of other elements also exceed respective average crustal abundance levels. Soil testing found that soils were mainly between pH 6 and 8. Salinity generally increased with depth. Average nutrients for the Operational Area were generally low for total nitrogen and all extractable nutrients. Elemental analysis results indicated that chromium, copper, lead and nitrogen were regularly measured at levels above the limit of reporting, as were two individual samples for zinc and mercury. Comparison of these results with average crustal abundances for these elements found that a few individual results for Chromium and Lead were above average crustal abundances in both 'Quaternary sand over laterite" and "Sandstone or ferricrete regolith types". Comparison with DEC Ecological Investigation Levels found all elemental concentrations were below respective Ecological Investigation Levels, with the exception of Chromium.		**Not considered to be a relevant environmental factor**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
Conservation reserves	Approximately 9.4% of the GVD is protected in formal reserves, including the Queen Victoria Spring Nature Reserve (272, 000) 20km SE of the Operational Area, the Plumridge Lakes Nature Reserve (310,000) 100km NE and the Neale Junction Nature Reserve (725,000) 1km SE. Improved access to the region may have a negative impact on nearby nature reserves.	Government Organisations • Only one access route should be developed incorporating both the access road and the communication corridor.	**Not considered to be a relevant environmental factor**
Fire	Fires are a frequent occurrence in hummock grasslands in the semi-arid and arid zones of Australia. Although native flora is adapted and in many cases dependent on fire, too frequent or too hot bushfires can result in detrimental changes to composition and diversity of the vegetation. Activities associated with the Project may result in an increased likelihood of accidental fire. Management of fire would focus primarily on the prevention and control of fires. A Fire prevention and Control Management Strategy would be developed in consultation with DEC and local authorities.		**Not considered to be a relevant environmental factor**
POLLUTION			
Air Quality	During dry conditions project activities have the potential to generate dust and particulate matter. Given the remote rural nature of the Operational Area, the existing concentrations of combustion related emissions are assumed to be negligible. Combustion related emission would be present following lightening derived fires: between October and April as a result of thunder storms. Heggies (2009) were commissioned by the TJV to assess potential health and environmental impacts associated with changes in air quality resulting from the project. This included an assessment of Volatile Organic Compounds, nitrogen dioxide, sulphur dioxide, carbon monoxide, PM_{10} as well as general dust deposition. The results indicated that the concentrations of the pollutants would satisfy all applicable air quality assessment criteria and that the emissions would not adversely impact on the biological integrity of threatened flora and fauna populations situated to the west of the Operational Area. Health risks from airborne dust would be managed in accordance with the *Mine Safety Act 1978*. Ongoing dust suppression measures would be adopted to abate known dust lift-off areas. This would be achieved by undertaking progressive rehabilitation, limiting clearing and adopting effective dust control strategies such as chemical additives, dust extraction systems and water suppression.	Government Organisations • The dust monitoring plan should include validation of the modelling which predicts NEPM PM_{10} would be met at the village location. The plan should also include monitoring of air emissions during activities that may affect sensitive premises (i.e. the village) both during construction and operation phases. The plan should incorporate adaptive management practices to respond proactively to conditions likely to generate dust. • The existing DEP limit for the maximum allowed level of dust concentration in the atmosphere is 1000 micrograms per cubic metre of air, measured over 15 minutes and not 1000 mg/m^3 as appears in the PER. This level (1000 $\mu g/m^3$) is not to be exceeded beyond the boundary of the premises and generally does not apply to road or rail corridors. • Dust visibility is not considered an acceptable monitoring method. Dust visibility alone should not be relied upon as a measure of PM_{10} exceedances or where boundary dust has the potential to affect sensitive receptors. • The *Mine Safety and Inspection Act 1978*	The EPA considers that this factor can be appropriately managed under Part V of the EPA Act.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		and 1994 are cited in Appendix 2-B1 on p38 and p48 respectively as providing appropriate guidance for managing dust containing fibrous material. Given that it has been identified potential health effects from fibrous minerals to workers: TJV should clarify whether both Acts apply; and the sections under the Act or Acts relevant to management of airborne dust containing fibrous material; or define the 'acceptable' levels referred to in the management of fibrous materials in the PER. • Monitoring of road side vegetation would be implemented, it is recommended that the proponent describe this monitoring plan and frequencies. Also at what frequencies would dust suppressants be applied? • What is the expected velocity and moisture count of emissions?	**Not considered to be a relevant environmental factor**
Greenhouse gasses	The estimated quantity of greenhouse emissions produced by the Project would be 330 kt CO2-e/year during operations and 4,500 kt CO2-e over the life of the Project. Final rehabilitation and closure of the site would result in the re-creation of the carbon capture ability of the area, therefore long term impacts are not anticipated. The JV's proposed contributing offset would be used in a research and development program to identify ways to reduce GHG emissions beyond the scope of the Project. A framework would be developed with stakeholders and research institutions. The program would commence following the first year of gold production. Each year The JV would invest (into a trust fund) $1.00/tonne/annum of CO2-e produced in the preceding year. New technologies resulting from the research and development program should provide opportunities for other mining operations to reduce their GHG footprint.		The PER outlines control and mitigation measures for greenhouse gas emissions, including: • incorporation of energy efficient technology such as high pressure grinding rolls and the use of best practice technology; • selection of appropriate mining fleet and equipment; • efficient design in blasting parameters and periodic review; • establishment of a 5 star energy rating village by use of solar panels, recycled water, double roofs, insulation, energy efficient lighting, refrigeration and cooling. The JV has committed to reducing its greenhouse footprint and to operating both a water and energy efficient site. **Not considered to be a relevant environmental factor**
Noise and vibration	The main construction and operational activities that would generate noise and vibration are earthworks, drilling and blasting. The project would meet the requirements of Australian Standard 2436-1981	<u>Government Organisations</u> • The biggest noise impact is considered to be on fauna in the area. Would silencing	The EPA considers that this factor can be managed under the *Environmental*

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	"Guide to Noise Control on Construction, Maintenance and Demolition Sites". Noise and vibration pollution may disrupt fauna or even alter community structure due to the fear response of wildlife. Over time most species would either habituate to the noise and vibration events or move to a suitable distance away from the source. Due to large areas of relatively undisturbed habitat in the region, movement of some individuals away from noise sources would not cause significant impacts. Noise and vibration reduction techniques may include sound insulation where required, silencers/mufflers, smart reversing alarms, noise barriers, vibration suppression controls, blast shielding or vibration monitoring equipment.	units be installed to lessen this impact?	*Protection (Noise) Regulations 1997*. **Not considered to be a relevant environmental factor**
Potential Contaminants	A contamination assessment undertaken identified a number of potential sources of contamination associated with the proposed Project activities. Tailings Storage Facility, Cyanide management and waste landforms is covered under Groundwater Quality (Section 3.4). Spills of hydrocarbons and other chemicals may occur over the life of the Project, these can result in localised areas of contamination. TJV would design, construct and implement hydrocarbon and chemical storage facilities to meet the Australian Standards and WA DEC and FESA requirements. Putrescible and Industrial waste would be managed in accordance with relevant regulations.		The EPA considers that this factor can be appropriately managed under Part V of the EPA Act. **Not considered to be a relevant environmental factor**
SOCIAL SURROUNDINGS			
Aboriginal heritage	In broad terms, the operational area spans lands that may have been used by the Wongatha and Spinifex peoples. Prior to the TGP, only a limited number of formal studies had ever been undertaken within the region, as a result there being limited documented knowledge of Indigenous occupation in the project area. Waru consulting was commissioned to undertake surveys for archaeological sites across the Operational Area, Infrastructure Corridors, Water Supply and water pipeline corridor. A total of 11 sites were discovered and recorded in the Operational Area, with an additional 12 sites discovered during surveys of the supporting infrastructure. No sites would be impacted by the project. No sites of ethnographic significance have been identified. The project layout and infrastructure has taken into account the location of archaeological sites and has been modified to achieve site	<u>Government Organisations</u> • DIA advises that the project can be managed to protect cultural heritage values of the project area if the proponent adheres to the commitments made in the PER document. <u>Non Government Organisations</u> • Issues raised by Traditional Owners and Central Desert Native Title Services (CDNTS) have not been addressed; • Consultations to date with traditional owners have been sporadic and inadequate, broader consultations required; • The archaeological surveys were not carried out with Traditional Owners. Ethnographic surveys carried out to date are	A draft Heritage Management Strategy has been prepared in consultation with the Department of Indigenous Affairs, Central Desert Native Title Services, the North East Independent Body and other members of the Indigenous Community which takes into account procedures for protection of sites and process should any further sites be discovered during operations. In December 2009, a new consultation plan was developed between CDNTS and the Joint Venture and an independent Anthropologist has been appointed to carry out further research

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	avoidance.	inadequate. Archaeological and ethnographic heritage surveys to be conducted over the Project Area by Traditional Owners who hold appropriate knowledge of laws and customs in the area. The Project Area to be surveyed with the aim of identifying all cultural heritage information in sufficient detail to inform a long term Heritage Management Plan; • It is essential that Traditional Owners are engaged and consulted regarding the management of archaeological sites and that any management plan is developed with the Traditional Owners; • A Heritage Management Plan between the JV and the Traditional Owners should be developed providing a clear understanding of cultural heritage requirements as advised by native title holders; • The JV's draft Heritage Management Strategy should be re-written in consultation with Traditional Owners following the development and implementation of the Heritage Management Plan.	and interviews to supplement the work completed for the PER. **Not considered to be a relevant environmental factor**
Mine Closure and Rehabilitation	The proposed mine is anticipated to have a 15 year mine life resulting in the disturbance of 3,440 ha and eventual rehabilitation of 3,040 ha (mine void would not be rehabilitated). The current post operational aim is to: establish a sustainable native ecosystem that is as similar to the pre-existing ecosystem as can be achieved within the limits of recognised good practice rehabilitation methods and the post mining environment. <u>Pit void</u> An abandonment bund would be constructed of competent waste rock material around the perimeter of the pit outside the zone of geotechnical instability and all access ramps would be blocked off. This would act as a barrier to humans and terrestrial fauna. The pit void/s would form permanent saline pit lakes. A 'groundwater sink' would be formed whereby evaporation would exceed the rate of groundwater inflow. The fresh rock in the Havana and Tropicana voids exhibits virtually nonexistent permeability and throughflow; therefore, these voids would effectively be closed water systems. The pre-mining water quality ranges from 14,000 – 40,000mg/L TDS. It is likely that the salinity of the void water would reach salt saturation (greater than 300,000mg/L TDS) as the	<u>Government Organisations</u> • Conditions should be applied to minimise the impacts of an increase in fauna and introduced animals attracted to the post-mining water-filled void. • Any formation that can hold water, such as tailings dams, refuse sites etc should be fenced to exclude wildlife entering those bodies of water and perishing. <u>Non-Government Organisations</u> • The company should be undertaking research into rehabilitation in the area and the EPA should be making sure there is a sufficient bond in place to cover this matter. <u>Individuals</u> • Why are the proponents of this operation being allowed to consider leaving such a large surface area of pit voids which would be recharged forever from rain and ground	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	evaporation rate in the region is 3,000mm/annum whereas the average annual rainfall is between 115 – 300mm. Water filled voids after closure could attract both native and feral animal populations, however given the high salinity of groundwater influx to the pit, the water would be too saline to support native or feral fauna from the onset. <u>Waste Material Landforms</u> The waste landforms would not exceed 375mRL. This is lower than the surrounding landforms. The waste landform slopes would be continuous at a maximum angle of 15º. Water erosion modelling confirmed that a landform (that is 40m high on 14 gradient) covered by a sandy growth medium would be stable and have an extremely small potential for run-off induced erosion. Initial overburden characterisation indicates small volumes of potentially acid forming waste could occur. The strategy for preventing acid formation and migration would be to co-dump with non-acid forming waste during operation. Materials characterisation testing has observed inherent acid neutralising capacity in the non-acid forming material. Successful rehabilitation of the surface of waste landforms would require careful management and placement of the weathered zone materials. <u>Tailings Rehabilitation</u> During operation the TSF would be constructed so that it is surrounded on up to three sides by the waste landform. This would enable cost effective closure of the TSF. Benign capping material for the TSF would be obtained from the adjacent waste landform or the pit. <u>Closure and Rehabilitation Strategy</u> TJV have developed a Conceptual Mine Closure and Rehabilitation Strategy which discusses the concepts behind the closure and rehabilitation outcomes and principles that would be incorporated into the closure and rehabilitation strategies. The proposed Mine Closure and Rehabilitation Strategy would be prepared within 5 yrs of the TGP commencing. The strategy would be reviewed every 3 – 5 yrs. The approved Mine Closure and Rehabilitation Strategy would be submitted to the relevant stakeholders for approval 3 – 5 yrs prior to the closure of the project. A research program would support the rehabilitation work and is aimed to understand the restoration requirements for the local area, the ecophysiology of framework species, seed bank handling, seed catchment and understanding, broadcasting, germination and	water seepage and then allowed to evaporate on a seasonal cyclic basis? With appropriate care and planning it should be possible for a very large portion of the three/four pit voids to be backfilled progressively by mine overburden and waste from the processing plant.	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	propagation. The TJV is collaborating with external parties such as the Botanic Gardens and Parks Authority and other specialist organizations to ensure the knowledge required to achieve successful rehabilitation is attained.		**Considered to be a relevant environmental factor**
Offsets	TJV are proposing direct and contributing offsets. The biodiversity and greenhouse offset packages focus on the residual environmental impacts such as impacts to threatened species habitats and greenhouse gas emissions that remain after implementation of the mitigation hierarchy. The Great Victoria Desert Trust (the Trust) forms the centrepiece of the proposed offsets. The TJV proposes that the Trust would be used to facilitate biological research to improve knowledge of the conservation significant taxa directly affected by the Project and provide resources to facilitate energy efficiency initiatives and the development of renewable energy sources that would benefit the wider community.	<u>Government Organisations</u> • Offset discussions between DEC and the proponent are outstanding. DEC would like the opportunity to advise the EPA on the outcome of offset discussions when they have been held. <u>Non-Government Organisations</u> • Concerns about offsets particularly those involving money provided by proponents. It is not clear what the financial component of the offset would be however we believe there is a real possibility that the State Government Department of Treasury would be taking a close look at non Consolidated Revenue Funding received or managed by government agencies and particularly the DEC. The likely consequence is that CRF funding to the DEC would be reduced by the amount received by any offset or similar arrangement. This would result in no net benefit to conservation.	TJV have initiated offset discussions and workshops for the TGP with DEC, DMP and DEWHA.

PRINCIPLES		
Principle	**Relevant Yes/No**	**If yes, Consideration**
1. The precautionary principle		
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.*	Yes	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.
2. The principle of intergenerational equity		
The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	Proposal would result in the loss of 3440 hectares of vegetation and has the potential to impact diversity. Vegetation is a relevant environmental factor discussed in this report. The resource would be permanently depleted in this area, however the product (gold) is high value and is likely to be used by future generations.
3. The principle of the conservation of biological diversity and ecological integrity		
Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	The proposal would result in the clearing of 3440 hectares of native vegetation/fauna habitat and has the potential to affect biological diversity/integrity. Vegetation is a relevant environmental factor discussed in Section 3 of this report. 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.
4. Principles relating to improved valuation, pricing and incentive mechanisms		
(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.*	Yes	The proposal requires a tailings storage facility. The proponent should bear the cost of containment, monitoring and management.

PRINCIPLES		
Principle	**Relevant Yes/No**	**If yes, Consideration**
(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.	Yes	In considering this principle, the EPA notes the following: • Potentially acid forming waste would be encapsulated in the waste disposal facilities. • Other waste products would created as a result of implementation of the proposal. • Impacts from acid forming waste has been discussed in Section 3 of this report.

Appendix 4

Identified Decision-Making Authorities
and
Recommended Environmental Conditions

Relevant 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:

Decision-making Authority (DMA)	**Approval**
Minister for Environment	Environmental approval
Minister for Water	Rights in Water and Irrigation act - water abstraction licences
Minister for Indigenous Affairs	Aboriginal Heritage Act – section 18 clearances.
Department of Water	Rights in Water and Irrigation act - water abstraction licences
Department of Indigenous Affairs	Aboriginal Heritage Act - s18 clearances.
Department of Mines and Petroleum	*Mining Act 1978*
Department of Environment and Conservation	Works Approval and Licence (Part V *Environmental Protection Act 1986*)
Shire of Laverton	Decision maker for permits and development approvals
Shire of Menzies	Decision maker for permits and development approvals
City of Kalgoorlie-Boulder	Decision maker for permits and development approvals

Note: In this instance, agreement is only required with DMAs 1-3 since these are Ministerial DMAs.

RECOMMENDED ENVIRONMENTAL CONDITIONS

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

TROPICANA GOLD PROJECT,
SHIRE OF KALGOORLIE

Proposal: The proposal is the construction and operation of an open-cut gold mine and associated infrastructure, located approximately 330 km east northeast of Kalgoorlie and 200 km east of Laverton.

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

Proponent: Tropicana Joint Venture (AngloGold Ashanti Australia Limited and Independence Group NL)

Proponent Address: Level 13 St Martin's Tower
44 St Georges Terrace
PERTH WA 6000

Assessment Number: 1745

Report of the Environmental Protection Authority: 1361

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 assessed by the Environmental Protection Authority and described in Schedule 1 of this statement subject to the condition 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 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 6 months prior to the first compliance report required by condition 4-6, or prior to ground disturbing activity, 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 reports; and

6 public availability of compliance 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 fifteen months from the date of issue of this Statement addressing the twelve month period from the date of issue of this Statement and then annually from the date of submission of the first compliance assessment report.

The compliance assessment report shall:

1 be endorsed by the proponent's Chief Executive Officer or a person delegated to sign on the Chief Executive Officer'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 Flora and Vegetation

5-1 The proponent shall ensure that there is no loss of plants of Declared Rare Flora species due to construction or operational activities unless otherwise approved.

5-2 The proponent shall undertake monitoring of the condition and abundance of vegetation and flora at reference and potential impact sites in accordance with the "Tropicana Gold Project Environmental Monitoring Strategy, Version: 1.0, Author: B Bastow, Issue Date: 18 February 2010" or subsequent revisions approved by the Chief Executive Officer of the Office of the Environmental Protection Authority. This monitoring is to be carried out to the requirements of the Chief Executive Officer of the Office of the Environmental Protection Authority on advice of the Department of Environment and Conservation.

5-3 Should the potential impact sites show a 25 per cent (or greater) decline in cover or productivity as compared to the reference sites, the proponent shall provide a report to the Chief Executive Officer of the Office of the Environmental Protection Authority within 21 days of the decline being identified which:

1. describes the decline;
2. provides information which allows determination of the likely root cause of the decline; and
3. if likely to be caused by activities undertaken in implementing the proposal, states the actions and associated timelines proposed to remediate the decline.

5-4 The proponent shall, on approval of the Chief Executive Officer of the Office of the Environmental Protection Authority, implement the actions identified in 5-3 (3) and

continue to implement such actions until the Chief Executive Officer of the Office of the Environmental Protection Authority determines that the remedial actions may cease.

5-5 The proponent shall make the Environmental Monitoring Strategy referred to in 5-2 publically available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

6 Threatened Species

6-1 The proponent shall implement the "Tropicana Gold Project Threatened Species and Communities Management Strategy, Version 2.0, Author: B Bastow, Issue Date: July 2009", or subsequent revisions approved by the Chief Executive Officer of the Office of the Environmental Protection Authority. The objective of this strategy is to minimise adverse impacts to conservation significant species and communities.

6-2 The proponent shall review and revise the Tropicana Gold Project Threatened Species and Communities Management Strategy referred to in 6-1, in consultation with the Department of Environment and Conservation, every three years to ensure that the mitigation and management techniques remain valid and incorporate any relevant new research.

6-3 The proponent shall make the Tropicana Gold Project Threatened Species and Communities Management Strategy referred to in 6-1 publically available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

7 Trapped Fauna

7-1 The proponent shall ensure that open trenches associated with construction of the water pipeline and the communications link are cleared of trapped fauna by fauna-rescue personnel at least twice daily. Details of all fauna recovered shall be recorded. The first daily clearing shall take place no later than three hours after sunrise and shall be repeated between the hours of 3:00 pm and 6:00 pm.

The open trenches shall also be cleared, and fauna details recorded, by fauna-rescue personnel no more than one hour prior to backfilling of trenches.

Note: "fauna-rescue personnel" means employees of the proponent whose responsibility it is to walk the open trench to recover and record fauna found within the trench.

7-2 The fauna-rescue personnel shall be trained in the following, through a program that meets the requirements of the Chief Executive Officer of the Office of the Environmental Protection Authority:

1. fauna identification, capture and handling (including venomous snakes);
2. identification of tracks, scats, burrows and nests of conservation-significant species;
3. fauna vouchering (of deceased animals);

4. assessing injured fauna for suitability for release, rehabilitation or euthanasia;
5. familiarity with the ecology of the species which may be encountered in order to be able to appropriately translocate fauna encountered; and
6. performing euthanasia.

7-3 Open trench lengths shall not exceed a length capable of being inspected and cleared by the fauna-clearing personnel within the required times as set out in condition 7-1.

7-4 Ramps providing egress points and/or fauna refuges providing suitable shelter from the sun and predators for trapped fauna are to be placed in the trench at intervals not exceeding 50 metres.

7-5 The proponent shall produce a report on fauna management within the water pipeline lateral easement and communication corridor at the completion of pipeline and communication link construction. The report shall include the following:

1. details of all fauna inspections;
2. the number of fauna cleared from trenches;
3. fauna mortalities; and
4. all actions taken.

The report shall be provided to the Chief Executive Officer of the Office of the Environmental Protection Authority no later than 21 days after the completion of pipeline installation, and shall be made publicly available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

8 Groundwater and Surface Water Quality

8-1 The proponent shall ensure that run-off and/or seepage from the tailings storage facility and waste material landforms does not impact the quality of surface water or groundwater within or adjacent to the proposal area to exceed the trigger values for a slightly to moderately disturbed ecosystem provided for in Table 3.4.2 of Chapter 3 of the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand 2000, *Australian Water Quality Guidelines for Fresh and Marine Waters* and its updates, taking into consideration natural background water quality.

8-2 The proponent shall monitor the quality of surface water and groundwater upstream and downstream of the tailings storage facility and waste material landforms to ensure that the requirements of condition 8-1 are met. This monitoring is to be carried out using methods consistent with Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand 2000, *Australian Guidelines for Water Quality Monitoring and Reporting* (and its updates) and to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority.

8-3 The proponent shall commence the water quality monitoring required by 8-2 before ground disturbing activities in order to collect baseline data.

8-4 The proponent shall submit annually the results of monitoring required by condition 8-2 to the Chief Executive Officer of the Office of the Environmental Protection Authority.

8-5 In the event that monitoring required by condition 8-2 indicates that the requirements of condition 8-1 are not being met, the proponent shall:

1. report such findings to the Chief Executive Officer of the Office of the Environmental Protection Authority within 21 days of the decline in water quality being identified;

2. provide evidence which allows determination of the root cause of the decline in water quality; and

3 if determined to be a result of activities undertaken in implementing the proposal, state the actions and associated timelines proposed to be taken to remediate the water quality.

8-6 The proponent shall, on approval of the Chief Executive Officer of the Office of the Environmental Protection Authority, implement the actions identified in 8-5 (3) and continue to implement such actions until the Chief Executive Officer of the Office of the Environmental Protection Authority determines that the remedial actions may cease.

8-7 The proponent shall make the monitoring reports required by condition 8-2 publicly available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

9 Rehabilitation

9-1 The proponent shall undertake progressive rehabilitation over the life of the proposal to achieve the following outcomes:

1. The waste material landforms and tailings storage facility shall be non-polluting and shall be constructed so that their stability, surface drainage, resistance to erosion and ability to support local native vegetation are similar to undisturbed natural analogue landforms as demonstrated by Ecosystem Function Analysis or other methodology acceptable to the Chief Executive Officer of the Office of the Environmental Protection Authority.

2. Waste material landforms, tailings storage facility and other areas disturbed through implementation of the proposal (excluding mine pits), shall be progressively rehabilitated with vegetation composed of native plant species of local provenance (defined as seed or plant material collected within the Great Victoria Desert Bioregions 1 and 2).

3. The percentage cover and species diversity of living self sustaining native vegetation in all rehabilitation areas shall be comparable to that of undisturbed natural analogue sites as demonstrated by Ecosystem Function Analysis or other

methodology acceptable to the Chief Executive Officer of the Office of the Environmental Protection Authority.

4. No new species of weeds (including both declared weeds and environmental weeds) shall establish in the area as a result of the implementation of the proposal.

5. The coverage of weeds (including both declared weeds and environmental weeds) within rehabilitated areas shall be no greater than the average of three reference sites on nearby land, with the reference sites to be chosen in consultation with the Department of Environment and Conservation.

Note: The methodology for Ecosystem Function Analysis is set out in Tongway DJ and Hindley 2004 *Landscape Function Analysis – Procedures for Monitoring and Assessing Landscapes*, Commonwealth Scientific and Industrial Research Organisation Sustainable Ecosystems, Canberra.

9-2 Rehabilitation activities shall continue until such time as the requirements of condition 9-1 are met, and are demonstrated by inspections and reports to be met, for a minimum of five years following mine completion to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority, on advice of the Department of Mines and Petroleum.

10 Final Closure and Decommissioning Plan

10-1 At least five years prior to mine completion, the proponent shall prepare and submit a Final Closure and Decommissioning Plan to the requirements of the Chief Executive Officer of the Office of the Environmental Protection Authority, on advice of the Department of Mines and Petroleum.

10-2 The Final Closure and Decommissioning Plan shall be prepared consistent with:

1. ANZMEC/MCA 2000, *Strategic Framework for Mine Closure Planning*; and

2. Department of Industry Tourism and Resources 2006 *Mine Closure and Completion* (Leading Practice Sustainable Development Program for the Mining Industry), Commonwealth Government, Canberra;

10-3 The Final Closure and Decommissioning Plan shall provide detailed technical information on the following:

1. final closure of all areas disturbed through implementation of the proposal so that they are safe, stable and non-polluting;

2. decommissioning of all plant and equipment;

3. disposal of waste materials;

4. final rehabilitation of waste dumps; tailings storage facilities and other areas (outside the mine pit(s));

5. management and monitoring following mine completion; and

6. inventory of all contaminated sites and proposed management.

10-4 The proponent shall close, decommission and rehabilitate the proposal in accordance with the approved Final Closure and Decommissioning Plan.

10-5 The proponent shall make the Final Closure and Decommissioning Plan required by conditions 10-1 and 10-2 publicly available in a manner approved by the Chief Executive Officer of the Office of the Environmental Protection Authority.

Procedures

1. Where a condition states "on advice of the Department of Environment and Conservation" or "on advice from the Department of Mines and Petroleum", the Office of the Environmental Protection Authority will obtain that advice and provide that advice to the proponent.

2. The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice.

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. The proponent is required to apply for a Works Approval and operating Licence for this project under the provisions of Part V of the *Environmental Protection Act 1986.*

Schedule 1

The Proposal (Assessment No. 1745)

General Description

The proposal is to develop and operate an open-cut gold mine with infrastructure and utilities located approximately 330 kilometres (km) east northeast of Kalgoorlie and 200 km east of Laverton.

The proposal is described in the following document – *Tropicana Gold Project Public Environmental Review, September 2009.*

Summary Description
A summary of the key proposal characteristics is presented in Table 1.

Table 1: Summary of key proposal characteristics

Element	Description
General	
Project life	Approximately 15 years of mining; total project duration up to 25 years (including post closure monitoring)
Mining and Processing	
Mining rate	Up to 75 million tonnes per annum (ore and waste)
Stripping ratio	8:1
Number of pits	Up to 4
Open pit void/s	Not more than 400 hectares
Maximum length of pit/s	6 kilometres (if pits combine)
Maximum width of pit	1.5 kilometres
Overburden and waste	Not more than 800 million tonnes
Waste landform	Not more than 1,200 hectares. Maximum height 375 mRL. Slope with maximum angle of 15 degrees
Water supply	Up to 7 gigalitres per annum
Dewatering rate	1,000 – 5,000 kilolitres per day
Infrastructure	
Mine access road	Pinjin Option – 370 kilometres (~210 kilometres of road construction)
Communications	Fibre Optic or Microwave via either Pinjin or Tropicana Transline Corridor
Aerodrome	All weather strip 2.4 kilometres long
Main power supply	Onsite power station with an installed capacity of up to 40 megawatts
Water pipeline	Approximately 50 kilometres in length from the borefield (located north northwest of Operational Area) to the process plant.
Tailings Storage Facility	Up to 7 million tonnes per annum; two-cell paddock tailings storage facility with possible in-pit deposition. Maximum height of 372 mRL. Approximately 1330 metres wide by 1850 metres.
Disturbance Areas	
Disturbance area	Not more than 3,440 hectares comprising: • operational area – 2,570 hectares. • water supply area – 200 hectares. • infrastructure areas – 670 hectares.

Figures:
Figure 1: Regional location of mine site (see figure 1 above)
Figure 2: Project footprint and layout of key components (see figure 2 above)

Appendix 5

Summary of Submissions and
Proponent's Response to Submissions
(On attached CD)