

KALGOORLIE CONSOLIDATED GOLD MINES



Kaltails Seepage and Groundwater Management Plan

October 2014

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1 INTRODUCTION

Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) operations include the Fimiston Open Pit, Mt Charlotte Underground Mine and the Fimiston and Gidji Processing Plants. KCGM is the management company of the Kalgoorlie Operations for the Joint Venture Owners; Barrick Australia Pacific Ltd (50%) and Newmont Asia Pacific Ltd (50%).

KCGM was formed in 1989 by the amalgamation of several small scale mining operations along Kalgoorlie's Golden Mile ore body. KCGM's mining operations are currently projected to continue until 2019 and mineral processing until 2029.

Gold ore from KCGM's mining operations is processed at the Fimiston Plant, which is located on the eastern side of the Fimiston Open Pit. Tailings generated by the Fimiston Plant are deposited into the Fimiston I, Fimiston II or Kaltails Tailings Storage Facilities (TSFs).

The Kaltails TSF was formerly a part of the Kalgoorlie Tailings Retreatment Project (Kaltails) - a joint venture project between Normandy Australia LTD and the Western Australian Mint. It was in operation during the period 1988 through to 1999. A rise in groundwater levels early in the life of this operation caused detrimental impacts to the vegetation to the south of the TSF. A loss of vegetation was evident peripheral to the TSF and from the timber reserve further to the south. Seepage management activities implemented at the Kaltails TSF in 1992 subsequently controlled the rising groundwater levels.

KCGM has undertaken extensive groundwater modelling and studies to ensure that the Kaltails TSF can be recommissioned without further impact to vegetation in the surrounding area. Potential impacts from recommissioning the Kaltails TSF on surrounding vegetation including the conservation reserve, is considered manageable through implementation of the KSGMP. This is supported by the EPA who noted in Bulletin 1273 (Dec 07) that; *"With appropriate management from recommissioning, seepage from the historic Kaltails tailings dam is unlikely to cause any further environmental impact."*

Groundwater in the vicinity of the Kaltails TSF is saline with total dissolved solids (TDS) concentrations varying from background levels of 40,000 mg/L to >100,000 mg/L. The quality of this groundwater is not suitable for potable or agricultural use (stock water and irrigation). The Beneficial Use of the groundwater in the Goldfields region is recognised by the DER as that defined in the Goldfields Groundwater Area Management Plan (Water Authority, 1994); for the purpose of mining related activities including mineral processing.

Where applicable, this Kaltails SGMP incorporates the current KCGM practices used at the Fimiston TSFs to control seepage and groundwater. However there are a number of factors specific to the Kaltails TSF which required consideration during development of this plan including:

- Natural land surface elevations around the Kaltails TSF mean that the aquifer is shallower (i.e. closer to the surface) than at the Fimiston TSFs (the shallow water table is expected to pre-date all influences from mining activities).
- The Kaltails TSF is on the fringe of the approved Historical Groundwater Model for Fimiston TSFs, therefore a model specific to the vicinity of the Kaltails TSF was required.

- Different performance indicators for the different infrastructure being used e.g. use of electric rather than air bores, greater reliance upon seepage interception trenches.

The KSGMP is intended to be a live document which will evolve from the experience gained during operations, routine performance review and feedback from regulators and other stakeholders. This KSGMP represents KCGM's management strategy for the Kaltails TSF incorporating requirements of the DER Licence to Operate. It also provides additional contextual information with regards to the target setting philosophy for the Kaltails TSF.

2 STANDARDS

2.1 DER Licence

The Department of Environment Regulation (DER) Licence L6420/14 requires KCGM to:

- Operate the Kaltails TSF in line with:
 - Table 3.8.1 (groundwater level limit and groundwater monitoring);
 - Table 3.8.2 (groundwater level actions);
 - Table 5.2.1 (FSGMP);
 - Condition 3.1.1 (groundwater monitoring);
 - Schedule 1 Map 1 & 2 (vegetation monitoring).
- Take measures to further reduce groundwater levels to protect native vegetation, when advised by the DER.
- Prepare quarterly reports presenting the results of the monitoring program required by Table 5.2.2.
- Advise the DER in writing within 24 hours of becoming aware of an exceedance as listed in Table 5.3.1.
- Prepare an Annual Environmental Report as required by Table 5.2.1.
- Provide to the DER an annual audit compliance report as required by Condition 5.1.3.

2.2 DoW Licence

The Department of Water (DoW) Licence to Take Water GWL159860(3) requires that KCGM:

- Operate the Kaltails TSF Borefield in accordance with conditions specified in the current Operating Strategy.
- Prepare annual reports on the required groundwater data from the Kaltails TSF Borefield.

2.3 Construction and Decommissioning of Bores

New monitoring bores and production bores that are established within the KCGM Kaltails TSF Borefield will be constructed according to the requirements of the DER, and to relevant guidance contained in the following:

- National Minimum Bore Specification Committee - *Minimum Construction Requirements for Water Bores in Australia* (3rd edition, 2012).
- Department of Water (DoW), *Water Quality Protection Guideline No 4 - Installation of Mine Site Groundwater Monitoring Bores*.

If there is an inconsistency in construction standards, the requirements specified by the DER will take precedence over those specified in the *Minimum Construction Requirements for Water Bores in Australia*.

The reporting of details of newly constructed monitoring bores and production bores will be carried out in-line with DoW requirements.

2.4 Collection and Analysis of Groundwater Samples

Groundwater sampling conducted within the scope of this KSGMP is collected according to Australian Standard 5667.1-1998. Groundwater samples are submitted for analysis to a laboratory with current NATA Accreditation, and in accordance with the "Standard Methods for Examination of Water and Wastewater-APHA-AWWA-WEF".

Groundwater samples requiring only pH and EC analysis during the monthly monitoring programme are completed by field determination of pH and EC.

3 OBJECTIVE

The primary objective of the KSGMP is to prevent impact to vegetation as a consequence of rising groundwater levels due to seepage from the Kaltails TSF.


The secondary objective of the KSGMP is to manage the groundwater levels post closure. The Kaltails TSF Borefield will require active management after cessation of TSF operation. Groundwater levels are expected to stabilise over time, with gradual reduction in pumping volumes. It is anticipated that groundwater will naturally deepen toward estimated historical groundwater levels for this area in the long term.

4 GROUNDWATER LEVEL MANAGEMENT

The primary focus of the KSGMP is groundwater level management as the major environmental value in the area around the TSF is vegetation. Protection of vegetation requires the depth to groundwater to be maintained sufficiently deep so as not to impact on the soils or roots from which plants source water.

Groundwater level management is most difficult in the immediate proximity of the TSF with this area having the greatest potential to fluctuate. This fluctuation is due to operational changes in deposition of tailings within the facility and the supernatant pool on the TSF surface. The majority of the production bores in the Kaltails TSF Borefield are located within 100m of the Kaltails TSF.

The Operational Area of the TSF includes the footprint of the facility plus a halo around the perimeter as shown in Appendix 1, in which infrastructure associated with the



operation of the facility is located. The halo is a maximum of 100m wide or within the premises boundary. In the case of the Kaltails TSF this operational area equates to about 20% of the TSF footprint and is considered part of the facility. The size of the Operational Area halo is subject to annual review to ensure that it remains appropriate.

Groundwater level targets for the Kaltails TSF have been developed based upon existing vegetation assemblages (particularly salinity tolerance and root depth) and current and historical groundwater levels in the area.

The Kaltails TSF is located on the edge of a floodway and there is a substantial fall in ground level elevation across the facility. These natural ground level elevation changes mean that the aquifer is significantly shallower (i.e. closer to the surface) in some areas. Depth to groundwater at the Kaltails TSF ranges from >15mBGL to the northeast to <2mBGL to the southwest.

This groundwater level variation has resulted in marked differences in the type and quality of vegetation assemblages that exist around this facility. Where as the historical depth to groundwater contours across the Fimiston TSFs are relatively flat and deep – prompting a single depth to groundwater target – the degree in variation across the Kaltails facility warrants that different targets to be set for different zones.

It may not be practical to lower groundwater levels within this Operational Area below 4 mBGL while the TSF is operational and so this area is not considered as part of the primary goal of the KSGMP. This Operational Area is also recognised in DER Licence, with several licence conditions only applicable to bores outside the TSF Operational Area (Compliance Bores).

4.1 Operation of Kaltails TSF Borefield

Two distinct depth to groundwater targets are applied to the Kaltails TSF during operation. The boundaries separating these target zones are largely based around the requirements of the identified vegetation assemblages surrounding the TSF. In addition to this however, these zones also take in to consideration all of the factors that apply to closure target setting.

The first zone – Zone A – is the larger zone and encompasses the majority of the area surrounding the Kaltails TSF (Appendix 1). Vegetation surveys conducted during 2009 identified this area as mainly transitional Eucalyptus open woodland. The proposed target depth to groundwater for Zone A is 6mBGL with a limit of 4mBGL. This is consistent with the current Fimiston target which has been effective in protecting Eucalypt woodland vegetation.

It is proposed that the western boundary of Zone A is the boundary of Prospecting Lease P26/2373. The second zone – Zone B applies to the area to the southwest of the Kaltails TSF (Appendix 1). The target depth to groundwater for Zone B is 2mBGL with a limit of 1mBGL. The northern and eastern boundaries of this zone have been established based on vegetation surveys conducted during 2009.

Toward the southwest and to Hannan's Lake the groundwater table naturally tends toward surface and so there must be some limit to which this target applies in this direction. Zone B is defined by an alignment from the southern boundary of General Purpose Lease G26/165 to the south and by the western boundary of the Prospecting Lease P26/2373 to the west.

The depth to groundwater targets for the Zone A and Zone B areas surrounding the Kaltails TSF (Appendix 1) are set out in Table 1.

Table 1: Groundwater Level Targets for the Kaltails TSF		
Area	Minimum Target Depth to Groundwater (mBGL)	Stretch Target Depth to Groundwater (mBGL)
Zone A	4	6
Zone B	1	2

4.2 Groundwater Level Trends

Groundwater levels and trends in a Kaltails TSF Borefield Compliance Monitoring Bores are to be reviewed during the preparation of the quarterly report to DER. Depending on groundwater levels and trends, a decision will then be made as to whether an increase in groundwater recovery capacity is required according to the current DER Licence (Table 2).

An increase in pumping capacity can be achieved by:

- Maximising the use of near-by production bores,
- upgrading existing infrastructure, such as pumps and pipelines, and
- construction of new production bores.

Table 2: DER Licence: Required Actions for Groundwater Level & Quality Targets		
Emission Point Reference	Event	Management Action
Kaltails Zone A Monitoring Bores	Groundwater level <4 mBGL	Increase pumping capacity within 6 months
	Groundwater level >4 mBGL and <mBGL	Increase pumping capacity within 9 months
Kaltails Zone B Monitoring Bores	Groundwater level <1 mBGL	Increase pumping capacity within 6 months
	Groundwater level >1 mBGL and <2mBGL	Increase pumping capacity within 9 months
Kaltails Compliance Bore	Groundwater quality results >0.50 mg/L WAD CN	Increase pumping capacity within 9 months

Short-term increases in groundwater levels in response to significant rainfall events do not necessarily trigger the requirement to increase pumping capacity.

The results of the quarterly assessment of groundwater levels and trends are presented and discussed in the quarterly report to the DER.

The key steps/factors that determine the timeframe required for new bore installation are as follows:

- Expert consultation on water level trend – whether long/short term or event related (rainfall).

- Identification of bore locations.
- Licence application and approval to construct bores.
- Drilling contractor availability.
- Equipping of bores and possible upgrading of related services (air, power, and piping).

The number of groundwater production bores will progressively be increased, where required, to achieve a stretch target depth to groundwater >6mBGL outside the Operating Area of the TSF.

4.3 Management of TSF Supernatant Pool Size

The supernatant pool size is a significant contributor to the seepage rate. To limit the potential for seepage, the size of the supernatant pools on top of the Kaltails TSF will be kept to a minimum. Pool size is monitored through a combination of daily visual inspections and fortnightly area surveys with the rate of reclamation of this water being adjusted to maintain target levels.

The aim is that the pools will be maintained below a maximum of 15% of the total surface area of the paddock in which deposition is occurring. The paddock surface area will be that value determined by survey upon the completion of each wall raise.


In the event that the area of the supernatant pool becomes greater than the target size (e.g. high rainfall), decant water from the TSFs will be used as a priority for mineral processing in preference to groundwater derived from remote saline water borefields (i.e. the Northern Borefield and Southern Borefield).

4.4 Long Term Groundwater Level Targets

The Kaltails TSF is located on the extreme fringe of this model and simply extending the contours developed from the Fimiston HGLR was not considered appropriate. A separate historical groundwater model has been developed for Kaltails TSF, this model indicates a depth to groundwater ranging from approximately 17mBGL on the northeast point of the facility to 4mBGL on the southwest, were groundwater shallows to near surface as the floodway approaches Hannan's Lake.

Whilst the Kaltails historical groundwater model forms a substantial consideration in determining the final depth to groundwater targets for this facility upon closure, numerous other factors must be considered including:

- The changes to the natural topography,
- The hydrological behaviour,
- The impact of surface water drainage lines on groundwater levels,
- Previous operating history,
- The current environmental values of the area,
- The impact of neighbouring operations, and
- The overall purpose and intent.



It is unlikely that substantial further improvements to the water levels in the vicinity of the TSFs will be achievable during operations, particularly in those areas close to the TSFs. Simplistic single level targets will be unachievable as a long term objective in a natural groundwater regime with no active pumping bores.

The long term management targets for the TSFs and associated reduction in groundwater levels will be developed within the framework of the KCGM Closure Plan. As a requirement of Ministerial Statement 782, KCGM submits a Closure Plan every three years. The Closure Plan approval process allows for review by numerous regulatory agencies and the integration of their requirements to be considered for long term strategies.

5 GROUNDWATER QUALITY MANAGEMENT

5.1 Monitoring

The monitoring programme for groundwater quality is specified in the current DER licence. Sampling results shall be presented in the quarterly reports to the DER, and in the annual groundwater monitoring review to the DoW.

5.2 Groundwater Recovery

All groundwater that is recovered from the Kaltails TSF Borefield is returned to the Fimiston Processing Plant. The operation of this system has priority over the sourcing of water from other borefields.

Groundwater quality and trends are to be reviewed quarterly. Depending on the results and in consultation with the DER, the requirement for additional groundwater pumping capacity may be identified.


Electrical conductivity, WAD cyanide and other Trace Elements may be useful indicators of seepage from the TSFs. A combination of these may be used to define the recovery priority within the context of the Beneficial Use of the groundwater being suitable only for mining related activities including mineral processing.

Groundwater targets relating to recovery specified in the current Fimiston DER Licence, require KCGM to increase groundwater recovery capacity within six months of becoming aware that groundwater levels in Monitoring Compliance Bores are shallower than 6mBGL or within nine months of becoming aware of levels greater than 0.50mg/L WAD CN.

Should monitoring trigger a need for increased groundwater recovery KCGM shall include these details in the subsequent quarterly report to the DER.

6 VEGETATION MONITORING

To confirm that the KSGMP is protecting the environmental value of the area (i.e. vegetation), KCGM has implemented a vegetation monitoring programme for the Kaltails TSF (Appendix 2). The requirements for the vegetation monitoring programme are specified in the current DER Licence.



The Kaltails TSF Vegetation Monitoring Programme was adapted from the Fimiston TSF Vegetation Monitoring Programme, with results from this vegetation monitoring programme reported annually as part of the KCGM Annual Environmental Report, submitted by 31st March each year.

Future revisions and refinement of the monitoring program are anticipated as knowledge of the vegetation health is gathered over time, changes would be made with the support of the DER. Results from the monitoring program are reported as part of the KCGM Annual Environmental Report submitted by 31st March each year.

Where possible, KCGM will also undertake opportunistic tree root investigations to gain a better understanding of Eucalypt root depths in the areas surrounding the Kaltails TSF.

7 REVIEW

It is intended that performance against the KSGMP will be audited annually. The KSGMP may be periodically revised by KCGM based upon audit findings as well as recommendations from the DER or other key stakeholders.

Groundwater data will be reviewed and reported to the DER on a quarterly basis. This will continue and will include commentary on performance against KSGMP targets.

The review of the groundwater component of the KSGMP will be completed by an experienced, independent groundwater hydrogeologist.

The review of the vegetation monitoring component of the KSGMP will be completed by an experienced, independent vegetation specialist.

8 DELIVERABLES

The scope of the KSGMP has a number of objectives and targets detailed in Table 3 and Table 4. Any changes to delivery dates will be made in consultation with the DER.

The achievement of all targets in the KSGMP is not necessary to confirm the success of this plan. The measure of success is that the Beneficial Use of the groundwater and condition of the vegetation around the TSF are not being impacted.

Table 3: KSGMP Objectives and Targets		
Item	Objective	Target
TSF Pool Size	Minimise the pool size by operating within a target area.	<15% on the operating paddock under routine operation.
Groundwater Level	Maintain groundwater level targets.	Maintain groundwater depth >6 mBGL in Monitoring Compliance Bores in Zone A. Maintain groundwater depth >2 mBGL in Monitoring Compliance Bores in Zone B.
Groundwater Quality	Maintain groundwater level targets	Maintain groundwater quality <0.5 mg/L WAD cyanide in all Monitoring Compliance Bores.
Vegetation Monitoring	Assess the effectiveness of the KSGMP.	To demonstrate the ongoing effectiveness of the KSGMP.

Table 4: SGMP Specific Actions			
Item	Objective	Actions	Timing
Groundwater Reports	Presentation of Monitoring results from the sampling programme specified in the DER licence.	Reports to be submitted 46 calendar days after the reporting period	Quarterly
Vegetation Monitoring	Vegetation monitoring aspect of KSGMP to be completed.	Vegetation Monitoring to be completed by external consultant in accordance with agreed programme.	Annually
	Confirm that the KSGMP is protecting the environmental value of the area. Vegetation monitoring aspect of KSGMP to be reported.	Vegetation Monitoring report prepared by external consultant to be submitted to DER as part of the AER.	Annually
KSGMP Audit	KSGMP performance to be reviewed.	Audit Review to be undertaken by external consultant as per licence conditions.	Annually
		Draft Audit Report to undergo public consultation via the CRG.	Annually
		Final Audit Report to be submitted to the DER as per licence conditions.	Annually
KSGMP Review	KSGMP document to be reviewed and updated.	Review of KSGMP to be undertaken by KCGM (including feedback received via Audit Review).	Annually



GLOSSARY OF TERMS

Annual: A twelve (12) month period.

Beneficial Use: The current or future uses of an identified resource. Beneficial Use is also referred to as the Environmental Value of a resource. Beneficial use designations provide objectives for the management, use and protection of the resource.

Bore: A narrow, normally vertical hole drilled in soil or rock to monitor or withdraw groundwater from an aquifer.

Borefield: A group of bores to monitor or withdraw groundwater.

BGL: Is the groundwater level or depth below ground level.

Compliance Bores: Those bores outside the Kaltails TSF Operational Area and within designated Zone A and Zone B as shown in Appendix 1.

Cyanide (WAD): (Weak Acid Dissociable) is a measure of the concentration of cyanide ions that when mixed in a weak acid will revert to the free cyanide state. This value includes the free cyanide concentration.

Decant Water: Is water recovered from the tailings storage facility surface after the solids (tailings) have settled.

DER: Department of Environment Regulation.

DMP: Department of Mines and Petroleum.

DoW: Department of Water

Kaltails TSF Borefield: This is the bore network that is constructed around the Kaltails TSF and comprises all of the Production and Monitoring Bores and associated infrastructure. This is distinct from the Kaltails Borefield which is a saline water supply borefield located approximately 5km further to the southeast.

Electrical Conductivity (EC): A measure of the electrical current transferred through water. The EC of water is a relatively reliable indicator of its TDS or Salt content.

Environmental Value: A quality, characteristic or attribute that is conducive to ecological health or any beneficial use, which requires protection from the effects of pollution, waste discharges and deposits. Two types of environmental value are considered, ecological and social.


KSGMP: Kaltails Seepage and Groundwater Management Plan.

Groundwater: Any water contained below the earth's surface. It includes moisture contained inside soil and rock, and water accumulating in gaps between soil particles and in cracks in the rock.

Groundwater Level: The upper surface of groundwater, or the level below which an unconfined aquifer is permanently saturated with water, (also known as water-table, piezometric level).

Groundwater Quality: The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

Historic Groundwater Levels: Depth to groundwater that is agreed to be reasonably indicative of natural levels that occurred prior to operations commencing.



Increased Pumping Capacity: Increased abstraction of groundwater from an area which may be achieved by additional bore installation, pump or pipeline upgrade.

Licence: A statutory document, issued under Part V of The Environmental Protection Act, permitting a person or organisation to discharge, emit, or deposit wastes into the environment subject to a variety of conditions relating to control measures, monitoring, volume, timing, nature, and composition of waste. Licences may often be varied or rescinded at any time. Breaches of licence conditions may result in prosecution.

Monitoring: Is the process of sampling and measuring certain parameters.

Monitoring Bore: A small diameter bore that is used for monitoring groundwater quality and groundwater levels. These are not used for groundwater extraction and are not typically able to be equipped to become a Production Bore.

NATA: National Association of Testing Authorities.

Operational Area: The area of the Kaltails TSF that includes the immediate footprint of the facility plus a halo around the perimeter in which infrastructure associated with the operation of the facility is located. The halo is a maximum of 100m wide.

pH: a measure of the acidity or the basicity of a solution ranging on a scale from 0 (acidic) to 7 (neutral) to 14 (basic).

Pumping: Extraction of water from saturated soil (groundwater) using an electric, wind powered or compressed air pump and bore hole.

Production Bore: A large diameter bore that is primarily used for extracting groundwater to lower the groundwater level. It is usually permanently equipped with a pump and associated power and pipeline services.

Paddock: An area which the TSF is divided into which the tailings slurry is deposited. The Kaltails TSF is a two paddock facility.

Potable: Water of a quality suitable for drinking.

Quarterly: A three (3) month period.

Seepage: Water infiltration into the soil beneath the TSF.

Supernatant Pool: This is the pool of water that forms on the surface of an active TSF paddock and comprises water that has bled to the surface from the tailings slurry as it settles. The water then flows to the low point on the TSF surface from where it is reclaimed for reuse in the Plant.


Tailings: Finely ground rock from which minerals have been removed which may include process chemical residues; discarded portion of the ore.

Tailings Storage Facility (TSF): An engineered structure (holding area) that consists of embankments designed for storing tailings usually with a mechanism to recover water for re-use.

Total Dissolved Solids (TDS): A measure of the weight of dissolved solids in water. This is the salt content of the water.

Trace Elements: Elements that occur at very low concentrations.

Transect: A common ecological tool used to observe vegetation along a defined path.



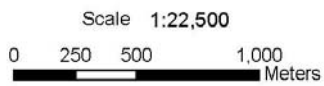
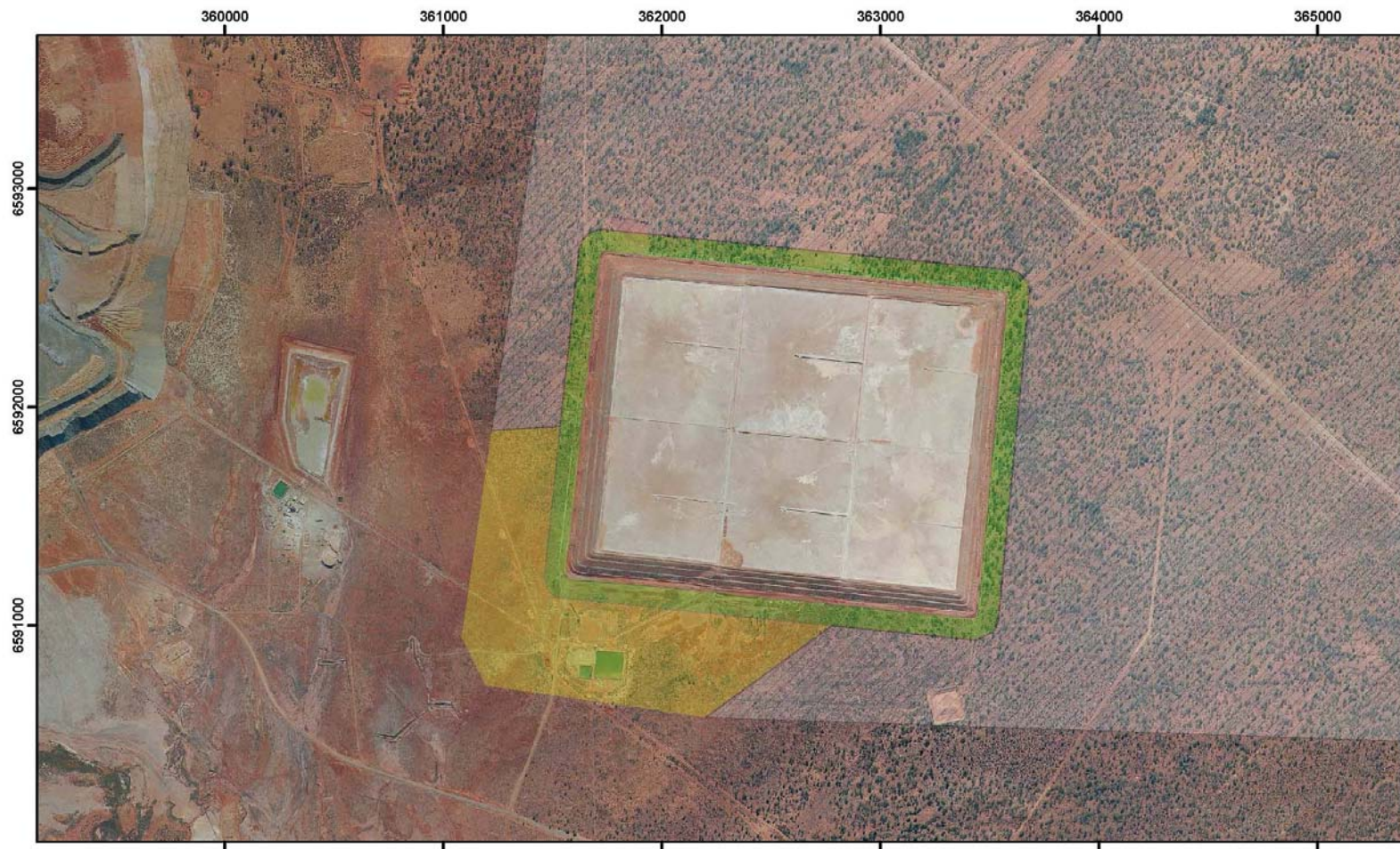
Water Table: The upper surface of the groundwater. The zone immediately below the watertable is saturated. The aim of the Groundwater Management Plan is to keep the watertable at least 4 metres from the soil surface.

HGLR: Historical Groundwater Level Review.



Appendix 1

Kaltails TSF Groundwater Target Zones including the TSF Operational Area Halo



- Legend**
- ZONE B
 - ZONE A
 - TSF OPERATIONAL AREA



KALTAILS GROUNDWATER ZONES



Appendix 2

Kaltails TSF Vegetation Monitoring Programme

Kaltails TSF Vegetation Monitoring Programme

1 Introduction

In 2006 Kalgoorlie Consolidated Gold Mines (KCGM) released a Public Environmental Review (PER) – Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning which included the option of recommissioning the Kaltails TSF. The primary purpose of a PER is to provide information on how a proposal may impact the environment and how those impacts may be mitigated and managed so as to be environmentally acceptable.

A rise in saline groundwater levels early in the Kaltails TSF operation in the 1990s caused detrimental impacts to the vegetation to the south of the TSF, including that within the timber reserve, Lakeside Miscellaneous Conservation Reserve (No. 19214), to the south. This reserve was declared in 1957, is managed by Department of Environment Regulation (DER) for the preservation of sandalwood (*Santalum spicatum*). The reserve is located approximately 800 m to the south-southeast of the Kaltails TSF (Figure 1). The area affected by seepage was excised from the conservation reserve in 1995. Seepage management activities implemented at the Kaltails TSF in 1992 subsequently controlled the rising groundwater levels.

Potential impacts from recommissioning the Kaltails TSF on surrounding vegetation including the conservation reserve, is considered manageable through implementation of the Kaltails Seepage and Groundwater Management Plan (SGMP). Management of groundwater levels under the SGMP requires the depth to groundwater to be maintained sufficiently deep so as not to impact on the soils or roots from which plants source water. To confirm that the SGMP is protecting the environmental value of the area surrounding the Kaltails TSF (i.e. vegetation), KCGM undertakes a vegetation monitoring programme.

2 Vegetation Monitoring Programme Overview

In 2005, KCGM engaged a suitably qualified professional to review the Fimiston TSFs vegetation monitoring programme. The findings of this 2005 review have also been considered and incorporated into this Kaltails TSF vegetation monitoring programme. The findings were that:

- Photographic monitoring was deemed to be an adequate monitoring technique;
- Photographic monitoring should cover vegetation surrounding the entire TSF; and
- Landscape Function Analysis (LFA) monitoring should be implemented in conjunction with photographic monitoring to give a more robust assessment of vegetation health.

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LFA gives additional information to assess vegetation condition and provides a scientific data component. LFA is a monitoring procedure that assesses the functional performance of a developing ecosystem, including the assessment of factors such as nutrient cycling, water management and species composition and diversity.

The combination of LFA and photographic monitoring enhances the quality and quantity of monitoring relating to vegetation surrounding the TSF, which will help to demonstrate the effectiveness of the SGMP to protect the environmental value of the area.

This programme is conducted as per licence requirements:

12. The licensee shall undertake a vegetation monitoring programme along transects as shown in Attachment 6 and Attachment 7, near the Fimiston TSF and the Kaltails TSF. The programme shall be in the following schedule:

- a. transects shall link between monitor bores or identifiable field markers;*
- b. photographs shall be taken at intervals to record key vegetation features along each transect;*
- c. photographs shall be taken annually in early spring, at a fixed focal length, and away from the facility to standardise the information gained; and*
- d. a professional photographer or technician skilled in vegetation identification and sampling shall be engaged in this work.*

14. The licensee shall provide a report on the vegetation monitoring programme required in condition 12 as a part of the Annual Environmental Report required by condition 20. This report shall include a copy of the photographic record for that year and assessment of the vegetation by a suitably qualified professional.

An additional photographic monitoring point (No. 24) has also been monitored annually since 2012 annually satisfy commitments in the Section 45 C Application for Kaltails TSF.

Given the history and proximity of the Lakeside Miscellaneous Conservation Reserve to the south-southeast of the Kaltails TSF, KCGM has included a LFA and photographic monitoring site in the northern corner of the Reserve (Figure 1). KCGM understands that the requirement to submit a Regulation 4 application to access the reserve has been superseded by tenement condition 3 for G26/110:

“At least five working days prior to accessing the reserve, unless otherwise agreed with the relevant DEC Regional Manager (DEC-R), the holder providing the DEC-R with an itinerary and program of the locations of operations on the licence area and informed at least five days in advance of any changes to that itinerary. All activities and movements shall comply with reasonable access and travel requirements of the DEC-R regarding seasonal/ground conditions.”

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Pre 2012, KCGM engaged a professional photographer to conduct the photographic monitoring in conjunction with qualified botanical consultants, who produced the final reports. In 2012, it was decided that the botanical consultants were sufficiently qualified to conduct the photographic monitoring as part of the LFA monitoring.

A summary of the programme is outlined below:

Site Name	Monitoring Points	Number of Photos	Number of LFA Sites
15 - 22	8 LFA and photo sites	32	8
Analogue 3	1 Analogue Site	4	1
23	1 LFA and photo site on Timber Reserve	4	1
24	Photo site at South West Corner of TSF	4	0
Total		44	10

Photographic and LFA monitoring will be conducted annually in early spring by a professional photographer or technician skilled in plant identification. The findings will be reported each year in the KCGM Annual Environmental Report.

The monitoring programme is outlined in Appendix 1. The table indicates the specific monitoring undertaken at each site. Location plans of the vegetation monitoring programme are shown in Figure 1.

Timing	Action
August	Organise consultant/photographer to complete the annual Photographic Vegetation Monitoring and LFA monitoring in early Spring (September) <i>At least 5 days prior to accessing the Timber Reserve, the Kalgoorlie Branch of the DER must be notified by email of the intent to monitor.</i>
September	Photographic and LFA Monitoring to be conducted
October – December	Report to be written by consultant and reviewed by KCGM
March	Report to be submitted to DER as part of the AER

2.1 Outcomes and Reporting

If the annual monitoring report indicates that health of the vegetation surrounding the TSFs is declining, an AIRS record is to be raised and depending on the severity of the vegetation response, investigated accordingly as per ***KIMS Management Standard – Incident Investigation***, with any preventative or corrective actions identified and managed in an action plan in accordance with ***KIMS Management Standard – Preventative and Corrective Actions***. Part of this investigation will

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include a review of groundwater levels in the affected area and any other potential activities (not necessarily KCGM) or conditions that may have caused a decline in vegetation health, for example;

- disease,
- natural senescence,
- fire,
- climatic conditions (below average rainfall),
- natural water logging in flood prone areas, and,
- illegal vegetation clearing in publically accessible areas,

The findings of monitoring shall be reported as an Appendix each year in the KCGM Annual Environment Report (DER). A brief summary of the vegetation monitoring should be included in the AER text which details:

- Findings of annual vegetation health monitoring,
- where vegetation health was shown to be declining as a result of seepage, KCGM actions to address declining vegetation health, and,
- where applicable, a review of any areas previously recorded as declining and a status update on any actions resulting from previous investigations.

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Appendix 1: Kaltails TSF Vegetation Monitoring Programme Detail

Transect	Photo Direction and Distance	Photo Monitoring	LFA Monitoring
15	TSF Corner - SW (0m, 100m, 200m, 300m)	4	1
16	TSF Wall - W (0m, 100m, 200m, 300m)	4	1
17	TSF Corner - NW (0m, 100m, 200m, 300m)	4	1
18	TSF Wall - N (0m, 100m, 200m, 300m)	4	1
19	TSF Corner - NE (0m, 100m, 200m, 300m)	4	1
20	TSF Wall - E (0m, 100m, 200m, 300m)	4	1
21	TSF Corner - SE (0m, 100m, 200m, 300m)	4	1
22	TSF Wall - S (0m, 100m, 200m, 300m)	4	1
23	Timber Reserve – N (0m, 100m, 200m, 300m)	4	1
Analogue 3	SW (0m, 100m, 200m, 300m)	4	1
24 (MB K04)	SW (0m, 100m, 200m, 300m)	4	0

Figure 1:
Kaltails TSF Vegetation Monitoring Location Plan



Kaltails TSF Vegetation Monitoring Locations



0 0.2 0.4 0.8 1.2 1.6 Kilometers

Coordinate System: Oroya East

- LFA
- Photo Transects
- Timber Reserve

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