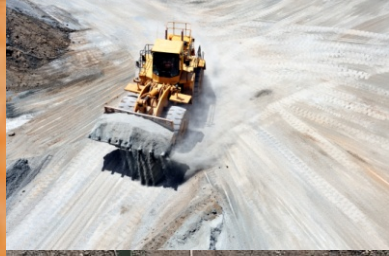
# Tropicana Gold Project: Public Environmental Review

# 10. Closure and Rehabilitation







INDEPENDENCE GROUP NL

360 environmental

# 10. CLOSURE AND REHABILITATION

The proposed Tropicana Gold Project (the Project) is located on the western edge of the Great Victoria Desert. Despite the small impact of the Project relative to such a vast landscape, the Joint Venture acknowledges its environmental responsibilities inherent in this development. To this end the Project's current post operational aim (subject to stakeholder consultation) 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 (adopted from the International Council of Mining and Minerals 2005).*

This Chapter outlines the Joint Venture's approach to the rehabilitation and eventual closure of the Project. As the Project is located in an area that has not seen the development of a mining operation in the past, the Joint Venture is approaching closure and rehabilitation planning from first principles. Closure and rehabilitation planning, trials and implementation will be based on an adaptive management approach so that as site-specific data is obtained the closure and rehabilitation plans will be refined (Figure 10.1).

At present the end land use for the site will be a returned to unallocated crown land, which is the current tenure underlying the Project's tenements. This end land use is the desired outcome of the key stakeholders including government agencies and conservation groups. Consultation with these stakeholders and the wider community will continue over the life of the Project to ensure that the needs and wants of all stakeholders are considered by the Joint Venture.

The agreed end land use is the target that the Joint Venture' closure and rehabilitation planning is targeted toward. Planning for closure and rehabilitation has been initiated at a conceptual stage that provides a framework of concepts and outcomes for future refinement as the Project progresses (Appendix 3-D). A Proposed Mine Closure and Rehabilitation Strategy will be prepared within five years of project commencement, and reviewed every two to three years. A draft Approved Mine Closure and Rehabilitation Strategy will be prepared three to five years prior to the end of the Project's operational phase and submitted to the relevant stakeholders for approval. Once finalised, this Strategy will be implemented to rehabilitate and close the Project. The development and refinement of these closure strategies will be informed by a closure and rehabilitation research program, and by ongoing consultation with key stakeholders.

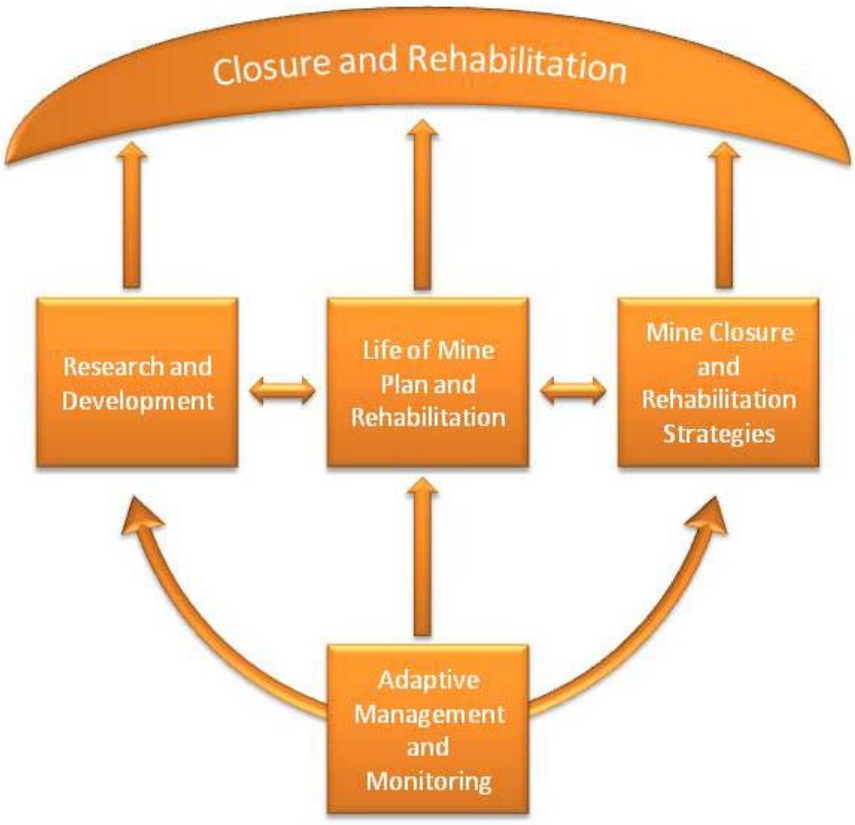



**Figure 10.1: Closure and Rehabilitation Planning**

The current proposal for the Project will see the operational phase run for approximately 15 years resulting in the disturbance and eventual rehabilitation of potentially 3,040 ha (total disturbance is 3, 440 ha as the mining void is not included in the rehabilitation figure). The major features of the Project are the mining area/ waste landforms, processing plant and associated infrastructure (such as the village, aerodrome, and power station), borefield and pipeline, a mine access road along the Pinjin Infrastructure Corridor and a communications link via the Tropicana-Transline Communications Corridor.

Where appropriate, rehabilitation will occur progressively throughout the life of the Project commencing during the construction phase. For example, waste landforms will be battered to their final shape as they are constructed in preparation for revegetation when the landform is completed and areas no longer needed such as the communications corridor (once infrastructure has been installed) will be revegetated as they become available. Due to the need for continual use of many disturbed areas throughout the life of the Project, the bulk of rehabilitation will occur during the de-commissioning and closure phases of the Project.

The following general objectives are relevant to rehabilitation and closure planning are:

- to ensure that rehabilitation achieves an acceptable standard compatible with the intended land use and consistent with appropriate criteria;
- to ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values;
- to ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable; and,
- to create the integrity, ecological functions and environmental values of landscapes and landforms.

These objectives have formed the basis of the Joint Venture's aims for rehabilitation and closure for the Project. Successful rehabilitation of disturbed areas and eventual closure of the Project will occur by adhering to the following principles:

- enshrining a whole of mine life approach to closure;
- adequately provisioning for closure;
- allocating responsibilities across the operation and through time;
- undertaking progressive rehabilitation where practicable; and,
- developing an understanding of the local environment to establish site-appropriate rehabilitation standards by embarking on a program of research and development that aims to fill current gaps in rehabilitation knowledge.

The following sections outline the planning, potential impacts and management actions for the rehabilitation, closure and eventual relinquishment of the Joint Venture's responsibilities for the Project. The remainder of this chapter has been divided into rehabilitation and closure, with rehabilitation focusing on the biological aspects leading to final relinquishment and closure focusing on the more physical aspects of relinquishment. Note that rehabilitation and closure activities are inextricably linked in many cases (e.g. stability of landform and successful revegetation and successful revegetation and attainment of completion criteria for relinquishment). As rehabilitation activities are planned to begin prior to ground disturbance (e.g. initiation of the Rehabilitation Research Program, discussed below) and will proceed throughout the life of the Project, prior to the closure phase (e.g. progressive rehabilitation where appropriate), rehabilitation is discussed before closure.

Further detail can be found in the Conceptual Closure and Rehabilitation Management Strategy in Appendix 3-D and Appendix 2-A5.

## 10.1. Commitment to Successful Rehabilitation for Closure

The Conceptual Closure and Rehabilitation Management Strategy (Appendix 3-D) demonstrates how the Joint Venture is considering rehabilitation as an integral part of the Project. This includes proposing completion criteria and outlining pathways to successfully achieve the completion criteria.

The pathway to successful rehabilitation, and hence closure and relinquishment, is to secure baseline data, adapt leading practice from other sites (where appropriate) for the local conditions) develop an adaptive rehabilitation strategy and conduct research into areas of remaining uncertainty. The Joint Venture is collaborating with external parties such as the Botanic Gardens and Parks Authority (a lead agency in restoration ecology in Western Australia) and other appropriate specialist organisations to ensure the knowledge required to achieve a successful rehabilitation is obtained.

## 10.2. Rehabilitation

Rehabilitation is the major management measure to be enacted when an impact to the land is unavoidable. The key to successful rehabilitation and eventual site closure and relinquishment is appropriate planning, scheduling and resourcing. One of the challenges that the Joint Venture faces is the general lack of information on appropriate and successful rehabilitation techniques and protocols for similar environments within Australia. For example, the bulk of the Project is located in the Great Victoria Desert, which contains very few active mining projects and thus almost no information on historic rehabilitation practices is available. Another challenge is the lack of an appropriate analogue site. The Joint Venture has recognised and accepted these challenges and has taken a 'first principles' approach to rehabilitation and closure. This centres on recognising natural landforms and ecosystems in the area that can be incorporated into the final rehabilitated landscape and identifying techniques to replicate them (e.g. propagation and topsoil/ growth medium handling). For example, planning for the waste

landform has been based on existing dunal landforms in the area, with a designed final slope (e.g. sand dune slopes are typically 12-16°) and height reflecting natural landforms (e.g. 350 – 385 mRL) adjacent to the Operational Area. The final vegetation community (or communities – it is likely that the rehabilitated crests and slopes of the final landform will differ in composition) will be based on the vegetation communities recorded on similar environment within the Operational Area (It is likely that a mixed community will be applied). A Rehabilitation Research Program will be designed and will be carried out over the life of the Project, with some aspects already completed (e.g. erosion modelling for the waste landform see Appendix 2-B11 and 2-B12) and other aspects to be carried out progressively (e.g. investigations of appropriate propagation techniques for framework species).

### Management Objectives

The objective of the Joint Venture is to ensure that rehabilitation achieve a standard that is acceptable to stakeholders, is compatible with the intended land use and consistent with appropriate completion criteria.

### Applicable Standards and Guidelines

- Biodiversity Standard (AngloGold Ashanti Australia 2007);
- Rehabilitation Management Standard (AngloGold Ashanti Australia 2007);
- Decommissioning and Closure Standard (AngloGold Ashanti Australia 2008);
- Mine Rehabilitation (Commonwealth of Australia 2006);
- Good Practice Guidance for Mining and Biodiversity (International Council of Mining and Metal 2006); and,
- Rehabilitation of Terrestrial Ecosystems Guidance Statement 6 (EPA 2006).

EPA Guidance 6 applies to rehabilitation of terrestrial habitats and concerns land clearing where natural ecosystems will be reinstated. The focus is on effective use of completion criteria to measure biodiversity in rehabilitation projects and this has been incorporated as part of the Mine Closure and Rehabilitation Strategy.

### Potential Impact

Over the life of the Project up to 3,440 ha hectares of land could be disturbed and require rehabilitation (note the area rehabilitated will exclude the mining voids which are predicted to be 400 ha). The potential risks associated with the rehabilitation are:

- failure to establish a safe non-polluting landform;
- failure to establish self-sustaining vegetative cover; and,
- rehabilitation falls short of agreed completion criteria.

As a principle, rehabilitation will be progressively undertaken as an area ceases to be operational. Progressive rehabilitation will reduce environmental risk, reduce financial liability at closure and enable site specific rehabilitation techniques to be proven.

**Table 10.1: Estimated Maximum Disturbance Area for Tropicana Gold Project Infrastructure Areas**

| Activity | Area (ha) |
|---|---|
| Operational Area[1] | 2,570 |
| Water Supply Area | 200 |
| Infrastructure Area[2] | 670 |
| Disturbance Estimate – Total[3] | 3,440 ha |

*1. Covers all the site activities located within the mining lease except the Access Road and Communication corridor*
*2. Includes both potential infrastructure corridors – one road and a separate communications corridor*
*3. Includes the area required to establish borrow pits and quarry.*

### Management Measures

The Conceptual Closure and Rehabilitation Strategy enables successful outcomes by:

- adopting whole of mine life approach to closure and rehabilitation;
- adequately provisioning for rehabilitation and closure;
- allocating responsibilities for rehabilitation and closure across the operation and throughout the life of the Project; and,
- developing a deep understanding of the local environment and challenging the boundaries of rehabilitation best practice by embarking on a long term program of research and development.

*Constructed Landforms*

Permanent constructed landforms will include (but are not limited to) waste landform (Figure 10.2), run of mine and low grade stockpile areas and the pit void(s). The philosophy underlying the design of the constructed landforms is to blend, as much as possible, into the existing landscape.

- Waste Landforms

  The waste landforms will not exceed 375 mRL. This is lower than the surrounding landforms (dunes and rock outcrops) ensuring that the final landforms are not visible outside of the immediate broad valley in which the Mining Area occurs. The waste landform slopes will be continuous (rather than benched) at a maximum angle of 15°. This is a similar slope angle to sand dunes in the area. Water erosion modelling undertaken by Landloch (Appendix 2-B11) confirmed that a landform (that is 40 m high on 14° gradient) covered by a sandy growth medium such as that found at the Operational Area will be stable and have an extremely small potential for run-off induced erosion.

  Initial overburden characterisation indicates small volumes of potentially acid forming waste occur. The strategy for preventing acid formation and migration will be to co-dump 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 observed during the SRK material characterization testing program (Appendix 2-B18). The dilution and potential neutralisation of potentially acid forming waste by co-dumping is intended to avoid the creation of a cell of waste that could be potentially harmful if exposed. A layer of approximately 10 m depth of non-acid forming waste will be placed as the final layer of waste material on each waste landform to provide a barrier between the co-dumped waste and the 1 m layer (at least) of rehabilitation substrate (topsoil/ sand) to prevent access to the waste by the roots of surface vegetation and thus the uptake of metals present in the waste and to further reduce the likelihood of rainwater infiltrating the waste landform post closure. Modelling undertaken by Landloch on the

reconstructed landform suggests that rainfall infiltration following a typical or an extreme event will remain within the 10 m layer of inert material, further reducing the potential for acidic or metal contaminated seepage from the waste landforms (Appendix 2-B11). In the unlikely event that high levels of potentially acid forming waste are detected during the construction or operational phase another method of landform construction will be adapted. The waste landforms will also be surrounded by a toe drain to prevent sediment generated from the structures from dispersing into the surrounding landscape. Surface runoff from the waste landforms collected by the toe drain will either evaporate or will be directed into the pit void where it will mix with void water.

Work carried out by Soil Water Consultants (Appendix 2-B19) has suggested that the risk of acid drainage from the waste material landform is very low, due to the combined effects of the neutralising capacity of the waste (total acidity is only 1/50th of total alkalinity of the waste), the strategy of co-dumping and capping of the co-dumped waste by a 10 m layer of non-acid forming material.

Any elements released from the co-dumped waste (e.g. calcium, magnesium, manganese) under neutral or acidic conditions are unlikely to reach the layer of growth medium over the waste material landforms due to the very low hydraulic gradients and very small capillarity of the 10 m capping layer. Thus the uptake of metals is unlikely to exceed normal background levels of uptake (Appendix 2-B19).

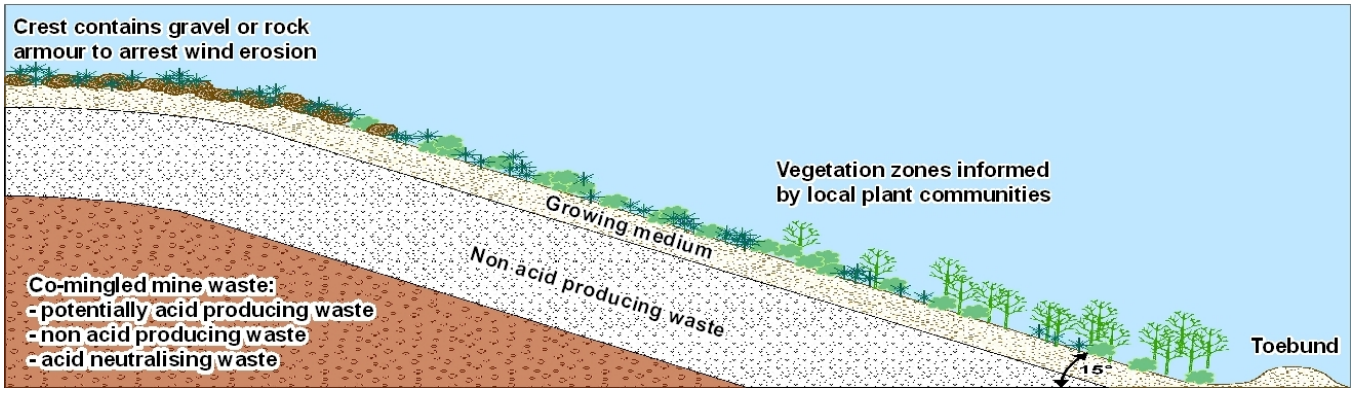



**Figure 10.2: Conceptual Waste Landform Cross-section for Tropicana Gold Project**

- Tailings Rehabilitation

The tailings storage facility is located adjacent to the north east waste landform. During operation the two facilities will be constructed such that the tailings storage facility is surrounded on up to three sides by the waste landform. This will enable the cost effective closure of the tailings storage facility at the completion of the operational phase. Benign capping material for the tailings storage facility will be obtained from the adjacent waste landform or the pit. This capping material will prevent:

- Salinisation of the growth medium;
- Roots from the re-established vegetation accessing the saline tailings; and,
- Prevent water infiltration into the tailings post-closure.

The potential for seepage from beneath the tailings storage facility will be minimised by the use of a tailings thickener and further minimised by the installation of a low permeability liner. In the event that seepage does occur, seepage is predicted to flow towards the pit void, thus is not expected to migrate to the wider environment.

- Landfill Rehabilitation

  Putrescible and inert wastes will be disposed of at the site landfill, to be located in a construction quarry pit. The site will be capped with at least two metres of inert material and then spread with at least one metre of growing medium before being revegetated.

- Pit Void(s)

  The pit void(s) will form permanent saline pit lakes. An abandonment bund will be constructed around the perimeter of the pit outside of the zone of geotechnical instability and all access ramps will be blocked off. This will act as a barrier to humans and terrestrial fauna limiting access to the void. The bund will be constructed of competent waste rock material and will be at least two metres high and five metres wide at the base, consistent with statutory requirements (DMP 1997). Provision will be made to divert runoff from the waste landforms to the void while still meeting the DMP (1997) requirements.

  At the completion of mining all pit dewatering will cease and the surrounding groundwater will slowly reach a new equilibrium. The pit void will become a 'groundwater sink' whereby evaporation will exceed the rate of groundwater inflow (Water and Rivers Commission 2003). The fresh rock in the Havana and Tropicana voids exhibits virtually nonexistent permeability and throughflow; therefore, these voids will effectively be closed water systems (Appendix 2-B17). The water level in each pit void is expected to rise due to the influx of direct rainfall recharge and groundwater seepage, until it comes to an equilibrium point where this influx is balanced by evaporation from the void (Appendix 2-B17). Salts derived from rainfall and groundwater influx will steadily accumulate and be concentrated in the void water through continuous evaporation, turning the void/s hypersaline within approximately 50 years (Appendix 2-B17). The pre-mining water quality ranges from 14,000 – 40,000mg/L TDS. It is likely that the salinity of the void water will reach salt saturation (greater than 300,000mg/ L TDS) as the evaporation rate in the region is 3,000 mm/ annum whereas the average annual rainfall is between 115 – 300 mm. The creation of a hypersaline pit lake in this hydrogeological environment will most likely have no significant impact on the existing hypersaline conditions of the adjacent groundwater because the voids will be a closed water system.

  Water filled voids after closure could attract or supporting both native and feral animal populations, however given the high salinity of groundwater influx to the pit, the water in each void will be too saline to support native or feral fauna from the onset (Appendix 2-B17). The bund will also prevent native fauna entering the pit void.

*Re-establishing Ecosystems*

Re-establishing functioning ecosystems that fit into the surrounding area is crucial to the success of the Project and will be achieved by addressed the following factors:

- Growing Medium

  The post closure landforms will be covered with topsoil/ sand as a growing media. Research will determine what depth of growing medium is required to support the new ecosystem and whether an impervious layer below the growth medium is needed to support dune vegetation. At a minimum, one metre of growth medium will be applied. An estimated volume of 17 $Mm^3$ of growth medium is required. As stated in section 2.2.4 the calculated approximate volume of available growth medium is 18.8 $Mm^3$, providing sufficient competent material (Table 10.2).The waste landform crests may be vulnerable to wind erosion and will require a growth media that consists of a mix of sand and gravel/ rock to minimise erosion (particularly important in the early phase of rehabilitation while the vegetation community is establishing). The cover material will be carefully selected to be able to support vegetation. The growth

medium will be selected from material that is not dispersive hard setting, acidic or saline to improve the likely success of vegetation establishment.

**Table 10.2: Required and Available Competent Material**

| Item | Layer Thickness | Estimated Volume | Available Volume |
|---|---|---|---|
| | m | $Mm^3$ | $Mm^3$ |
| Waste Landforms | | 13 | |
| Tailings storage facility | 1 | 2.4 | |
| Run Of Mine Pad | 1 | 0.2 | |
| Low Grade & Marginal Stockpiles | 1 | 0.5 | |
| Ready Line | 1 | 0.1 | |
| **TOTAL** | | **17** | **18.8** |

Tailored rehabilitation protocols will be developed to prepare areas for revegetation outside the active mine area (such as access roads, water extraction infrastructure and the village).

If trials (investigated during the Rehabilitation Research Project, discussed below) prove it possible, biological attributes such as seed and soil biota will be recovered from the clearing and stripping process, stored appropriately and used to rehabilitate the reconstructed landscape.

- Vegetation Composition

  The ideal vegetation assemblage will be informed by developing a comprehensive understanding of the various vegetation communities that occur in the local area and matching that with a comprehensive understanding of what sort of communities are possible in the reconstructed landscape. For example, the local breakaway may provide an ecological analogue for the upper section of the waste landforms while the sand dune slopes and swales may provide ecological analogue for the lower section of the landforms. Alternatively, other areas for rehabilitation around the site may be more analogous to dune swales, plains, rocky outcrops or salt pan plant communities.

- Revegetation Approach

  The establishment of nominated vegetation communities will be tackled by applying the following hierarchy of priority:

  - focus on framework species. Vegetation surveys have identified a number of species that make up the majority of plant cover in the various plant communities expected to be routinely rehabilitated. These framework species include *Eucalyptus gongylocarpa* (marble gum) and a variety of other tree form and mallee eucalypts, *Acacia aneura* (mulga) and *Casuarina cristata* (Black Oak);
  - dominant understorey species including *Triodia basedowii* (Lobed spinifex) and other ubiquitous grass species;
  - Priority species affected by mining operations; and,
  - other species that were present before clearing. Ideally all species that were present prior to clearing for the mine operation will be returned into the rehabilitation, however the Rehabilitation Research Project may demonstrate that this is not feasible, within reasonable constraints.

- Rehabilitation Methods

  Successful rehabilitation at other locations invariably relies on a combination of techniques to reintroduce biodiversity. There are currently no other mines in the Western Australian portion of the Great Victoria Desert and hence the best combination of rehabilitation methods is yet to be determined, but will be progressively investigated over the life of the Project. Methods typically employed to re-establish a vegetative ecosystem are:

  - re-introduce plant species and soil biota by careful handling of topsoils;
  - direct seeding;
  - growing seedlings for planting out;
  - growing cuttings for planting out;
  - direct transplanting;
  - employing micro-propagation methods to multiply plants; and,
  - creating habitat and micro-habitat for fauna re-colonisation by employing methods such as increasing surface roughness or replacing sheltering logs and rocks within the rehabilitation area are also important components of ecosystem function.

- Seed Management

  Seed collecting for direct seeding or seedling propagation are the tools most consistently included in a rehabilitation program. Effective seed management will be key to the Rehabilitation Research Program. Seed management will include the following elements:

  - establish seed collection provenance zones that guarantee the genetic integrity of the new vegetation communities;
  - establishment of seed storage protocols that maximise viability and shelf life; and,
  - establish seeding techniques that maximise germination and establishment.

- Recognise Uncertainty

  The Project is located in a semi-arid environment with highly variable weather from year to year. New rehabilitation will be vulnerable to drought and other weather extremes. To address this uncertainty, the Project will:

  - monitor and analyse rehabilitation establishment;
  - make provision for poor rehabilitation establishment; and,
  - include rehabilitation remediation as part of its standard practice.

- Monitoring and Remediation

  Monitoring serves two purposes; it confirms that rehabilitation is tracking towards the completion criteria, and if it is not, a remedial response will be triggered. The Joint Venture recognises that remediation is a critical element of successful rehabilitation and is building remediation planning into standard operating practice. Rehabilitation remediation may require a different suite of methods to rehabilitation establishment. The Joint Venture will address gaps in remediation knowledge in its Rehabilitation Research Program.

Employing a state and transition model of rehabilitation development, a series of interim criteria of rehabilitation progress will be defined to measure against. The interim criteria will, in effect, act as gates that a section of rehabilitation must successfully pass through to its next interim criteria or completion criteria. If a section of rehabilitation is unable to reach an interim criterion the monitoring program will trigger a remedial response.

- Fire Management

  Fire is a ubiquitous factor in the semi-arid landscape. Management of fire directly associated with the Project will focus primarily on the prevention and control of fires accidentally generated by Project staff, as well as fires generated by other sources that have potential to impact Project infrastructure and/ or staff. Management of fire for rehabilitation may include:

  - excluding fire for at least seven years to protect young rehabilitation as it develops to a state that is fire resistant;
  - using fire as a tool (in a highly controlled manner) to manipulate rehabilitation development; for example to encourage re-sprouting species and grasses or to create space for enrichment seeding or planting; and,
  - introducing controlled fire into established rehabilitation to test the resilience of the rehabilitation.

- Weed Management

  Only three minor weed species have been identified in baseline flora surveys. Weed management will focus on ensuring those species remain at a low presence and new weed species are excluded by quarantine and monitoring. Weed management measures will include:

  - a weed hygiene procedure for light vehicles and mobile heavy equipment will be developed to prevent weeds from entering the Project or the surrounding areas; and,
  - weed surveys will be undertaken across the Project areas to identify and eradicate any weed species that might gain a foothold within the Operational Area including rehabilitation sites.

- Commitment to Research

  The Joint Venture in partnering with appropriate research institutes such as Botanic Gardens and Parks Authority aim to further exploring the ecology of this remote area and to advance leading practice in semi-arid and arid zone mine rehabilitation. As the Project becomes operational a program of research will be defined. There are numerous areas of potential investigation and the future directions for research will be dictated by where the areas of greatest challenge arise.

  There are four interrelated research themes so far identified to be explored for the Project, they are:

  1. revegetation biology and ecology – this theme looks at the species that would be included in the rehabilitation program and what they would require to persist;
  2. creating a landscape suitable for revegetation – this theme looks at creating landforms that can sustain vegetation;
  3. utilising rehabilitation resources – this theme looks at understanding and valuing the resources that rehabilitation will use; and,
  4. enabling technologies – this theme looks at enabling the Project's rehabilitation practitioners to use the scientific knowledge on the ecology and rehabilitation to create on ground rehabilitation outcomes.

These and other areas of research will be covered in the Rehabilitation Research Program (Figure 10.3) which will be used to inform rehabilitation activities for the Project to ensure a best possible result.

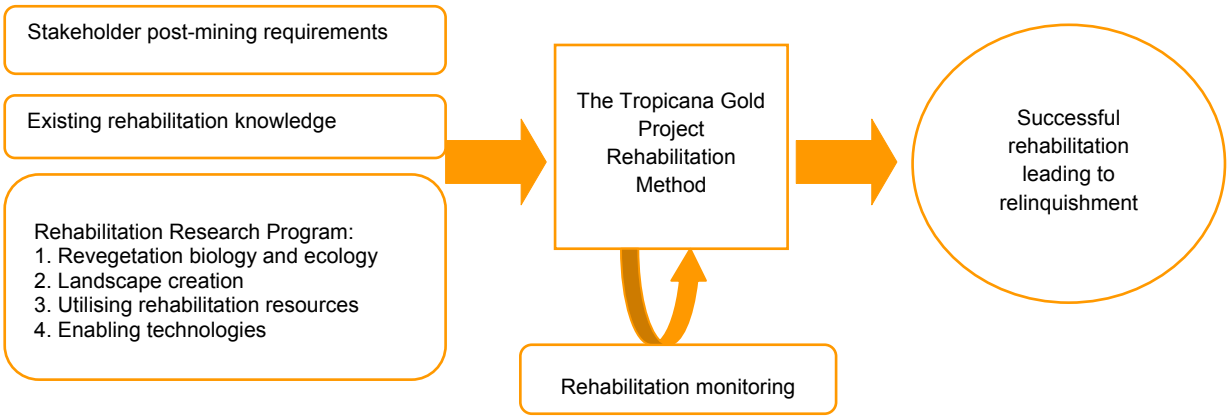



**Figure 10.3: Rehabilitation Research Strategy to Achieve Rehabilitation Completion Criteria**

*Developing Rehabilitation Completion Criteria*

The completion criteria for the Project will be developed in consultation with stakeholders. Requirements for good completion criteria are that they:

- represent the best possible outcome for the environment;
- are realistic and achievable;
- represent pre-mining parameters;
- meet with the approval of the stakeholders; and,
- are measurable.

By establishing preliminary completion criteria at this early stage of the Project, a clear pathway is determined that will help identify knowledge gaps and thus research requirements at the start of the Project. This applied research program will assist in the arrival at criteria values or ranges of values to aim for during rehabilitation and closure activities. Potential completion criteria offered in the Conceptual Closure and Rehabilitation Management Strategy are outlined in Table 10.3.

**Table 10.3: Potential Rehabilitation Completion Criteria for the Tropicana Gold Project**

| Goal | Objective | Indicator | Completion Criteria |
|---|---|---|---|
| Agreed land use | Stakeholders agree on the final land use for each mine domain. | Agreement. | Documented consultation and agreement on the final use for each mined domain. |
| Safe | The site is safe for humans and animals, now and in the foreseeable future. | Presence/ absence of hazards. | Safety hazards removed or controlled including:<br>• Void protected by bunding<br>• No unstable areas<br>• Mining infrastructure removed<br>• No hazardous materials |
| Non-polluting | Groundwater remains uncontaminated. | Groundwater monitoring. | Ground water quality outside the mine void is consistent with baseline data or season variations. |
| Stable landform | Landform erosion comparable to undisturbed areas. | Slope angle and length. | Slope angles meet agreed design specifications. |
| Sustainable land use | Self sustaining vegetation community. | Presence of framework species. | Appropriate framework species densities to be determined through research. |
| | | Species richness. | Appropriate species richness target 70% of pre-existing. |
| | | Priority species returned. | Appropriate percentage return to be determined through research. |

### The Joint Venture Actions

**Action 16**: Completion criteria will be developed within five years of operations commencing as outlined in the Conceptual Closure and Rehabilitation Strategy (Appendix 3-D).

**Action 17**: Achieve the agreed completion criteria as per the Closure Strategy.

## 10.3. CLOSURE

### 10.3.1. Closure Aims and Objectives

Setting objectives for closure at this early stage sets in train the whole of mine life closure planning recommended in closure guidance documents. The following objectives are informed by the Strategic Framework for Mine Closure (ANZECC and MCA 2000):

- closure planning and implementation - to ensure that the process of closure can occur in an orderly, cost-effective and timely manner with clear accountabilities defined;
- risk appreciation – to identify and manage risks to closure according to their likelihood and consequence;
- financial provision – to adequately represent and plan for the cost of closure in company accounts so that the community is not left with a liability;
- stakeholder involvement – to consider stakeholder interests during the mine closure process;
- completion criteria – to establish a set of indicators and criteria that will demonstrate successful completion of the closure process;
- waste materials management – to minimise waste generation over the mine life and to ensure that remaining waste cannot adversely affect the surrounding environment;
- decommissioning – to ensure that the decommissioning process can occur in an orderly, cost-effective and timely manner with clear accountabilities defined; and
- relinquishment – to arrive at a point where the Joint Venture has met, or is confidently tracking towards, agreed completion criteria to the satisfaction of the Western Australian Government.

The Conceptual Closure and Rehabilitation Strategy (Appendix 3-D) documents a closure strategy that will be progressively refined as the Project proceeds.

### 10.3.2. Life of Mine Closure Planning

Life of mine closure planning is a process that necessarily begins conceptually. The strategy acquires greater resolution as decisions and facts surrounding closure accumulate. Figure 10.4 illustrates this with the following diagram. The diagram also highlights that stakeholder consultation over closure is an ongoing process with several key junctures where stakeholder input will assist in successful closure outcomes.

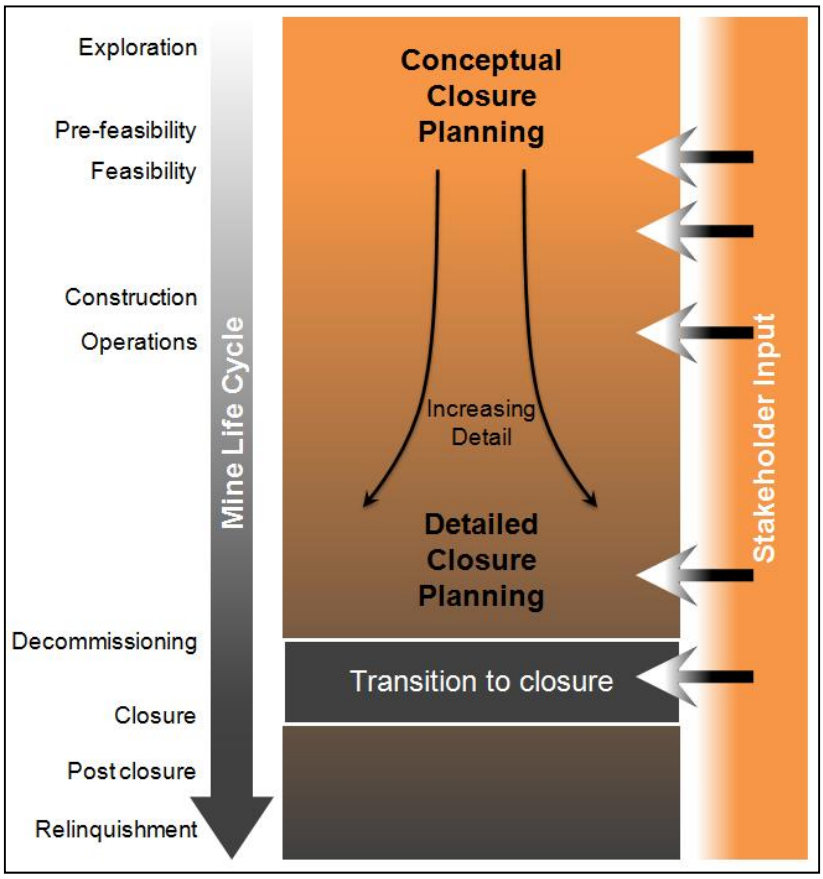



**Figure 10.4: Closure planning process illustration (Adapted from International Council of Mining and Metal 2008)**

The intended progression of closure and rehabilitation planning for the Project will be:

- Conceptual Closure and Rehabilitation Strategy – documents the concepts behind the closure and rehabilitation outcomes and principles that will be incorporated into the closure and rehabilitation strategies (Appendix 3-D);
- Proposed Mine Closure and Rehabilitation Strategy – the proposed strategy will be prepared within five years of the Project commencing. The strategy will be reviewed every two to three years;
- Approved Mine Closure and Rehabilitation Strategy – The document will be submitted to the relevant stakeholders for approval three to five years prior to the closure of the Project; and,
- Closure and Rehabilitation Research and Development Strategy - The strategy combines existing broad-scale rehabilitation knowledge with a research program tailored to improve the understanding of the rehabilitation requirements for the Project. This strategy will be a live document that will be modified to meet the requirements of closure and rehabilitation objectives (Figure 10.3).

### *10.3.3. Contingency Planning*

The various iterations of the Project's mine closure and rehabilitation strategies will contain plans/ strategies for the forced or unexpected early closure of the Project. These strategies will be documented in the care and maintenance component of the main document. They will require the following in the event of sudden/ temporary closure:

- an environmental audit of the entire site will be undertaken to fully appreciate any environmental risks that will exist during the closure period;

- the Care and Maintenance Plan will be reviewed immediately; and,
- the reviewed Care and Maintenance Plan will be submitted to the relevant authorities (such as the DMP, DEC and DEWHA)) for their information.

The Care and Maintenance Plan will include:

- an Emergency Response Procedure;
- a mine access and security review;
- a geo-technical monitoring program to ensure the ongoing stability of the pit(s), tailings storage and waste landforms;
- a program to address incomplete rehabilitation and remediation works; and,
- a program of environmental monitoring and inspection. This will include; license requirements, chemical and hydrocarbon storage, treatment plant condition, pit water monitoring, erosion monitoring, and rehabilitation monitoring.

### *10.3.4. Knowledge Management*

The retention of knowledge is a critical factor for orderly and effective closure and rehabilitation. The Closure Strategy will confirm the location of important documents at each review and will allocate responsibility for the filing and cataloguing of operational documents, environmental documents and stakeholder consultation documents that are pertinent to closure and relinquishment.

The Joint Venture aims to achieve relinquishment and the return of Environmental Performance Bonds as soon as possible following the cessation of operations. To achieve this, the Joint Venture will need to achieve the agreed completion criteria. It is understood that a life of mine commitment is required for successful closure and rehabilitation of a site so that early relinquishment can be achieved.

The Joint Venture will propose a relinquishment process that includes:

- the division of the Project into Closure Management Units to allow for individual rehabilitation and closure strategies to be applied and for each Closure Management Unit to be individually assessed against the agreed completion criteria;
- the formation of a Consultative Closure Committee with a role in ascertaining the success of rehabilitation and closure efforts; and,
- the establishment of formal closure, sign off and relinquishment mechanisms.

### *10.3.5. Successful Closure and Relinquishment*

**Management Objectives**

The ultimate objective of the Joint Venture is to successfully close the Project and relinquish commitments to ongoing management. To this end, the Joint Venture aims to develop appropriate completion criteria and closure commitments in consultation with stakeholders and to meet (if not exceed) these requirements, thereby ensuring closure and relinquishment.

**Applicable Standards and Guidelines**

Refer to section 10.2 for applicable standards and guidelines associated with Closure and Relinquishment.

### Potential Impact

Potential impacts of unsuccessful closure include:

- failure to reconstruct a safe, stable and non-polluting landform over the disturbed areas;
- failure to meet completion criteria;
- failure to successfully close the Project; and,
- failure to relinquish responsibility back to the State.

### Management Measures

As described in the preceding sections (10.2, 10.3.2, 10.3.3, 10.3.4, 10.3.5)

### The Joint Venture Actions

See Actions 16 and 17 above.