Tropicana Gold Project
Tailings Environmental Management Strategy

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Document Name	Version	Author	Issue Date	Page
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1 OVERVIEW

The Tailings Environmental Management Strategy (TEMS) contained within this document provides the framework for managing environmental issues associated with tailings and associated infrastructure including the tailings storage facility (TSF) for the Tropicana Gold Project (the Project). The TEMS forms part of the Project's Integrated Management System that will ensure the effective management of all health, safety, environment, community and operational issues associated with the Project.

The Integrated Management System (including the TEMS) establishes the environmental framework and standards that must be achieved for all activities associated with the Project. It includes the development and management of policies, management strategies, procedures and reporting requirements.

This document has been developed in conjunction with Knights Piézold Consulting.

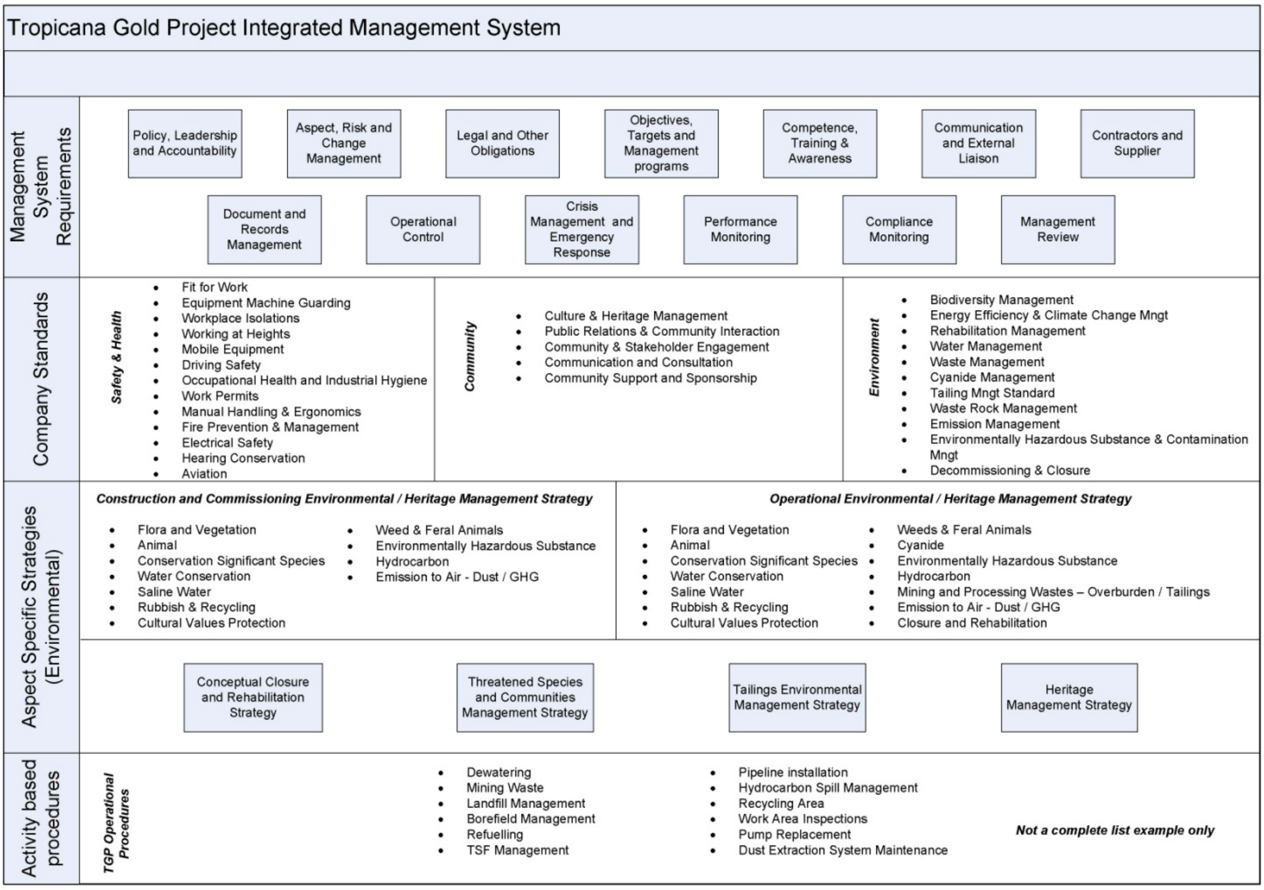

Figure 1 Tropicana Gold Project Integrated Management System

2 PURPOSE OF THE STRATEGY

The purpose of this document is to:

- ensure the effective management of all process wastes, tailings and the TSF in a manner that reduces operational risk; and,
- minimise the immediate and long-term impacts of the TSF on the environment and the community.

This document identifies the key principles for managing tailings to ensure that the risk to the environment is minimised and management is acceptable to stakeholders.

3 SCOPE

This TEMS is applicable to all employees and contractors working in the processing and tailings facilities associated with the Project.

The document covers planning, design, operation and rehabilitation/ decommissioning of the TSF and related infrastructure.

4 OBJECTIVES

The environmental objectives for the management of processing waste and more specifically the TSF are:

- permanent and secure containment of all solid waste materials;
- removal and reuse of free water;
- minimisation of seepage;
- effective and secure transportation of tailings to the TSF;
- ease of operation;
- prevent loss and poisoning of wildlife; and,
- compliance with all applicable legislation and other obligations such as the International Cyanide Management Code (the Cyanide Code).

5 LEGAL AND OTHER OBLIGATIONS

The management of process waste and more specifically tailings is governed not only by State requirements but also community expectations and industry codes of conduct.

Commonwealth and State legislation relevant to the management of tailings and the construction, operation and decommissioning/ rehabilitation of the TSF include:

- *Contaminated Sites Act 2004* and regulations;
- *Environmental Protection Act 1986* and regulations;

- *Mining Act 1978*;
- *Mines Safety and Inspection Act 1994* and regulations;
- *Rights in Water and Irrigation Act 1914*;
- *Soil and Land Conservation Act 1945;*
- *Wildlife Conservation Act 1950*; and,
- *Dangerous Goods Safety Act 2004.*

In addition to the above legislation the State Government has a number of policies, standards and guidelines that are also applicable to the management of process waste for the Project, these being:

- Environmental Protection Authority (EPA) Position Statement 2 Environmental Protection of Native Vegetation in Western Australia, 2000;
- EPA Position Statement 5 Environmental Protection and Ecological Sustainability of the Rangelands in Western Australia, 2004;
- EPA Position Statement 7 Principles of Environmental Protection, 2004;
- EPA Guidance Statement 6 Rehabilitation of Terrestrial Ecosystems, 2006;
- Water Quality Protection Guidelines No. 2 Guidelines for mining and mineral processing: Tailings facilities, 2000;
- Water Quality Protection Guidelines No. 3 Guidelines for mining and mineral processing: Liners for waste containment, 2000;
- Water Quality Protection Guidelines No. 4 Guidelines for mining and mineral processing: Installation of minesite groundwater monitoring bores, 2000;
- Department of Minerals and Energy Guidelines on the Development of an Operating Manual for Tailings Storage, 1998; and
- Department of Minerals and Energy Guidelines on the Safe Design and Operating Standards for Tailings Storage, 1999.

Industry Codes and Company Policies / Standards / Guidelines applicable to the management of the Project's tailings and TSF include:

- International Council of Mine and Metals Sustainable Development Framework;
- Mineral Council of Australia Ensure Values;
- Cyanide Code;
- Australian National Committee on Large Dams (ANCOLD) Guidelines for dam instrumentation and monitoring systems, 1983;
- ANCOLD Guidelines on design floods for dams, 1986; and
- ANCOLD Guidelines on tailings dam design, construction and operation, 1998.
- AngloGold Ashanti Australia and Independence Group Environmental Policies; and
- AngloGold Ashanti Australia Tailings Management Standard.

6 DESCRIPTION OF ACTIVITY

6.1 DESCRIPTION OF TAILINGS STORAGE FACILITY

The TSF will comprise two cells as shown in Figure 2, constructed downstream utilising open pit mine waste. The final embankment on the downstream face will blend into the surrounding waste landform, producing an overall slope of 15% to facilitate rehabilitation. The embankment will comprise an upstream low permeability zone (Zone A) and a downstream bulk fill zone (Zone C). A continuous low permeability cut-off trench will be located beneath the upstream toe, excavated to a nominal depth of 2.5 m (depending on ground conditions) to extend through the sandy near surface soils into the calcrete or saprolite layers. Typical embankment sections are shown in Figure 3.

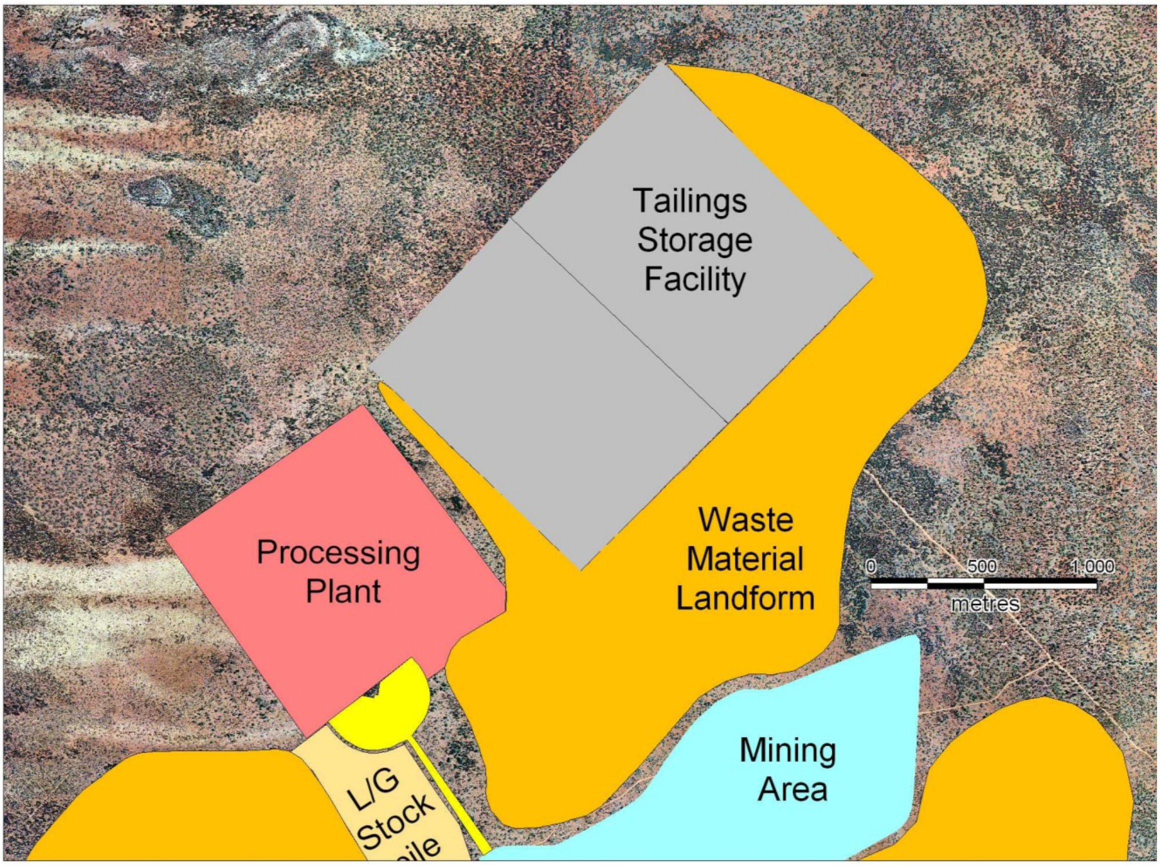

Figure 2 Tailings Storage Facility General Arrangements

The base of the TSF will be lined with a combination of geomembrane and clay. A geomembrane liner (covering 20% of the basin area in each cell) will comprise 1.5 mm smooth High Density Polyethylene (HDPE) geomembrane overlying a subgrade layer of either scarified and recompacted in situ soils or imported fill to provide a smooth surface free from angular gravels and depressions. The soil liner will extend throughout the TSF basin, overlain by sand to reduce drying and cracking of the compacted soil. Textured HDPE geomembrane liner will be deployed below the TSF decant tower and causeway footprint as required to aid stability of the structures.

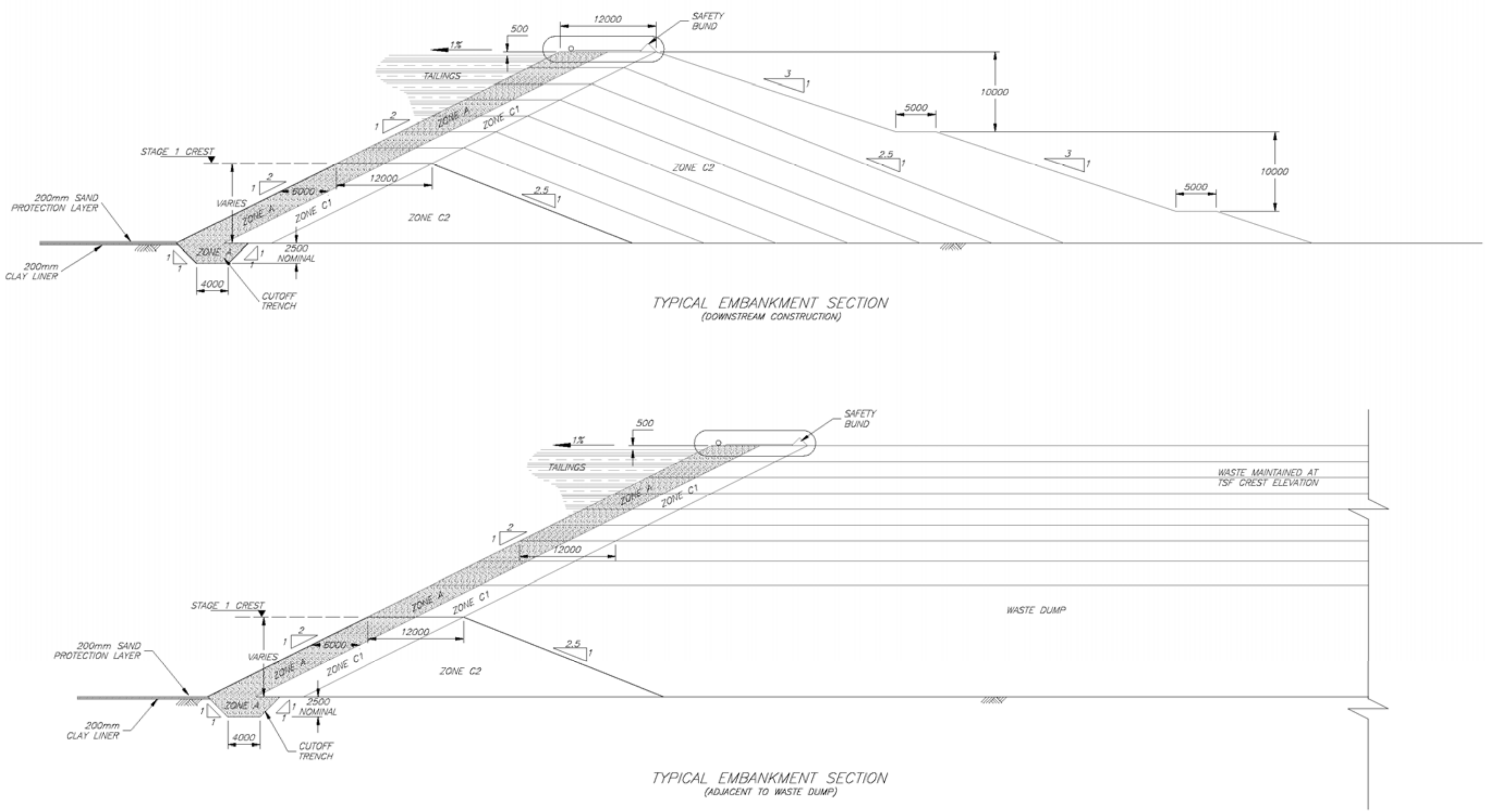

Figure 3 Typical Embankment Section

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An underdrainage collection system will be constructed throughout the basin area and is designed to reduce the phreatic surface on the basin liner and upstream of the embankment. This will reduce seepage, increase tailings density and improve geotechnical stability of the TSF. The underdrainage system will drain by gravity to a collection sump located at the lowest point in the TSF basin for each cell, and return the solution to the supernatant pond. The decant tower abstraction system will return supernatant water to the plant site. The underdrainage system will consist of two drainage networks, namely collector drains and branch drains. Collector drains and branch drains will be placed in both soil and geomembrane lined areas.

6.2 Operational Methodology

Tailings will be deposited into the TSF sub-aerially from the embankments in order to locate the supernatant pond in the centre of each cell. The tailings distribution pipeline will run along the entire perimeter of each cell.

Deposition will occur from multiple spigots inserted along the tailings distribution line. The deposition locations will be moved progressively along the distribution line as required to maintain the location of the supernatant pond centrally in each cell. After initial establishment of the tailings beaches, a suitable cycle time will be determined in order to evenly deposit the tailings around the facility, thereby maintaining the supernatant pond location and maintaining the formation of tailings beaches.

The proposed sub-aerial deposition technique allows for the maximum amount of water removal from the facility by the formation of a large beach for drying and draining tailings. As well as keeping the pond size to a minimum, sub-aerial deposition should increase the settled density of the tailings and hence maximise the storage potential and efficiency of the facility. However, during the early stages of operation (i.e. during the oxide ore processing) the deposition plan will be modified to improve the return water efficiency. This will be achieved by using relatively thick tailings layers on the beach to reduce evaporation. Whilst this will result in lower settled densities initially it should help to reduce water loss from the beaches during the early stages of operation.

The tailings will initially be deposited in the TSF from the north embankment of each cell in such a way as to encourage the formation of beaches over which the slurry will flow in a laminar manner and allow the supernatant pond to migrate to the centre of each cell. The solids will settle as deposition continues and water will be released to form a thin film on the surface of the tailings.

Deposition of tailings will be carried out on a cyclical basis with the tailings being deposited over one area of the storage until the required layer thickness has been built up. Deposition will then be moved to an adjacent part of the storage to allow the deposition layer to dry and consolidate. This will facilitate maximum storage over the whole area.

After deposition on a particular area of beach ceases and settling of the tailings has been completed, further de-watering will take place due partly to drainage into the underdrainage system but mainly due to evaporation. As water evaporates and the moisture content drops the volume of tailings will reduce to maintain a condition of full saturation within the tailings. This volume reduction process proceeds to an extent depending on the saturation of the tailings particles.

6.3 Key Stages of Operation

Construction of the TSF will take place in stages to suit storage requirements and the availability of suitable mine waste. It is envisaged that the embankments will be raised annually by an earthworks contractor with the bulk embankment fill for the South and East embankments being placed as part of the mining operations on an ongoing basis (i.e. waste dumps adjacent to these embankments). A summary of minimum expected crest level stages for annual raises is presented in Table 1.

Table 1 Conceptual Staged Embankment Construction Schedule

Stage	Embankment Elevation (m RL)	Storage Capacity (Mt)	Maximum Embankment Height (m)
1	336.7	7	7.9
2	339.1	14	10.3
3	340.9	21	12.1
4	342.4	28	13.6
5	343.8	35	15.0
6	345.1	42	16.3
7	346.4	49	17.6
8	347.6	56	18.8
9	348.7	63	19.9
10	349.8	70	21.0
11	350.9	77	22.1
12	351.9	84	23.1
13	353.0	91	24.2
14	354.1	98	25.3
15	355.3	105	26.5

Construction of the first stage embankment is expected to require a minimum of eight months, with subsequent raises requiring approximately an additional four months each.

7 ENVIRONMENTAL ASPECTS AND ASSESSMENT OF ENVIRONMENTAL EFFECTS AND RISKS

7.1 Identification

7.1.1 Seepage and Groundwater

Seepage rates under normal operating conditions are estimated to be below the guideline limit of 1 kL/ha/day as set by the Department of Water. Seepage from the facility is not considered a significant issue (see Section 7.6). The TSF is located in close proximity to a higher permeability sub-surface drainage zone (HPS drainage zone) and the open pit. The open pit will be dewatered to facilitate mining and water in the HPS drainage zone will be utilised as a water resource for the operation. It is therefore anticipated that both of these features will influence the direction and rate of seepage from the TSF.

7.1.2 Spillway Discharge

The TSF is designed to completely contain a 1 in 100 year recurrence interval, 72 hour duration storm event, or a 1 in 100 year recurrence interval wet annual rainfall sequence. There is sufficient capacity in each cell to contain the Probable Maximum Precipitation event, therefore no spillway is proposed.

7.1.3 Tailings Discharge

Should tailings be released into the environment, cyanide and heavy metal contamination may occur, posing a threat to local flora, fauna, waterways and subsurface aquifers. Uncontrolled tailings discharge via pipeline or dam failure is not expected, due to the containment corridor surrounding the pipeline and the stability of the embankment.

7.2 PHYSICAL ENVIRONMENTAL ASPECTS

For maximum utilisation of natural topography, the proposed TSF lies within a broad watercourse. Consequently, diversion channels upstream of the TSF are required, thereby modifying the natural flowpath of runoff. The effects of the diversions are expected to be negligible, due to the variability in magnitude and existence of runoff in arid environments as a result of their storm and cyclonic origins. There is no perennial stream at this location and runoff is rare and infrequent.

Rainfall falling directly onto the facility will be captured, in this manner affecting the local flow and infiltration regimes. The effect is expected to be insignificant as a consequence of the limited spatial extent of the TSF. In addition, seepage from the facility will be monitored and is not expected to pose a significant issue.

Seepage from the TSF could result in a change to the natural environment in two ways:

- elevation in groundwater table beneath and/or adjacent to the facility, and,
- alteration in water quality.

Depending on the rate of seepage and management strategies implemented elevations in water table can result in localised impacts of vegetation through water logging or changes in water quality via salinisation or pH changes. The changes in water quality occur as the rising water level mobilise salts or trigger redox reactions which result in the generation or acid or mobilise metals. It is important to note that the groundwater table within the operational area in located between 20 – 30 mbgL so provided appropriate management measures are implemented significant changes in the groundwater level should not materialise.

The release of processing / tailings water can also directly affect the water table beneath the facility by increasing salinity or metals and / or releasing processing chemicals (e.g. cyanide) depending on the processing water source. Section 7.7 discusses in detail the existing water quality of the Operational Area and the water quality of the proposed water supply. Clearly, if not managed, seepage water could alter the potential beneficial uses of the water beneath or adjacent to the facility.

7.3 BIOLOGICAL ENVIRONMENTAL ASPECTS

There is the potential for wildlife to gain access to the tailings and water located on the TSF, particularly during the summer months when water in the region is in short supply. This can result in the loss of wildlife via the ingestion of cyanide containing water or entrapment in the tailings.

7.4 SOCIAL ENVIRONMENTAL ASPECTS

Large tailings storage facilities will modify the visual aesthetics of the landscape. However, due to the absence of communities near the Operational Area the TSF site is currently of inconsequential amenity value.

7.5 PRE-OPERATIONAL ASPECTS

Approximately 350 ha of clearing, grubbing and topsoil stripping is required prior to construction.. Water cycle influences are expected to be negligible due to the limited mass of vegetation existing and the limited ability of plants in arid environments to affect evapotranspiration and runoff rates. Local erosion may be accelerated by the loss of vegetative cover, which is not a significant issue should construction commence shortly after clearing.

Excavations for the TSF basin are also required prior to construction. However, the design of the underdrainage system takes advantage of the natural fall of the ground and thus only minor reshaping of the basin will be required.

Topsoil and spoil stockpiles will be constructed concurrently with basin preparations. These are not expected to have any significant adverse impacts on the local environment.

7.6 SITE-SPECIFIC CONSIDERATIONS

The existence of a HPS drainage zone beneath the TSF site has been identified. Consequently, it is imperative that seepage from the facility be quantified to assess the risk of subsurface contamination. To this effect, comprehensive seepage modelling for the TSF was conducted.

The seepage model created in the analysis program Seep/W incorporated the underdrainage system drains, soil liner, HDPE geomembrane liner and the in situ soil strata. For the assessment and based on available information, all in situ soils below the TSF were designated to exhibit a permeability at least two orders of magnitude higher than the TSF basin lining systems and therefore do not impact at all on the rate of seepage from the facility. The depth of sandy gravel present in the HPS drainage zone was inferred from Joint Venture data presented in the *Tropicana Joint Venture memorandum 'Tailings Dam Paleochannel Interpretation', 17 October 2008*.

Two scenarios were modelled, both representing the final TSF:

- Scenario 1 – Average pond extents (minimum operating volume), underdrainage system fully operational. This is intended to reflect the expected operational conditions; and,
- Scenario 2 – Wet pond extents resulting from a 1 in 100 year return interval storm event, underdrainage system fully operational.

Under Scenario 1, the phreatic surface in the TSF is located well within the HDPE liner extents and as a result low rates of seepage are forecast. The estimated rate of seepage from the TSF is in the order of 213 kL/day equivalent to 0.76 kL/ha/day.

Under Scenario 2, the phreatic surface remains within the HDPE liner extents. The estimated rate of seepage from the TSF is in the order of 214 kL/d or an equivalent of 0.77 kL/ha/day. Operation of the facility will need to be in strict accordance with the operating guidelines to ensure the pond does not exceed the HDPE liner extents and is returned to average operating conditions as quickly as possible.

It is therefore estimated that seepage rates under both normal operating conditions and extreme wet weather conditions will be below guideline limits as set by the Department of Water. Seepage from the facility is not considered a significant issue. The detailed analysis is provided in Appendix A.

7.7 WATER QUALITY

The water quality in the vicinity of the TSF has a salinity ranging from 19,000 – 52,000 µs/cm and has a pH range of 6.6 – 7.85. This saline to hypersaline water is currently not being used by the vegetation (groundwater located 20 - 30 mBgL) and does not contain any aquatic subterranean fauna. Table 2 presents a summary of the baseline elements naturally occurring in the ground water located in the vicinity in the Operational Area.

Table 2 Water Quality Data Ranges from the Operational Area

Elements	Operational Area
pH	6.6 - 7.85
EC (µs/cm)	19,000 - 49,000
TDS (mg/L)	14,000 - 52,000
Ca (mg/L)	350 - 850
Mg (mg/L)	710 – 2,800
Cd (mg/L)	<0.001 - 0.012
Cu (mg/L)	<0.005 - 0.016
Fe (mg/L)	<0.01 - 3
Mn (mg/L)	0.004 - 0.89
Pb (mg/L)	<0.02 - 0.11
B (mg/L)	2.9 - 14
Ba (mg/L)	0.021 - 0.046
Sr (mg/L)	5.5 - 15
Zn (mg/L)	0.015 - 3.2

8 ENVIRONMENTAL PERFORMANCE OBJECTIVES AND STANDARDS

8.1 OBJECTIVES AND STANDARDS

As stated in Section 4, the primary purpose of the TSF is to permanently and securely contain all solid waste materials. Accordingly, zero tailings release is the target standard to achieve this.

The effect of seepage on the environment will be measured against baseline values. Water quality and level as determined by monitoring bores installed downstream of the TSF will be compared against baseline values collected prior to construction of the facility to indicate if any contamination has occurred.

The risk of overflow will be measured against TSF inputs, outputs and the maximum storage capacity. The minimum designed freeboard will be maintained at all times.

Stability of the embankment will be measured via embankment movement, the phreatic profile and by visual inspection. Measured values will be compared to expected values to validate embankment stability.

It is also the intent of the Joint Venture that the TSF comply with all aspects of the Cyanide Code such as limits on weak acid dissociated cyanide (WAD CN) in TSF surface water (less than 50 mg/L) and impact on the beneficial use of groundwater. The Joint Venture is also aware that the Department of Environment and Conservation / Department of Water require that cyanide levels in ground water do not exceed 0.07 mg/L WAD CN.

Prevention of wildlife loss will be achieved via the implementation of management controls (refer to section 9.2). This aspect will be monitored by daily visual inspection of the facility and control systems and the regular testing of WAD CN in the decant water to ensure compliance with the established thresholds.

8.2 Measurable Criteria for Assess Performance

The effect of seepage will be determined via multiple criteria. Leachate volumes collected by the underdrainage system, as well as water quality will be analysed to determine the effectiveness of the underdrainage. Leachate bypassing the underdrainage system will be detected by groundwater levels around the TSF. Water quality from these locations will also be assessed in terms of concentrations of the major geochemical constituents of the tailings.

Storage availability of the TSF will be determined by the tailings surface levels, deposition rates, supernatant pond levels and decant reclaim rates. A minimum freeboard of 0.3 m will apply at all times. Tailings beach surveys will also be conducted regularly to examine the performance of the tailings.

Embankment stability will be ascertained with the use of survey pins to determine embankment settlement and displacement. Pore water pressures at key locations within the embankment will be measured to ensure the phreatic surface does not compromise embankment stability. Regular visual inspection of general embankment integrity will be used as a qualitative check for stability. Finally, the TSF will be subjected to an annual audit by a suitably qualified Geotechnical Engineer.

9 PROCEDURES FOR MANAGING AND MITIGATING RISKS

9.1 WASTE, CHEMICALS AND HAZARDOUS MATERIALS MANAGEMENT

The TSF is designed for the permanent and secure containment of all solid waste materials. For the liquid component, three out-fluxes are possible:

- supernatant evaporation;
- decant return to plant site; and,
- seepage.

Of these, only seepage has the potential to adversely affect the environment (as described in section 7.2). Seepage is minimised by the use of liners and the underdrainage network. To facilitate early detection and remediation of any seepage that occurs, a series of groundwater quality monitoring stations will be installed around the facility. It is proposed that each monitoring station consists of one shallow hole, extending through approximately 5 – 10 m of the near surface horizon and one deep hole terminating at approximately 25 m (to the base of the saprolite layer). Each borehole will be cased and screened over an interval set in the field during installation and sealed back to surface with low permeability grout. The boreholes will be constructed before commissioning the TSF to accumulate baseline data specific to the storage location.

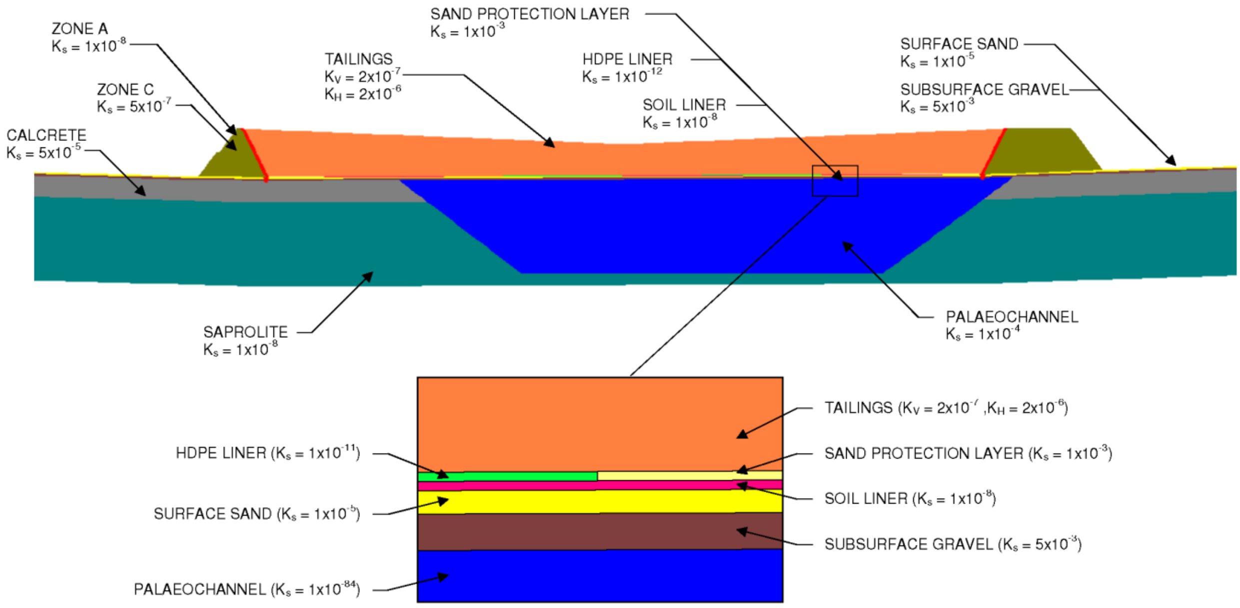


Figure 4 Tailings Storage Facility Liner Configuration

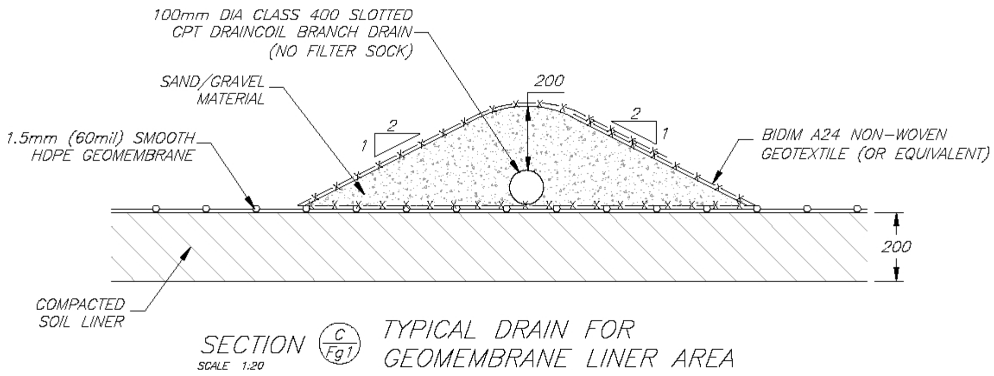


Figure 5 Under Drainage Configuration Over HDPE Liner Area

In the event it is determined that seepage is migrating away from the facility, seepage recovery strategies will be implemented. The exact method will be selected at the time of the event and will depend on the type of issue occurring. The types of strategies that will be considered are:

- enhanced tailings thickening;
- dewatering bores;
- seepage interception trenches; and,
- a combination of the above.

9.2 ANIMAL MANAGEMENT

The TSF will be fenced to prevent/ limit access by non-Avian fauna onto the tailings deposition area. Furthermore, the water recovery system will be operated to remove decant water from the TSF as quickly as practicable. Cyanide levels in the tailings will be managed to ensure that the standing water area on the TSF complies with the Cyanide Code standing water level WAD CN restriction (less than 50 mg/L WAD CN) designed to prevent impacts on Avian fauna.

The facility will be monitored daily and all observed animal impacts will be recorded as an incident and investigated.

9.3 CYANIDE MANAGEMENT

The facility will be operated in accordance with all the Cyanide Code requirements. Cyanide levels in the tailings discharge and decant water will be monitored. Strategies (such as dilution or ultraviolet destruction) will be adopted to ensure that the decant water and groundwater below and adjacent to the facility meet all the Cyanide Code compliance levels, such as the 50 mg/L WAD CN limit for pooled surface water, and that groundwater in the monitoring bore adjacent to the TSF does not exceed the Department of Environment and Conservation / Department of Water groundwater cyanide limit of 0.07mg/L.

9.4 DUST MANAGEMENT

Mitigation of dust generation can be achieved via modification of the deposition sequence according to tailings conditions. The salinity of the tailings is expected to improve the water retention characteristics of the tailings slurry and prevent desiccation. Should water loss become significant, rotation of the deposition cycle will occur more frequently to prevent dust generation. Inclusion of a wearing course on the embankment crest will reduce dust generation from vehicle movements.

9.5 Decommissioning

It is important to ensure the final deposition layers are in accordance with the rehabilitation plan for the TSF. Hence closure planning will be reviewed annually to ensure that the operating strategy and closure strategy are consistent and, if necessary, adjustments will be made.

Two years prior to decommissioning, a tailings rehabilitation and decommissioning audit will be conducted to ensure that adequate preparation is occurring or has occurred for rehabilitation to proceed in an orderly manner. A detailed closure and decommissioning plan will then be completed including designs and drawings that can be used for construction of the final landform.

Decommissioning of the TSF will include termination of tailings deposition and removal of the pond around the decant tower area. Drying of the tailings is expected to take several months and possibly require completion of the capping in the following dry season. The underdrainage system will continue to operate for a number of years after completion of capping and revegetation to drain excess water from the tailings deposit.

9.6 Rehabilitation Program

At the end of the mining operation, the perimeter embankments will have a downstream slope of 15 degrees so that it blends into the surrounding waste landform. The adopted downstream profile will be inherently stable under both normal and seismic loading conditions and will allow for revegetation. The embankment face can only be revegetated at closure due to the downstream construction method adopted.

A low permeability soil fill cover is proposed for the TSF as the most appropriate long-term solution for benign tailings. The main focus of the rehabilitation programme will be revegetation, erosion control and stormwater management. Establishing a surface cover of verdant vegetation will reduce the potential for adverse environmental impacts such as dust generation and rainfall erosion, as well as improving aesthetics. Stormwater will be retained on the TSF surface to provide moisture for vegetation development.

The top surface of the TSF will be covered with non-acid forming material from the adjacent waste landform to a minimum depth of 0.5 m but at a thickness dependent on the relative level (RL) of the tailings during rehabilitation. The outer slope and capped tailings surface will then be covered with 1 m of growth medium (sand or sandy gravel depending on the RL). The growth medium will be ripped along contour and revegetated with suitable shallow rooting local species.

Trials of the proposed rehabilitation scheme early in the life of the Project will allow determination of the optimal configuration for rehabilitation in terms of materials and layer thicknesses required and suitability of the selected vegetation.

Upon completion of the rehabilitation activities, as-built construction drawings will be drawn and incorporated into a closure completion report.

Once decommissioned and rehabilitated, the TSF should be:

- stable and structurally sound;
- resistant to major wind and rain erosion;
- visually compatible to the surrounding landform; and,
- functionally compatible with the agreed post-mining land use.

In the period after rehabilitation to relinquishment of bonds provision will be made for monitoring, repair and maintenance.

10 ROLES AND RESPONSIBILITIES

Personnel required in the operation of the TSF, along with a list of their respective responsibilities are shown in Table 3.

Table 3 Personnel Required in the Operation of the Tailings Storage Facility

Position	Responsibilities
Site Manager	Providing adequate staff and financial resources for effective tailings management.
Line Managers	Facilitate environmental & community risk assessments of tailings and TSF management and day to date management and monitoring of the facility.
Site Senior Environmental Person	Monitoring compliance with Approvals, License and Industry Codes.

11 TRAINING AND EDUCATION

As part of the development of the TSF, a clear and concise Tailings Operating Manual will be produced and issued to all supervising personnel. The information contained will include operating practices, maintenance requirements, reporting procedures and instructions in the event of equipment breakdowns, leaks, pipeline failure and blockages. Regular inspections and auditing will ensure the TSF is managed in accordance with all requirements.

12 MONITORING, AUDIT AND REPORTING REQUIREMENTS

12.1 SCHEDULE OF MONITORING PROGRAM

A comprehensive monitoring program will be developed to examine the geotechnical and hydrogeological performance of the TSF. The monitoring will include survey pins to check embankment movements, piezometers in the embankments and monitoring bores downstream of the embankments.

Instrumentation measurements that deviate appreciably from the anticipated performance of the facility will result in an increase in monitoring frequency and the designer will be notified immediately to assess the situation.

Pore water pressures will be monitored at various key locations within the embankment to ensure that stability is not compromised. To this end it is proposed that standpipe piezometers are installed at eight locations in critical areas around the embankment. The base of the piezometer will be contained within the embankment to ensure that the phreatic surface within the embankment is measured. Additional piezometers may be required as the embankment is raised to assess the process of consolidation in the tailings.

Survey pins will be installed along the embankment crest to monitor any movement and the resulting effects on the embankment.

Tailings performance monitoring will include monitoring of the following variables on a continuous basis:

- solids tonnage to the TSF;
- water volume to the TSF;
- rainfall and evaporation at the site;
- water return from the facility; and,
- collection efficiency of the under-drainage system based on under-drainage sump pump monitoring.

Monitoring of tailings moisture contents, densities, geochemical characteristics and surveying of the tailings beach and supernatant pond locations will be conducted four times a year.

Tailings delivery and return water lines as well as the TSF will be visually inspected at least once per shift. A record or log of these inspections will be documented and held in the process plant for auditing purposes. Regular thickness testing of lines to identify abrasion or other line decay problems will also be conducted. A summary of the performance monitoring envisaged is presented in Table 4.

Table 4 Monitoring Schedule

AREA	MONITORING REQUIREMENT	FREQUENCY
Section 1:	Short Term Operation Monitoring	
Tailings	Pipeline integrity	Daily
	Visual check of tailings level versus embankment crest	Daily
	Visual check of water level versus embankment crest	Daily
	Off-take location	Daily
	Blockage of discharge	Daily
	Check integrity of geomembrane lining	Daily
	Discharge of free cyanide	Real-time
Decant	Ingress of tailings into decant tower	Daily
	Location of decant pond	Daily
	WAD CN concentration	Weekly

AREA	MONITORING REQUIREMENT	FREQUENCY
Section 2:	Compliance Monitoring	
Embankment	Embankment integrity	Daily
	Seepage from embankments	Daily
	Access ramps	Daily
	Piezometer water level	Weekly
	Decant / supernatant water analysis	
	- Regular	Monthly
	- Comprehensive	Quarterly
	Water level and volume	Monthly
	Tailings level	Monthly
	Survey pins	Quarterly
	General inspection by suitably qualified engineer	Annually
Monitoring bores	Water level	Monthly
	Water quality	Quarterly
Section 3:		
Tailings	Tailings solids (tonnes)	Daily
	Water in tailings (tonnes or m^3)	Daily
	Average tailings flow (m^3/s)	Daily
	Freeboard monitoring survey	
	- Regular	Monthly
	- Comprehensive	Quarterly
	Outflow from decant, underdrainage	Daily
	Outflow from external seepage interception system	Daily
	Water return to plant	Daily
Return Water	Silt removal	Once every 6 months or more frequently if required
Climate	Precipitation	Daily
	Evaporation	Daily
	Maximum - minimum temperatures	Daily
	Wind direction and speed	Daily

12.2 Schedule of Compliance Auditing

The TSF will be audited and inspected after the following milestones:

- quality control throughout construction to ensure the TSF is constructed in accordance with the design intent;
- post-construction audit to ensure the TSF is safe to operate;
- regular internal spot audits / inspections conducted on operating practices and statutory requirements;
- external geotechnical audit of the TSF on an annual basis;
- external licence compliance audit to ensure the facility is managed in accordance with regulatory and AngloGold Ashanti Australia's guidelines every three years;
- external geotechnical audit prior to decommissioning;
- rehabilitation and decommissioning audit;

- post-closure auditing; and,
- as required by the statutory authorities, e.g. Department of Mines and Petroleum and the Department of Environment and Conservation.

All aspects of the TSF will be formally audited, inspected and reported.

12.3 System of Review

Reporting processes will be established to ensure monitoring and audit results are made available to personnel responsible for operational, engineering and maintenance functions associated with the TSF. Designated personnel will interpret monitoring and audit data and modify operational procedures or practices as required. In addition, this information will also be used to adjust any maintenance practices. The result is improved efficiency and environmental performance.

12.4 System of Data Maintenance

A record of seepage and any tailings losses from the TSF will be documented and held in the process plant. Procedures outlining these requirements will be incorporated into the Tailings Operating Manual.

12.5 System of Reporting

Procedures for the reporting (internally and externally) of all required information will be incorporated into the Tailings Operating Manual.

13 EMERGENCY EVENTS AND CONTINGENCY PLANNING

13.1 Sources of Risk and Procedures to Minimise Risks and Potential Impacts

Procedures will be developed to handle emergencies in the operation of the TSF prior to commissioning. Four such emergency scenarios are discussed below. For other situations, a qualified civil / geotechnical engineer experienced in tailings management will be referred to for immediate action. An action plan will then be developed for that situation or problem, implemented and incorporated into the operating procedures.

13.1.1 Rupture in the Pipelines

The tailings delivery and water return pipelines will be located away from sensitive environmental areas and contained in a bunded corridor constructed of low permeability material on both sides of the pipelines and along the full length. The pipeline will be fully welded. Any rupture or failure that occurs along the pipelines will hence be fully contained. A bund will be constructed on the downstream edge of the TSF embankment crest to prevent any tailings line failures from releasing tailngs into the surrounding environment. In addition, flow or pressure sensors will be installed along the pipeline, connected and alarmed through to the process plant control room.

13.1.2 Tailings Overflow

The TSF is designed to operate with a minimum of 0.3 m freeboard, to ensure that the potential for tailings or water to overflow the embankment is avoided. The shape of the tailings beach is such that the rainfall runoff from a Probable Maximum Precipitation event can be contained within the TSF.

13.1.3 Power Failure

The tailings delivery and decant pumps will be connected to the process plant power distribution system. In the event of a total loss of power all pump systems and automatic valves not connected to standby generators will cease operations. Shutdown of the decant pump will mean that the level of the water in the decant pond will begin to rise. Visual inspection of the supernatant pond level will be required. However, the available storage volume is very large and it would take a considerable time to fill. In this time, power would be restored or the plant would be shutdown.

13.1.4 Embankment Failure

The adopted downstream profile will be inherently stable under both normal and seismic loading conditions. The underdrainage system also acts to enhance the geotechnical stability of the TSF via reduced seepage and improved tailings density. Pore water pressures monitored at various key locations within the embankment should ensure that stability is not compromised.

13.2 Flow Slide Modelling

A flow slide analysis was conducted to determine the impact of an embankment breach in the unlikely event of dam failure. The method proposed by Blight, Robinson and Diering (1981) was used for the analysis, assuming a 105 m breach along the northern cell of the TSF. A long section of the resultant flow slide is shown in Figure 6.

Should a breach occur, most of the tailings volume would be contained in the tailings beach as illustrated in Figure 7. The remaining volume would flow downstream at shallow depth and without affecting the existing mining infrastructure. The dam failure contingency plan will incorporate the construction of an emergency bund approximately 3.5 km downstream of the embankment toe. This plan would require the mobilisation of one excavator, two dump trucks and a bulldozer to rapidly construct a three metre high emergency bund if it is deemed necessary. All other personnel and equipment would remain clear of the flow path of the tailings.

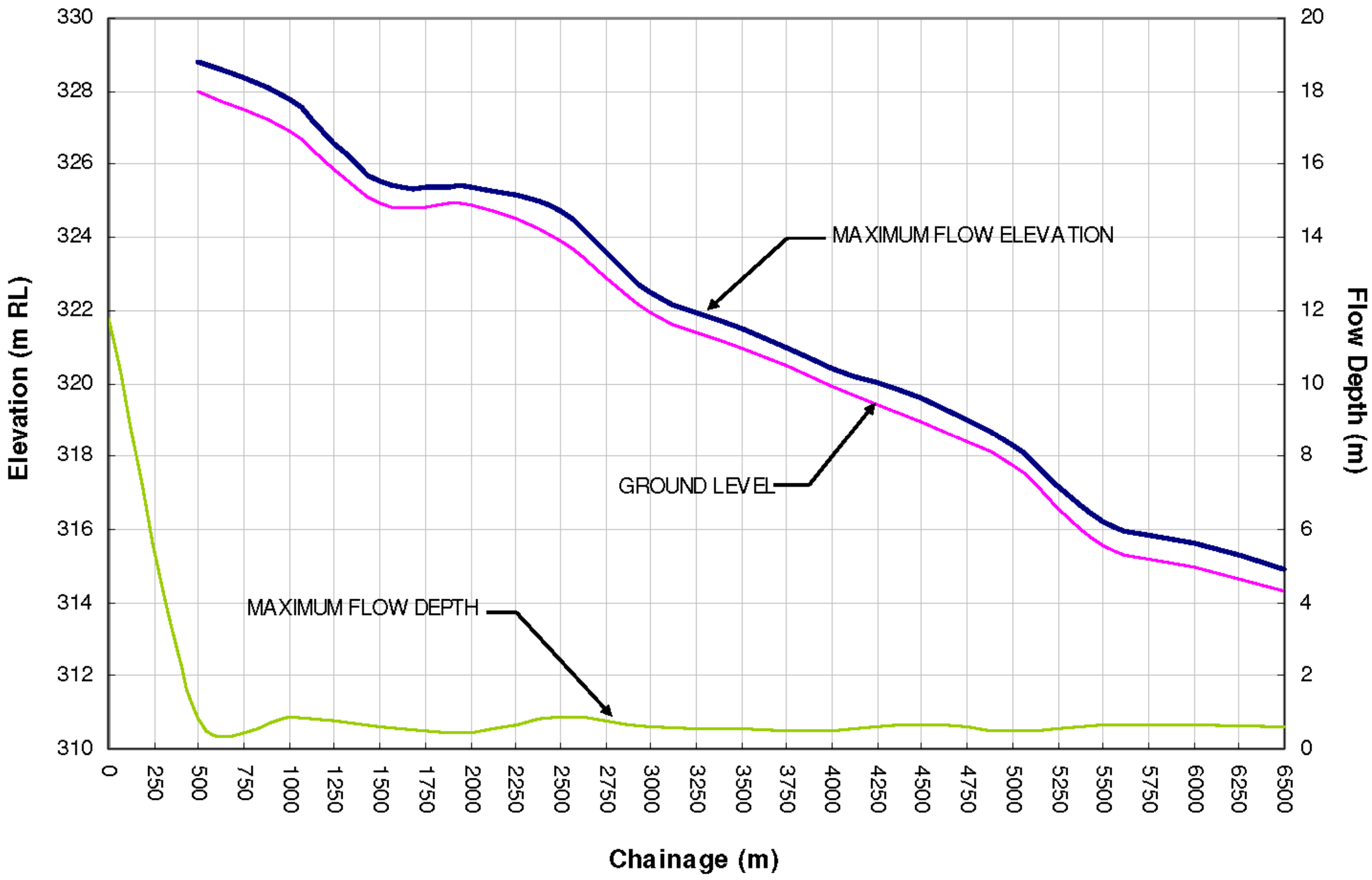


Figure 6 Flow Slide Depth

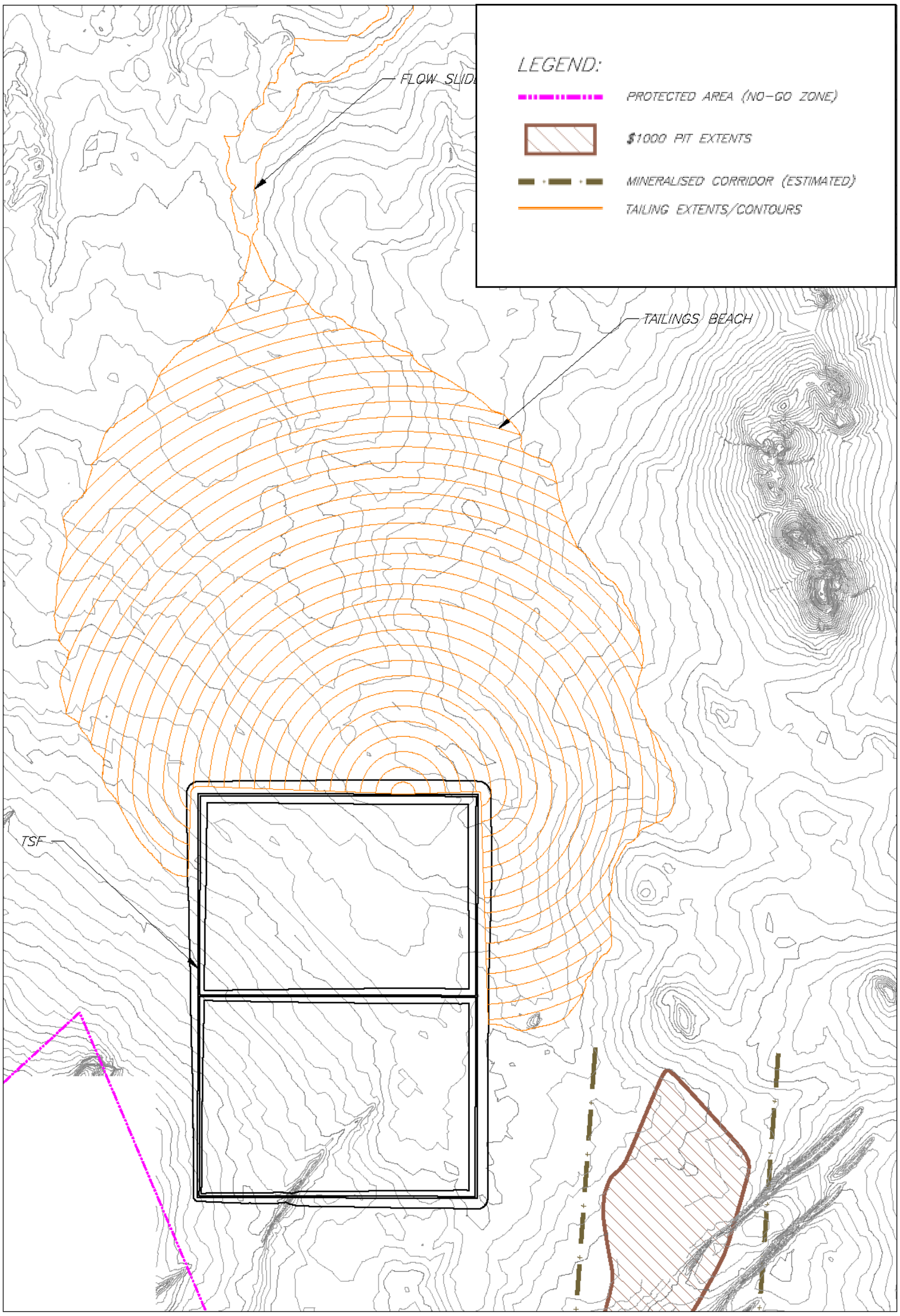


Figure 7 Flow Slide Extent

13.3 EMERGENCY RESPONSE

In the event of TSF failure, the people and agencies identified in Table 5 would be immediately contacted.

Table 5 Emergency Contacts

Emergency Advice	Responsibility
Tropicana Gold Project Emergency Response Manager	Mine personnel safety
Tropicana Gold Project Senior Environmental Person	Environmental matters
Tropicana Gold Project Site Manager	Safety and environmental protection
Department of Mines and Petroleum, Regional Mining Engineer	Safety
Department of Mines and Petroleum Environment Division, Regional Environmental Officer	Environmental protection
Department of Environment and Conservation, Site Environmental Officer	Environmental protection

13.4 SPILL RESPONSE AND CLEAN-UP STRATEGIES

13.4.1 Rupture in the Pipelines

Should a major rupture occur along the pipelines, local erosion of the embankment crest, or overtopping of the pipeline containment trench may occur. Any tailings spillage will be cleaned up and the tailings placed into the TSF. Any damage to the embankment, road, bund, etc. will be repaired and restored to its original condition.

A rupture in the Tailings Delivery or Water Return Pipeline will require a temporary shutdown of the respective pumps so that the line can be disassembled and repaired. Detection of a failure in this portion of the line will be notified to the Line Manager and Process Manager immediately so that arrangements can be made to take the respective pumps off line and effect immediate repairs. Upon completion of repairs, an investigation of all coupling failures will identify and correct the source of the failure.

13.4.2 Dam Failure

In the unlikely event of dam failure the following steps will be taken:

- the plant will be shut down and deposition into the facility ceased;
- the location and safety of any personnel known to be in the area will be checked. If it is possible that someone has been caught in the flow slide, emergency services will be informed and their recommendations adhered to;

- the incident will be reported to the relevant authorities;
- the flow area will be inspected to determine the extent of the flow slide and the damage it has caused;
- the facility will be inspected to determine the area of the embankment which has been damaged;
- if the tailings line has been buried or damaged the line will be disassembled, the damaged sections removed or repaired and the pipeline re-layed into another area of the facility (if possible) to allow continuation of tailings deposition when safe to do so;
- any damage to the decant structure, pipelines, access roads, etc. will be fixed as quickly as practicable;
- the breach and the overall facility will be inspected by a competent geotechnical engineer and a repair plan developed;
- after the tailings have dried and the breach is stable, the tailings will be picked up and placed into the facility;
- the breach will be repaired and damage to the environment will be assessed and rectified; and,
- the conditions leading up to the failure will be identified and the operating procedure modified so that the same situation does not occur again.

14 REFERENCES

The following documents were used in the production of this Strategy:

1. AngloGold Ashanti Australia "Tropicana Gold Project –Environmental Scoping Document", January 2009.
2. AngloGold Ashanti Australia "Environmental Policy", 22 August 2007.
3. AngloGold Ashanti Australia "Environment & Community Policy 2002 Tailings Management V1.5", 2002.
4. Knight Piésold Report Ref. PE801-00083/3 "Tropicana Gold Project – Tailings Storage Facility Prefeasibility Design Summary", September 2008.
5. URS Report Ref. 42906543 "Tropicana Hydrological Investigation", 22 August 2007.
6. Pennington Scott "TGP Operational Area Groundwater Assessment", June 2009.
7. AngloGold Ashanti Australia Fact Sheet "Tropicana Gold Project – Managing the Environment".
8. Knight Piésold Memo Ref. PE801-00083 EMEM-KP019 "Tropicana Project – TSF Seepage Assessment", 16 January 2009.
9. Knight Piésold Report Ref. PE801-00048/10 "Boddington Expansion Project – Technical Risk Assessment of RDA R4", December 2004.
10. Knight Piésold Report Ref. 661/2 – V2 "KCGM – Fimiston 1 Tailings Storage Facility – Volume 2 Operation and Maintenance Manual", September 2003.
11. Knight Piésold Report Ref. PE301-00132/09 "Buzwagi Project – Tailings Storage Facility and Water Management Infrastructure – Operations Manual", August 2008.
12. Australian National Committee on Large Dams "Guidelines on Dam Safety Management", 1994.
13. Blight, G.E., Robinson, J.J. and Diering, J.A.C., 1981, The Flow of Slurry from a Breached Tailings Dam, Journal of the South African Institute of Mining and Metallurgy, January.

APPENDIX A

Memorandum Ref. PE801-83-EMEM-KP019, 'Tropicana Project – TSF Seepage Assessment', 16 January 2009

Knight Piésold CONSULTING

MEMORANDUM

To:	**ANGLOGOLD ASHANTI AUSTRALIA**	**Date:**	16th January 2009
Attn:	Belinda Bastow	**Our Ref:**	PE801-00083sdmM9001
		KP File Ref.:	PE801-83 EMEM-KP019
cc:	Massoud Massoudi	**From:**	Brett Stevenson

RE: TROPICANA PROJECT – TSF SEEPAGE ASSESSMENT

As requested, please find herein an assessment of the likely seepage rates during operation from the proposed tailings storage facility at Tropicana.

1. TSF Design Summary

The current tailings storage facility design is summarised as follows:

- The TSF will comprise of two cells operated concurrently.
- The embankments will be developed by downstream construction methods.
- The basin area will have composite soil and HDPE geomembrane liner. The HDPE geomembrane area will be located below the typical operating supernatant pond extents.
- Tailings will be discharged into the facility by sub-aerial deposition methods, using spigots at regularly spaced intervals, from all embankments to locate the supernatant pond centrally in each cell.
- A basin underdrainage system is included to reduce seepage and improve the geotechnical stability of the TSF. The underdrainage system drains by gravity to a collection sump located at the lowest point in the TSF basin for each cell and is pumped back into the supernatant pond for reuse.
- Based on the guidelines provided by the Department for Water (Water Quality Protection Note WQPN 27, February 2006), seepage rates from an engineered soil lined facility should not exceed 1 kL/ha/day.

2. Insitu foundation conditions

The foundation conditions under the TSF will comprise of:

- Aeolian sand.
- Calcrete.
- Transported sandy gravels / gravely sand.

All insitu foundation materials are expected to have relatively high permeabilities. The permeability of the Calcrete and transported sandy gravels is estimated to be a minimum of two to three orders of magnitude higher than that of the tailings / lining systems and therefore, seepage rates from the facility will be governed by the engineered lining system installed within the facility.

The performance of the facility, specifically regarding seepage, is not expected to vary whether the foundation material is the Calcrete or sandy gravel / gravelly sands (ie: location is not critical).

3. Design measures to reduce seepage

The engineered seepage control system will consist of the following components:

i. TSF Basin Composite Lining

A composite basin liner will be provided in the TSF comprising:

- 1.5 mm HDPE geomembrane liner (covering 20% of the basin area in each cell) overlying;
- A low permeability soil layer of either scarified, conditioned and recompacted in situ soils and / or imported fill (covering 100% of the basin area of the cell);

ii. Basin Underdrainage Collection System.

The underdrainage collection system will be constructed throughout the basin area and is designed to reduce the phreatic surface on the basin liner. One of the benefits of the underdrainage system is that it reduces seepage through the basin and through the embankment.

The underdrainage system will consist of two drainage networks, namely collector drains and branch drains. Collector drains and branch drains will be placed in both soil and geomembrane liner areas.

In the soil liner areas, the main collector drains will be constructed along the main valley, and will be underlain by the soil liner in all areas (minimum thickness 200 mm). The drains will consist of 160 mm diameter draincoil pipes located at 25 m centres, embedded within a 300 mm sand layer covered with 300 mm of erosion protection material. Branch drains will consist of 100 mm diameter draincoil pipes surrounded with sand and wrapped in geotextile. The drains will be covered with a 150 mm thickness layer of erosion protection material. The branch drains will feed directly into the collector drains.

In HDPE geomembrane lined areas, branch drains will be located on top of the geomembrane liner and will consist of 100 mm diameter draincoil pipes located at 25 m centres surrounded with sand and wrapped in geotextile.

4. Seepage Assessment

4.1 Background

Based on the current TSF design and location, a seepage assessment was undertaken for the TSF to quantify the following aspects:

- Estimate the steady state seepage rate from the TSF.
- Estimate the effect of the basin underdrainage system and the HDPE geomembrane on the phreatic surface within the TSF.

For this assessment and based on available information, all insitu soils below the TSF were designated to exhibit a permeability at least two orders of magnitude higher than the TSF basin lining systems and therefore do not impact at all on the rate of seepage from the facility.

A seepage model was created in the analysis program Seep/W. The underdrainage system drains, soil liner and HDPE geomembrane liner were included in the model.

4.2 Sub-surface Profiles

The subsurface conditions and layer thickness for the section were based on the subsurface profiles presented in KP Report Ref. PE801-00083/03 (issued as Rev A, September 2008), and summarised in Table 4.1.

Table 4.1: Indicative Soil Profile – non paleochannel areas

Depth to Base (m)	Thickness (m)*	Description
0.2 – 1.2	0.2 – 1.2	Surface sand material (Aeolian)
0.9+ – 2.1+	0.0 – 1.6+	Sub-surface gravel material (transported)
3.0 – 18.0	0.5 – 8.0	Calcrete (calcareous cement) material (Residual)
4.0 – 37.0+	1.0 – 19.0+	Saprolite material (Residual)

*NB – Thickness of calcrete and saprolite material based on inspection of air core spoil piles.

The depth of sandy gravel present in the paleochannel was inferred from the internal Anglogold memorandum 'Tailings Dam Paleochannel Interpretation' (17 October 2008), provided by Anglogold in January 2009.

4.3 Material Parameters

A plan of the adopted TSF configuration is presented as Figure 1. Typical basin cross sections are shown on Figure 2. The resulting seepage model is presented as Figure 3.

The material types and parameters used in the model are summarised in Table 4.2.

Table 4.2: Seepage Modelling - Material Parameters

Material Type	Estimated Permeability k (m/s)
Embankment:	
Embankment Zone A – Low Permeability	1×10^{-8}
Embankment Zone C – Structural Fill	5×10^{-7}
Tailings mass:	
Vertical direction	2×10^{-7}
Horizontal direction	2×10^{-6}
Basin liner:	
HDPE Geomembrane (effective)	1×10^{-12}
Sand Protection Layer	1×10^{-3}
Low permeability soil liner / subgrade	1×10^{-8}
Foundation:	
Surface Aeolian Sand	1×10^{-5}
Sub-surface Gravel	5×10^{-3}
Calcrete	1×10^{-5}
Saprolite	1×10^{-8}

4.4 Scenarios Modelled

Two scenarios were modelled, both representing the final TSF.

- Scenario 1 – Average pond extents (minimum operating volume), underdrainage system fully operational. This is intended to reflect the expected operational conditions.
- Scenario 2 – Wet pond extents resulting from a 1 in 100 year return interval storm event, underdrainage system fully operational.

The following boundary conditions were assumed in the analysis:

- The supernatant pond is represented by a constant head boundary condition, where the head is equal to the elevation of the pond surface;
- The exposed beach consists of a constant flux input equivalent to the water infiltration due to freshly deposited tailings in an active cell;
- Either side of the model comprised nodes set to model infinite elements. In physical terms, water can seep through the soil layers to an infinite distance to either side of the model;
- Drainage systems were modelled as a series of free draining points (or zero pressure nodes). These nodes were placed at the design underdrainage spacing.

4.5 Modelling Results

The results of each of the design cases are outlined below:

- Scenario 1 was modelled with the basin underdrainage system operational, with average operating supernatant pond extents. The phreatic surface in the TSF is located well within the HDPE liner extents and as a result low rates of seepage are forecast. The estimated rate of seepage from the TSF is in the order of 213 kL/day equivalent to 0.76 kL/ha/day for a total TSF size of 280 Ha.
- Scenario 2 was modelled with the basin underdrainage system operational, with the supernatant pond extents resulting from a 1 in 100 return average return interval storm event. The phreatic surface remains within the HDPE liner extents. The estimated rate of seepage from the TSF is in the order of 214 kL/d or an equivalent of 0.77 kL/ha/day.

Table 4.3: Seepage Modelling – Estimated Seepage Flows

Scenario	Seepage From TSF ($m^3/s/m^2$)		Total Seepage from TSF (kL/day)	Figure
	HDPE Lined Area	Soil Liner Area		
1 – Average conditions	2.21×10^{-10}	4.94×10^{-9}	215	4
2 – Wet conditions	2.59×10^{-10}	4.93×10^{-9}	217	5

5. Conclusions

Based on the assessment, the following conclusions are made:

1. Seepage rate from the facility is not considered a significant issue.

2. The location of the facility, whether founded on Calcrete or the transported sandy gravel (paleochannel) has no impact on the rate of seepage from the facility, provided the pond extents remain within the HDPE liner extents.

3. Seepage rates under normal operating conditions are estimated to be below guideline limits as set by the Department of Water.

4. Seepage rates during extreme wet conditions continue to remain below the guideline limits.

5. Operation of the facility will need to be in strict accordance with the operating guidelines to ensure the pond does not exceed the HDPE liner extents and is returned to average operating conditions as quickly as possible.

6. Additional seepage control measures within the TSF basin are not considered necessary.

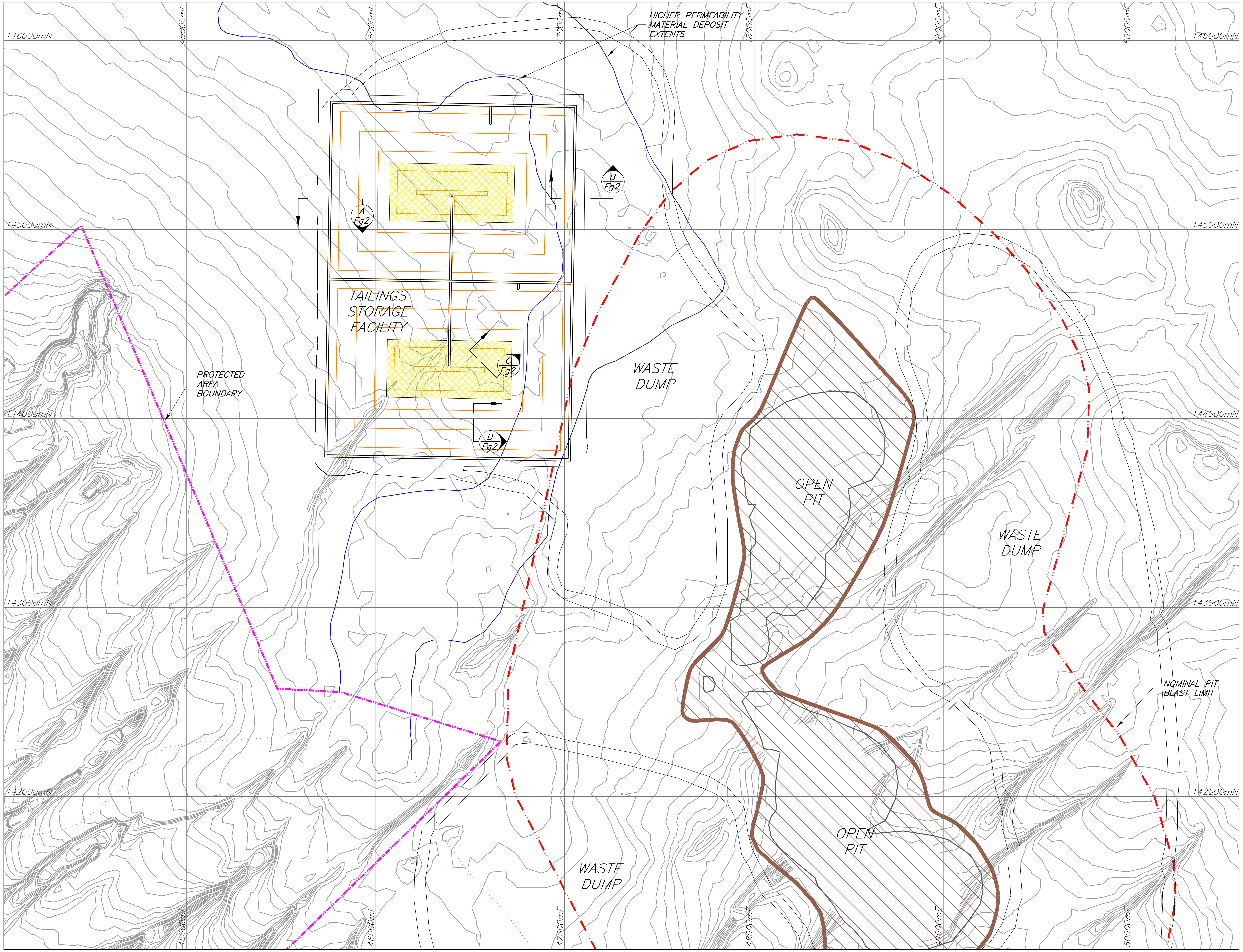
7. Monitoring and contingency plans currently nominated for the TSF remain valid.

We trust this is sufficient information for your current requirements. If you have any questions, please contact us.

Yours sincerely,
KNIGHT PIÉSOLD PTY LTD

BRETT STEVENSON
Associate Director

FIGURES



LEGEND:

PROTECTED AREA (NO-GO ZONE)

$1000 PIT EXTENTS

PIT BLAST LIMIT

HIGHER PERMEABILITY MATERIAL DEPOSIT EXTENTS

HDPE LINED AREA

NOTES:

1. 1m CONTOUR INTERVAL SHOWN. TOPOGRAPHY PROVIDED BY ANGLOGOLD ASHANTI, OCTOBER 2007.
2. PIT LAYOUT PROVIDED BY ANGLOGOLD ASHANTI, OCTOBER 2007.
3. HIGHER PERMEABILITY MATERIAL DEPOSIT EXTENTS PROVIDED BY ANGLOGOLD, JANUARY 2009.

SCALE 1:20,000 (A3)

400 300 200 100 0 200 400 600 800

METRES

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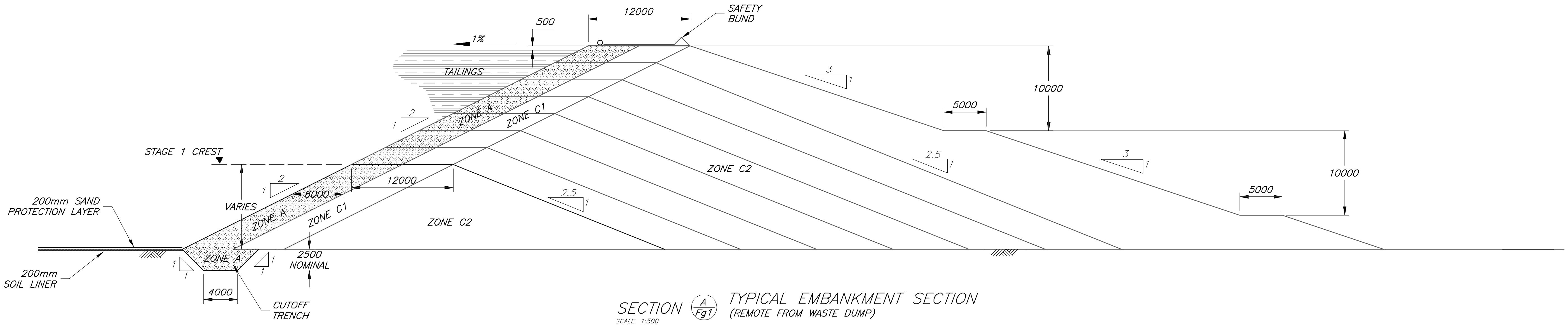
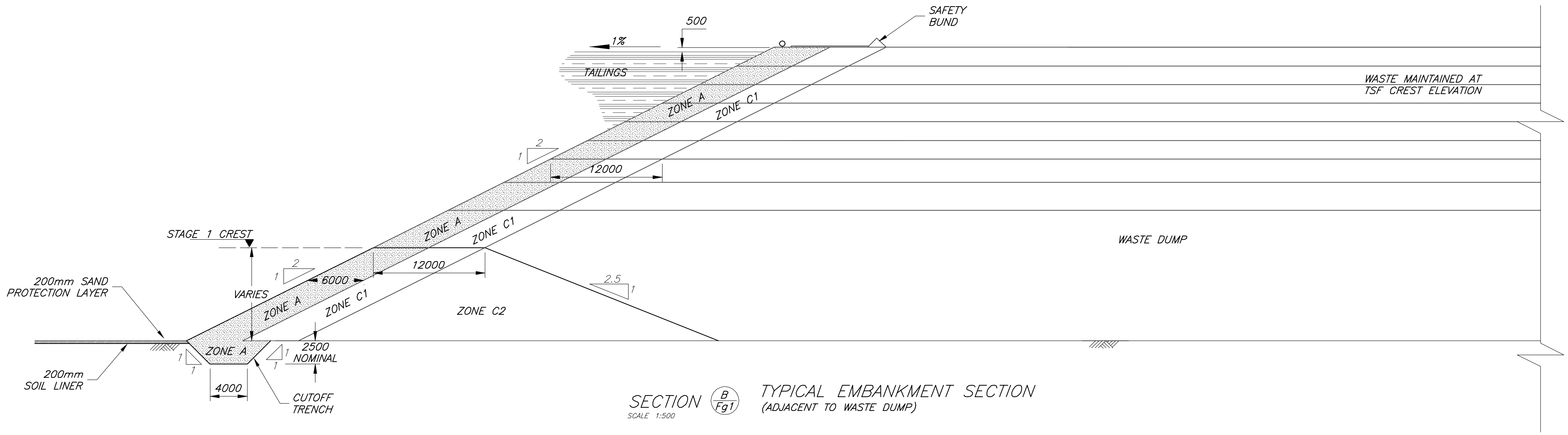
TROPICANA GOLD PROJECT
TAILINGS STORAGE FACILITY SEEPAGE MODELLING
FINAL GENERAL ARRANGEMENT

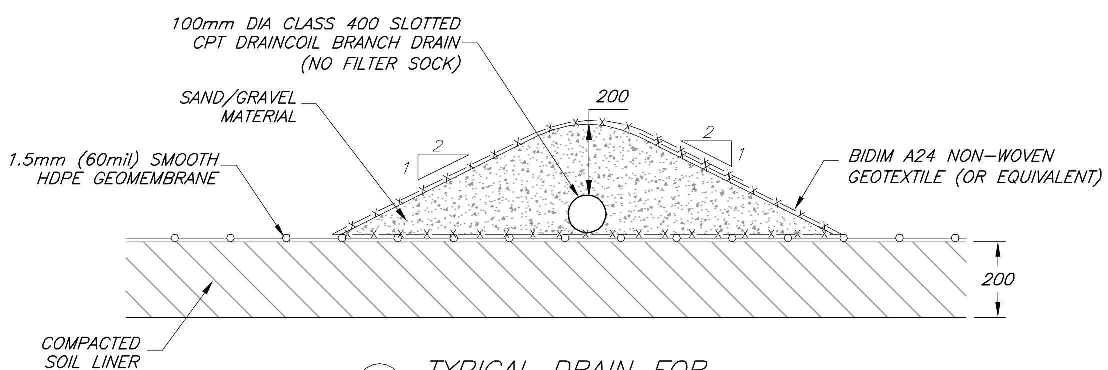
Ref: PE801-83-EMEM-KP019
Figure 1
Rev: 0



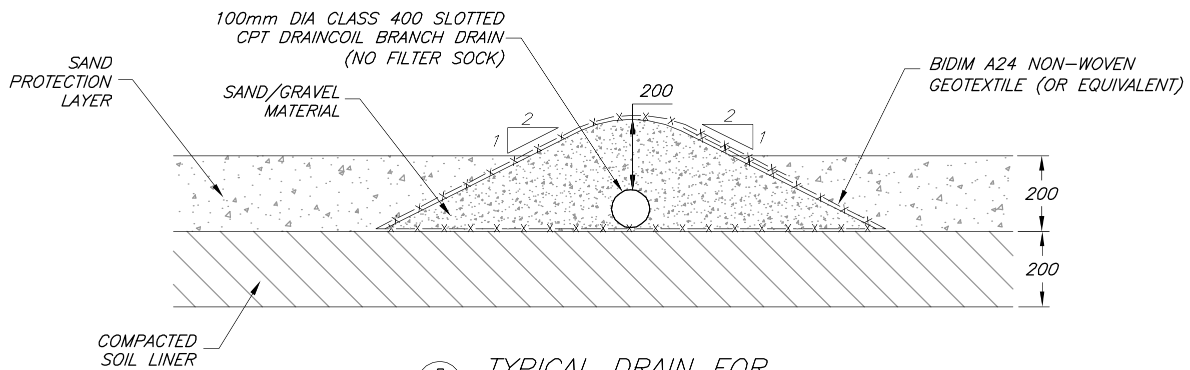
SECTION A/Fg1 TYPICAL EMBANKMENT SECTION
(REMOTE FROM WASTE DUMP)
SCALE 1:500



SECTION B/Fg1 TYPICAL EMBANKMENT SECTION
(ADJACENT TO WASTE DUMP)
SCALE 1:500



SECTION C/Fg1 TYPICAL DRAIN FOR GEOMEMBRANE LINER AREA
SCALE 1:20



SECTION D/Fg1 TYPICAL DRAIN FOR SOIL LINED AREA
SCALE 1:20

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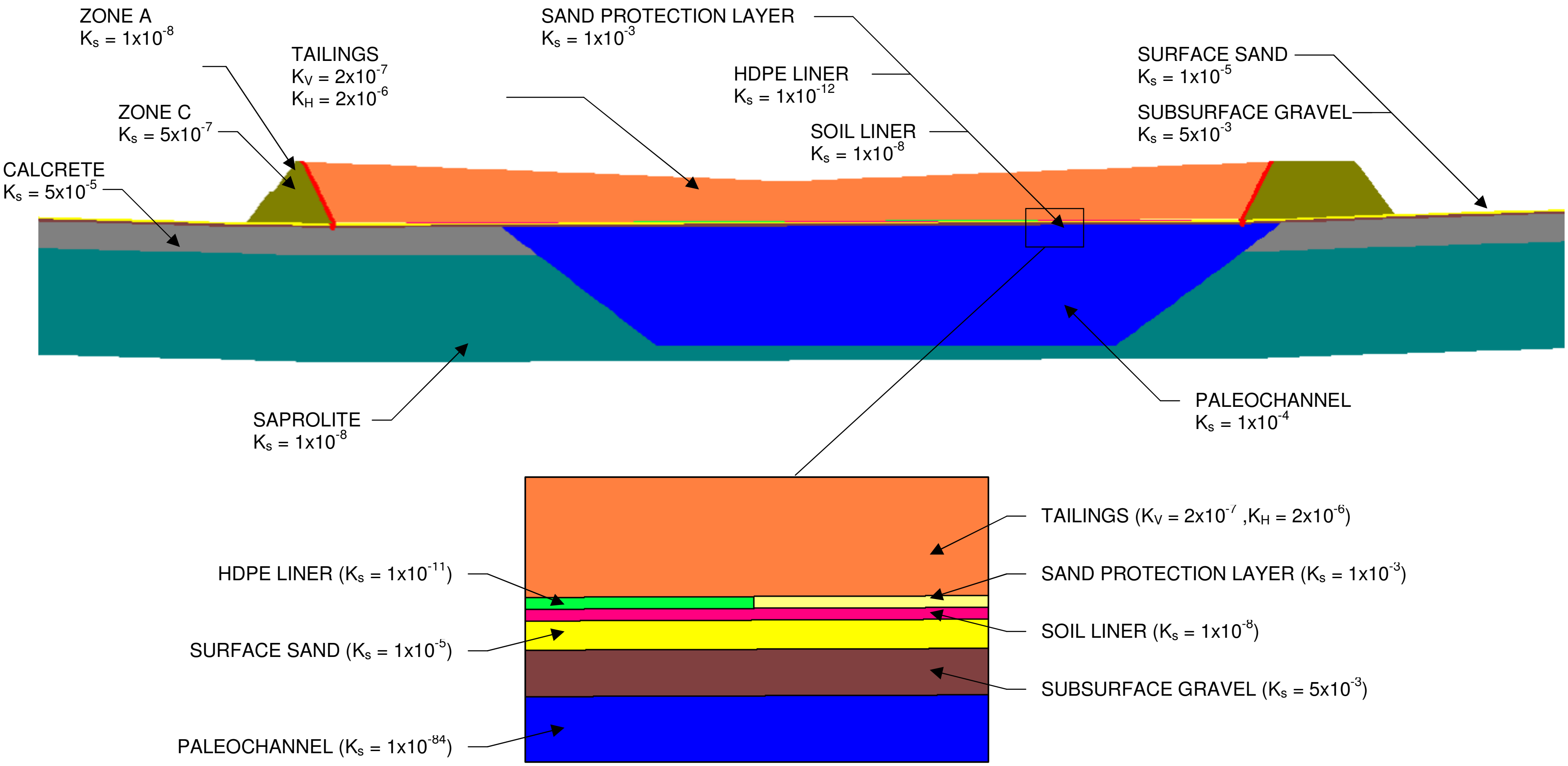
TROPICANA GOLD PROJECT
TAILINGS STORAGE FACILITY SEEPAGE MODELLING
TYPICAL EMBANKMENT SECTIONS

Ref: PE801-83-EMEM-KP019
Figure 2
Rev: 0



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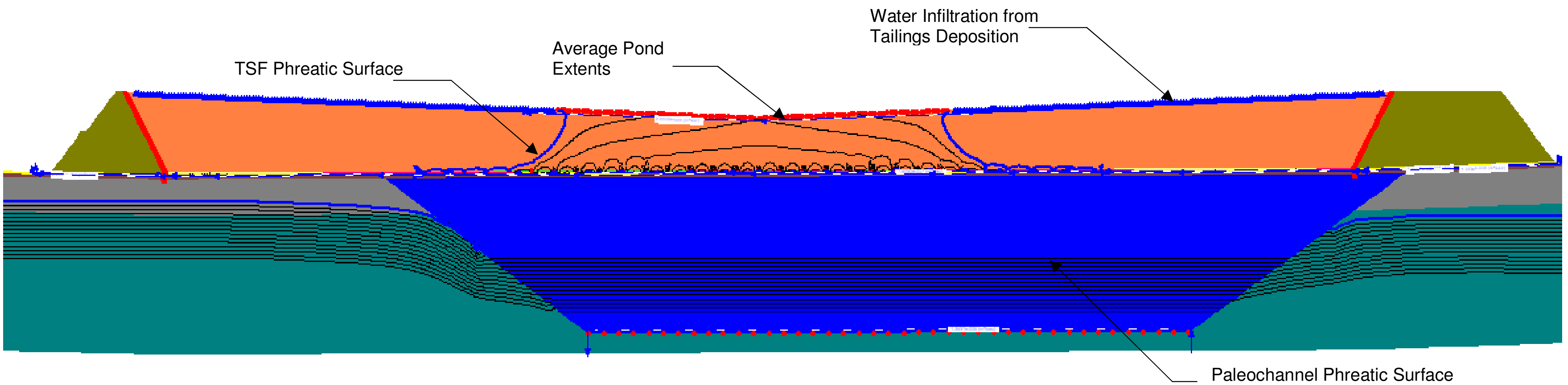
TROPICANA GOLD PROJECT
TAILINGS STORAGE FACILITY SEEPAGE MODELLING
MODEL

Ref: PE801-83-EMEM-KP019
Figure 3
Rev: 0



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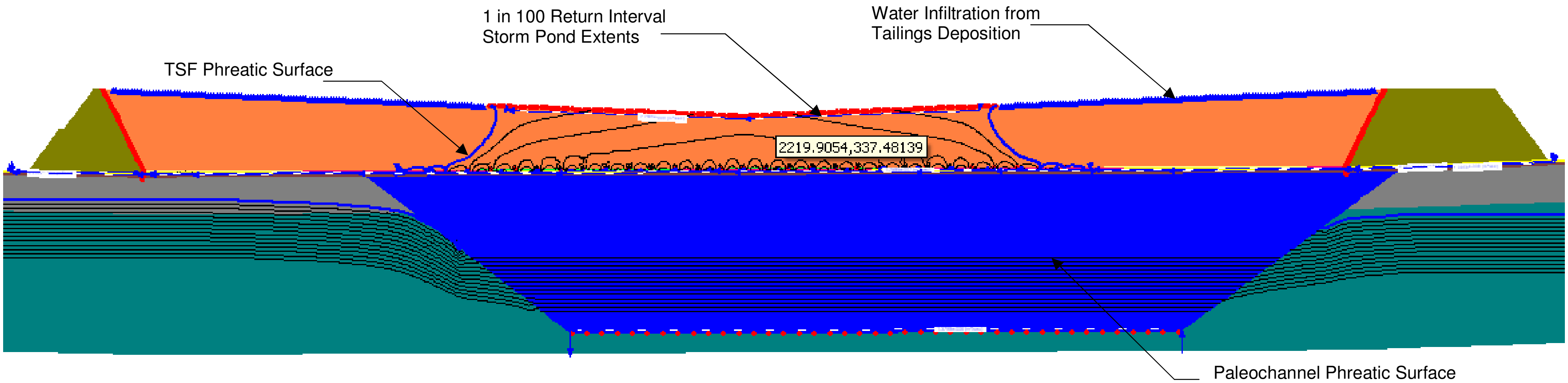
TROPICANA GOLD PROJECT
TAILINGS STORAGE FACILITY SEEPAGE MODELLING
PRESSURE HEAD - AVERAGE CONDITIONS

Ref: PE801-83-EMEM-KP019
Figure 4
Rev: 0



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TROPICANA GOLD PROJECT
TAILINGS STORAGE FACILITY SEEPAGE MODELLING
PRESSURE HEAD - WET CONDITIONS

Ref: PE801-83-EMEM-KP019
Figure 5
Rev: 0