



**Fimiston Operations**  
**Seepage and Groundwater**  
**Management Plan**



*Greening the Golden Mile*

Version	Revised By	Approval		Date	Reason for Change
		Manager	Document Owner		
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## 1. INTRODUCTION

Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) manages the mining and ore processing operations at the Fimiston Open Pit (Super Pit) and Mt Charlotte Underground gold mines on behalf of joint owners Barrick Gold of Australia Ltd and Newmont Asia Pacific Ltd. 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 2017.

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

Tailings disposal in the Fimiston I and Fimiston II TSFs has caused groundwater mounds to develop in the natural formations surrounding these TSFs. KCGM has been actively managing seepage from these facilities since the early 1990s by monitoring groundwater levels and hydrochemistry, and recovering seepage by means of production bores and seepage interception trenches. Monitoring of groundwater levels and hydrochemistry, and production of groundwater by the bores and trenches has been authorised and licensed by the appropriate state government agencies (currently the Department of Environment and Conservation (DEC), and Department of Water (DoW)), and performance against the requirements of these licences are routinely reported to the agencies by KCGM.

Natural groundwater in the vicinity of the Fimiston I and Fimiston II TSFs is saline with total dissolved solids (TDS) concentrations from >20,000 – 50,000 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 DEC as that defined in the Goldfields Groundwater Area Management Plan (Water Authority, 1994). Based on this Plan, the primary Beneficial Use is for the purpose of mining and mineral processing.

In 2003 KCGM submitted a Notice of Intent (NOI) to the Department of Industry and Resources (DoIR) to increase the maximum height of the Fimiston I TSF from 30 m to 40 m. As a consequence of the review of this NOI, which included a referral to the Environmental Protection Authority, and an independent review by Thompson and Brett Pty Ltd, KCGM has committed to develop a long-term Groundwater Management Plan (SGMP) to oversee the planning and management activities associated with controlling groundwater around the Fimiston I and Fimiston II TSFs.

In response to the Thompson and Brett Report, KCGM was supportive of a management strategy that would allow for the Fimiston I TSF height increase to proceed in a staged manner, with comprehensive checks at each phase. In the EPA Assessment Level Appeals Determination, the Minister for Environment outlined a strategy of staged 2.5 metre increases of the Fimiston I TSF and subsequently a similar staged approval process was applied to the Fimiston II TSF. Progressive raises are subject to KCGM demonstrating that groundwater levels are being managed in accordance with the agreed targets within this SGMP. In addition this plan is subject to annual independent audit and the results will be made available to the public.

This document presents the SGMP for KCGMs Fimiston I and Fimiston II TSFs. It incorporates current KCGM practices and recommendations from the Thompson and Brett Report to manage and control groundwater around the Fimiston I and Fimiston II TSFs, and establishes performance targets for the long-term management of TSF seepage.

The performance targets identify either standards to be maintained, or tasks and the timeframes over which these tasks are to be conducted. Standards cover items such as licence conditions and specifications for the construction of new monitoring or production facilities.

The SGMP was initially developed with the following objectives which were grouped into the following actions:

- Estimate historic groundwater levels.
- Minimise the normal operating supernatant pool area on the TSFs.
- Maximise the performance of the Eastern Borefield.
- Construct additional groundwater monitoring bores.
- Increase the frequency of monitoring groundwater levels.
- Increase the frequency and scope of monitoring groundwater quality.
- Continue vegetation monitoring.

In 2008 the Fimiston Operating Licence was renewed and several additional groundwater monitoring conditions were included. These changes were incorporated into the 2008 review of the SGMP.

In 2009 an appeal was submitted against the renewed licence and two Works Approvals in relation to height increases of the Fimiston I and Fimiston II TSFs. In response to the appeals KCGM committed to review the SGMP and include reference to the following:

- Groundwater level limits;
- Groundwater level targets;
- Groundwater quality targets;
- Vegetation monitoring
- Historical groundwater levels; and
- Staged targets towards meeting the agreed historical groundwater levels.

The current objectives of the SGMP are as follows:

- Minimise the normal operating supernatant pool area on the TSFs.
- Maximise the performance of the Eastern Borefield.
- Monitoring groundwater levels, as per DEC Licence 6420/12.
- Monitoring groundwater quality, as per DEC Licence 6420/12.
- Compare current groundwater levels to target historical groundwater levels to progress towards target accomplishment.
- Monitor Vegetation, as per Fimiston TSF Vegetation Monitoring Programme.

This SGMP for the Fimiston I and Fimiston II TSFs and associated performance targets is reviewed annually, and modifications made where necessary.

This document is the fifth revision of the Seepage and Groundwater Management Plan – originally drafted September 2005.

## 2. STANDARDS

### Licence Conditions

The Department of Environment and Conservation (DEC) Licence 6420/12 requires that KCGM;

- Operate the Fimiston I and Fimiston II TSFs in line with Conditions: 1 (groundwater level limit); 2 (groundwater level target); 3 (groundwater quality target); 4, 5 and 6 (SGMP); 7, 8 and 9 (groundwater monitoring); 10 and 11 (vegetation monitoring).
- Take measures to further reduce groundwater levels to protect native vegetation, when advised by the DEC.
- Prepare quarterly reports presenting the results of the monitoring program required by Condition 7.
- Advise the DEC in writing within 24 hours of becoming aware of an exceedence of any measurement which indicates that the groundwater limit specified in Condition 1 has been exceeded.
- Prepare an Annual Environmental Report as required by Condition 17.
- Provide to the DEC an annual audit compliance report as required by Condition 18.

The Department of Water (DoW) Licence to Take Water GWL66252(5) requires that KCGM;

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

### Construction of Monitoring Bores and Production Bores

New monitoring bores and production bores that are established within KCGM's Eastern Borefield will be constructed according to the requirements of the Department of Environment and Conservation (DEC), and to relevant guidance contained in the following:

- National Minimum Bore Specification Committee - *Minimum Construction Requirements for Water Bores in Australia* (2<sup>nd</sup> ed., 2003).

- 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 DEC 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. Bore construction plans and progress will be outlined to the DEC in the Quarterly Groundwater Reports. New monitoring bores will be added to the borefield monitoring schedule within three months of installation. In consideration of the additional infrastructure and commissioning requirements in the case of new production bores, these will be added to the borefield monitoring schedule within three months of commencement of operation.

### **Collection and Analysis of Groundwater Samples**

Groundwater sampling conducted within the scope of this SGMP is according to Australian Standard 5667.1-1998.

Groundwater samples collected within the scope of this SGMP and subsequently submitted for laboratory analysis are analysed by a laboratory with current NATA Accreditation, and in accordance with the "Standard Methods for Examination of Water and Wastewater-APHA-AWWA-WEF".

### 3. OBJECTIVE

The primary objective of the SGMP is to operate, monitor and develop the Eastern Borefield so as to minimise environmental impact to the local habitat. This is particularly in relation to the prevention of harm to vegetation assemblages as a consequence of rising groundwater levels. The secondary objective of the SGMP is to ultimately restore groundwater levels to agreed targets based upon the historical groundwater levels (Attachment 2) for the region. These targets have been developed in consultation with the DEC and are based upon an assessment of the historical data, reasonable hydrogeological estimations, practicability and intent.

The minimum target depth to groundwater below ground level (BGL) was four (4) metres with a stretch target of six (6) metres. Groundwater level limit and targets are also stated on DEC Licence 6420/12 as Conditions 1 and 2 in relation to the Monitoring Compliance bores.

It is expected that following closure of the TSFs, the Eastern Borefield can be progressively shut down over a number of years and the groundwater level remain at or close to the historical target levels. Once it is confirmed that the groundwater level is stable at or close to the historical target levels without active management, the Eastern Borefield will be decommissioned. It is anticipated that the groundwater will naturally deepen back to a new equilibrium in line with the estimated historical groundwater levels. Post closure the groundwater monitoring data will be reviewed periodically to confirm that the water levels behave as predicted.

#### 4. GROUNDWATER LEVEL MANAGEMENT

The primary focus of the SGMP is groundwater level management as the major environmental value in the area around the TSFs 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.

It must be recognised that groundwater level management is most difficult near to the TSFs with these levels having the greatest potential to fluctuate due to deposition of tailings within the nearby paddock and the location of the supernatant pool on the TSF surface. About two thirds of all the groundwater bores in the Eastern Borefield are within 100m of the TSF for this reason (see Bore Location Plan).

The Operational Area of the TSFs includes the footprint of the facility plus a halo around the perimeter, as shown in Attachment 1, in which infrastructure associated with the operation of the facility is located and limited vegetation exists. The halo is a maximum of 100m wide or within the premises boundary. In the case of the Fimiston TSFs this Operational Area equates to about 20% of the TSFs footprint and is considered part of the facility. The size of the Operational Area halo will be subject to annual review to ensure that it remains appropriate.

It may not be practical to lower groundwater levels within this Operational Area below 4 mBGL while the TSFs are operational and so this area is not considered as part of the primary goal of the SGMP. This is also recognised in DEC Licence 6420/12, with several licence conditions only applicable to bores outside the TSF Operational Area (Compliance Bores).

##### **Historical Groundwater Levels**

In March 2006 the first draft of the Historical Groundwater Level Review was released for public comment. This review determined the extent to which the water table should trend toward during operation and ultimately reach following decommissioning of the TSFs. A contour plan has been developed indicating a reasonable estimate of the spatial distribution of groundwater levels prior to the commissioning of the Fimiston I and Fimiston II TSFs and has taken into account the contemporary setting.

Feedback from the public and DEC was received regarding the first draft of the Historical Groundwater Review and a revised version of the report was released in June 2006. The DEC has provided further comment regarding the review. The final version of this document, *Estimation of Groundwater Level Distribution Prior to the Commencement of*

*the Fimiston Tailings Disposal Operations by KCGM*, dated May 2007, was approved by the DEC through a letter dated the 9 April 2008 (Attachment 2).

The data from this study is included in the quarterly reports to the DEC to track progress towards target depths. KCGM has committed to developing staged targets towards meeting the agreed historical groundwater levels, the goal for the coming year (2010) will be to achieve greater than 6 mBGL in all Compliance Monitor Bores. The targets beyond this time remain to be determined. KCGM has committed to completing this exercise within the next 12 months. This has been included as an action within this SGMP (Table 8.2).

The precise historical groundwater level distribution is difficult to determine given that there is limited information pre-dating the current mining activities. Also due to the modified topography in the catchment, some historical drainage patterns no longer exist, thus the future natural groundwater level distribution will differ from the past.

### **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 Fimiston I and Fimiston II TSFs 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. This is less than the normal operation target areas described in the NOI documents for these facilities.

In the event that the area of the supernatant pools 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). The operation of the Eastern Borefield will be maintained as a priority.

### **Operation of Eastern Borefield Bores**

The extraction rate of groundwater surrounding the TSFs is linked to the operation of the Eastern Borefield. To maximise the extraction rate the number of available bores within the Eastern Borefield needs to be as high as practical to maximise the potential for lowering of the groundwater levels around the TSFs.

It is not possible for a groundwater production bore to deliver 100% availability as it is a mechanical device. With less than 100% availability on each individual unit and in excess of 100 bores that are currently in service means that typically several bores will be inoperative at any one time.

Typically, KCGM will target an average of 90% of the installed production bores to be operational over a full calendar month; however, some provision is necessary to facilitate plant shutdowns as well as maintenance to the broader water transfer system. Where such works may be necessary, every effort will be made to minimise the impact of any disruption. Actions could include the prioritisation of bores in critical areas e.g. adjacent to active paddocks or the rigging of temporary bypass arrangements.

### Groundwater Level Trends

Groundwater levels and trends in all Eastern Borefield Monitoring Bores are to be examined each quarter during preparation of the quarterly report to DEC. 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 SGMP criteria in the following table:

Groundwater Level and Trend	Action
Groundwater level <4 mBGL with a shallowing or stable trend	Increase pumping capacity within two quarters
Groundwater level >4 mBGL and <6m BGS with a shallowing trend	Increase pumping capacity within three quarters
Groundwater level >6 mBGL with a shallowing trend	Extrapolate trend, and increase pumping capacity in sufficient time to maintain groundwater level below 6 mBGL

An increase in groundwater recovery capacity is also required by DEC Licence 6420/12 as per the criteria in the following table:

Groundwater Level and Quality Targets	Action
Groundwater level <6 mBGL in a Monitoring Compliance Bore	Increase pumping capacity within three quarters
Groundwater quality >0.50 mg/L WADCN in a Production or Monitoring Compliance Bore	Increase pumping capacity within three quarters

An increase in pumping capacity can be in the following forms:

- Maximise use of near-by production bores

- Upgrading existing infrastructure, such as pumps and pipelines
- Construction of new production bores

Coincident with any pumping capacity increase, the degree of monitoring required in that area will also be reviewed.

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

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

Since its inception the development of the Eastern borefield has required a staged approach due to the highly variable and unpredictable nature of the ground. It is not possible to determine groundwater bore locations prior to the groundwater rising. Increasing pumping capacity can be an unpredictable process.

The inconsistent nature of the ground can mean a substantial period of time is required to firstly find a suitable location, construct and subsequently equip new bores. This is then followed by an extensive period of time to determine a trend from the increased abstraction from the area before any further work is undertaken.

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, piping).

The number of groundwater bores will progressively be increased, where required, to achieve a target depth to groundwater >6 mBGL outside the Operating Area of the TSF. The practicality to achieve this target will be reviewed on a bore by bore basis based upon potential impacts and performance against historic groundwater level targets.

## 5. GROUNDWATER QUALITY MANAGEMENT

The following actions are used to identify changes that may occur in the groundwater quality around the TSFs.

### **Monitoring**

The monitoring programme for groundwater quality is specified in the Fimiston DEC Licence 6420/12.

Sampling results shall be presented in the quarterly reports to the DEC, and in the annual groundwater monitoring review to the DoW.

Should monitoring not be completed as per Condition 7 of the DEC Licence, KCGM shall include details in the subsequent quarterly report to the DEC, and in the annual groundwater monitoring review to the DoW.

### **Groundwater Recovery**

All groundwater that is recovered from the Eastern 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 examined quarterly. Depending on the results and in consultation with the DEC, 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 mineral processing.

Groundwater targets relating to recovery specified in the Fimiston DEC Licence 6420/12, require KCGM to increase groundwater recovery capacity within nine months of becoming aware that groundwater levels in Compliance Bores are shallower than 6 meters below ground level or greater than 0.50mg/L WADCN.

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

Groundwater recovery to manage groundwater levels continues to have higher priority than recovery due to quality in the SGMP because it has the greater potential to impact on the environmental value of the area (i.e. vegetation).

## 6. VEGETATION MONITORING

To confirm that the SGMP is protecting the environmental value of the area (i.e. vegetation), KCGM has implemented a vegetation monitoring programme around the Fimiston I and Fimiston II TSFs. The requirements for the vegetation monitoring programme are specified in the Fimiston DEC Licence 6420/12.

In December 2005 a review of the vegetation monitoring programme was undertaken and a number of recommended changes were made to ensure the monitoring programme adequately represents vegetation surrounding the Fimiston TSFs. The DEC subsequently provided comment regarding the review and proposed monitoring.

A revised version of the vegetation monitoring programme was discussed with the DEC and presented and agreed at the KCGM CRG meeting on 1 February 2007.

This revised vegetation programme is documented as EHS\_ENV\_PLN019\_Fimiston TSF Vegetation Monitoring Programme (Attachment 3).

Results from this monitoring program will be reported annually as part of the KCGM Annual Environmental Report submitted by 31<sup>st</sup> March each year.

It was recommended by the DEC in the 2006 Annual Audit response to consider a Tree Root Study of eucalypt species around the Fimiston TSFs. KCGM engaged Botanica Consulting to review the requirement for Tree Root Study. Results of this review were presented to the CRG and it was agreed that a Tree Root Study would not be necessary based on KCGM's current TSF monitoring programme and case study information. However KCGM will undertake further tree root investigations if the opportunity arises, to get a better understanding of tree root depths of eucalypts in the Goldfields region.

## **7. REVIEW**

Groundwater data is currently reviewed and reported to the DEC on a quarterly basis. This will continue and will include commentary on performance against SGMP targets.

The performance of the SGMP is reviewed annually and recommendations are included in the Annual Groundwater Production Summary or Triennial Aquifer Performance Review that is submitted as part of the licence requirements for operation of the Fimiston TSFs and the Eastern Borefield.

The SGMP will be revised based on recommendations from the review and submitted to DEC for approval.

The review of the groundwater component of the SGMP will be completed by an experienced, independent groundwater hydrogeologist. Mr Peter Clifton of Peter Clifton and Associates is presently undertaking this role.

The review of the vegetation monitoring component of the SGMP will be completed by an experienced, independent vegetation specialist. Mr Jim Williams and Ms Andrea Williams of Botanica Consulting are presently undertaking this role.

## 8. DELIVERABLES

The scope of this SGMP is wide and has many targets. Some of these form general goals intended to demonstrate KCGMs commitment to continuous improvement (eg increasing pumping capacity dependent on aquifer response). Others form specific actions that have clear paths and well defined end points (eg install 15 monitoring bores by December 2005). These are detailed in the following two tables.

The timing for action completion dates may be subject to reasonable change based upon factors such as operational changes, additional consultation requirements or the identification of higher priority issues. Any changes to delivery dates will be made in consultation with the DEC.

The achievement of all targets in this SGMP 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 TSFs are not being impacted.

### 8.1 TABLE OF SGMP GOALS

Item	Objective	Goal
TSF Pool Size	Minimise the pool size by operating within a target area.	<15% on the operating paddock under routine operation.
Operation of Eastern Borefield	Maximise the use of the Eastern Borefield.	>90% of bores operating over a full calendar month.
Groundwater Level	Comply with licence conditions and progress towards achieving historical groundwater level targets.	Achieve and maintain depth to groundwater >6 mBGL in all Monitoring Compliance Bores.
Historical Groundwater Levels	Restore groundwater levels to agreed targets based upon the historical groundwater levels for the region	To meet staged targets as set by the SGMP.
Groundwater Quality Monitoring	Comply with licence conditions to maintain groundwater quality (WAD cyanide levels less than 0.5 mg/L).	Maintain groundwater quality <0.5 mg/L WAD cyanide in all Monitoring Compliance Bores.
Vegetation Monitoring	Assess the effectiveness of the SGMP.	To demonstrate the ongoing effectiveness of the SGMP.

## 8.2 TABLE OF SGMP SPECIFIC ACTIONS

Item	Objective	Actions	Timing
Historical Groundwater Levels	Reach agreement on staged targets for meeting the historical groundwater levels.	<ul style="list-style-type: none"> <li>Meet initial staged target of &gt;6 mBGL in all Compliance Monitoring Bores</li> </ul>	Sep 2010
		<ul style="list-style-type: none"> <li>Determine appropriate future staged targets in consultation with CRG, DEC, DoW and interested parties.</li> </ul>	Aug 2010
		<ul style="list-style-type: none"> <li>Report on progress towards meeting staged targets to DEC via Quarterly Reports</li> </ul>	Commencing Q1 2010 and thereafter
SGMP Annual Audit	SGMP performance to be reviewed annually	<ul style="list-style-type: none"> <li>Audit Review to be undertaken by external consultant as per licence conditions</li> </ul>	Jul 2010
		<ul style="list-style-type: none"> <li>Draft Audit Report to undergo public consultation via the CRG.</li> </ul>	Aug 2010
		<ul style="list-style-type: none"> <li>Final Audit Report to be submitted to the DEC as per licence conditions.</li> </ul>	Aug 2010
SGMP Annual Review	SGMP document to be reviewed and updated annually	<ul style="list-style-type: none"> <li>Review of SGMP to be undertaken by KCGM (including feedback received via Annual Audit)</li> </ul>	Sep 2010
		<ul style="list-style-type: none"> <li>Reviewed SGMP to be approved by DEC.</li> </ul>	Oct 2010
Vegetation Monitoring	Vegetation monitoring aspect of SGMP to be completed annually	<ul style="list-style-type: none"> <li>Annual Vegetation Monitoring to be completed by external consultant in accordance with agreed programme.</li> </ul>	Oct 2009
	Confirm that the SGMP is protecting the environmental value of the area. Vegetation monitoring aspect of SGMP to be reported annually	<ul style="list-style-type: none"> <li>Annual Vegetation Monitoring report prepared by external consultant to be submitted to DEC as part of the AER.</li> </ul>	Mar 2010

## GLOSSARY OF TERMS

**Annual:** A twelve (12) month period.

**Aquifer:** A zone of rock or soil which is saturated with water and through which water can easily move. An aquifer is created when all the cracks and voids in soil and rock are filled with water.

**As:** Symbol for the element, arsenic.

**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:** bores outside the Fimiston TSF Operational Area as shown in Attachment 1.

**Cu:** Symbol for the metal, copper.

**Cyanide (Free, WAD and Total):** These are the three typical measurements of cyanide in groundwater.

- Free is a measure of the concentration of unassociated cyanide ions in solution.
- 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.
- Total is a measure of all forms of cyanide in solution. This value includes the WAD cyanide concentration.

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

**DEC:** Department of Environment and Conservation.

**DoW:** Department of Water

**Eastern Borefield:** This is the bore network that is constructed around the two Fimiston TSFs and comprises all of the Production and Monitoring Bores and associated infrastructure.

**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.

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**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.

**Fe:** Symbol for the metal, iron.

**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 may occur post mine closure.

**Hg:** Symbol for the metal, mercury.

**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 licencing 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 Fimiston TSFs that includes the footprint of the facility plus a halo around the perimeter in which infrastructure associated with the operation of the facility is located and limited vegetation exists. The halo is a maximum of 100m wide or within the premises boundary.

**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. Fimiston I TSF is a single paddock and Fimiston II TSF is a three 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.

**SGMP:** Seepage and Groundwater Management Plan.

**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.

**Triennial:** A three (3) year period.

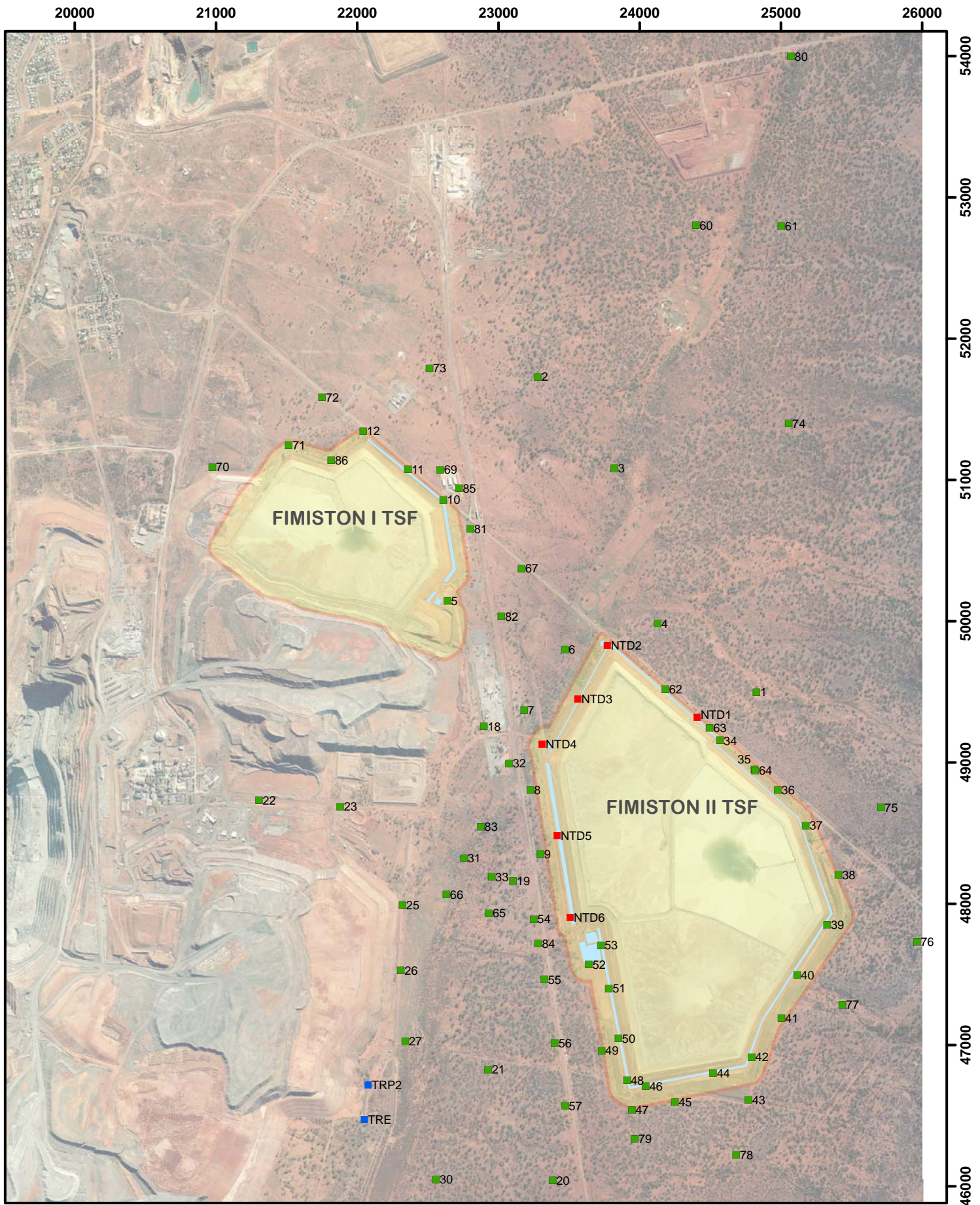
**Water Table:** The upper surface of the groundwater. The zone immediately below the watertable is saturated. The aim of the Groundwater Management Plan is to keep the watertable at least 4 metres from the soil surface.

**WRC:** Water and Rivers Commission, now part of the Department of Environment.

**Zn:** Symbol for the metal, zinc.

**ATTACHMENT 1**

***Fimiston I and II TSF Monitor and Production Bore Location  
Maps including the TSF Operational Area Halo.***



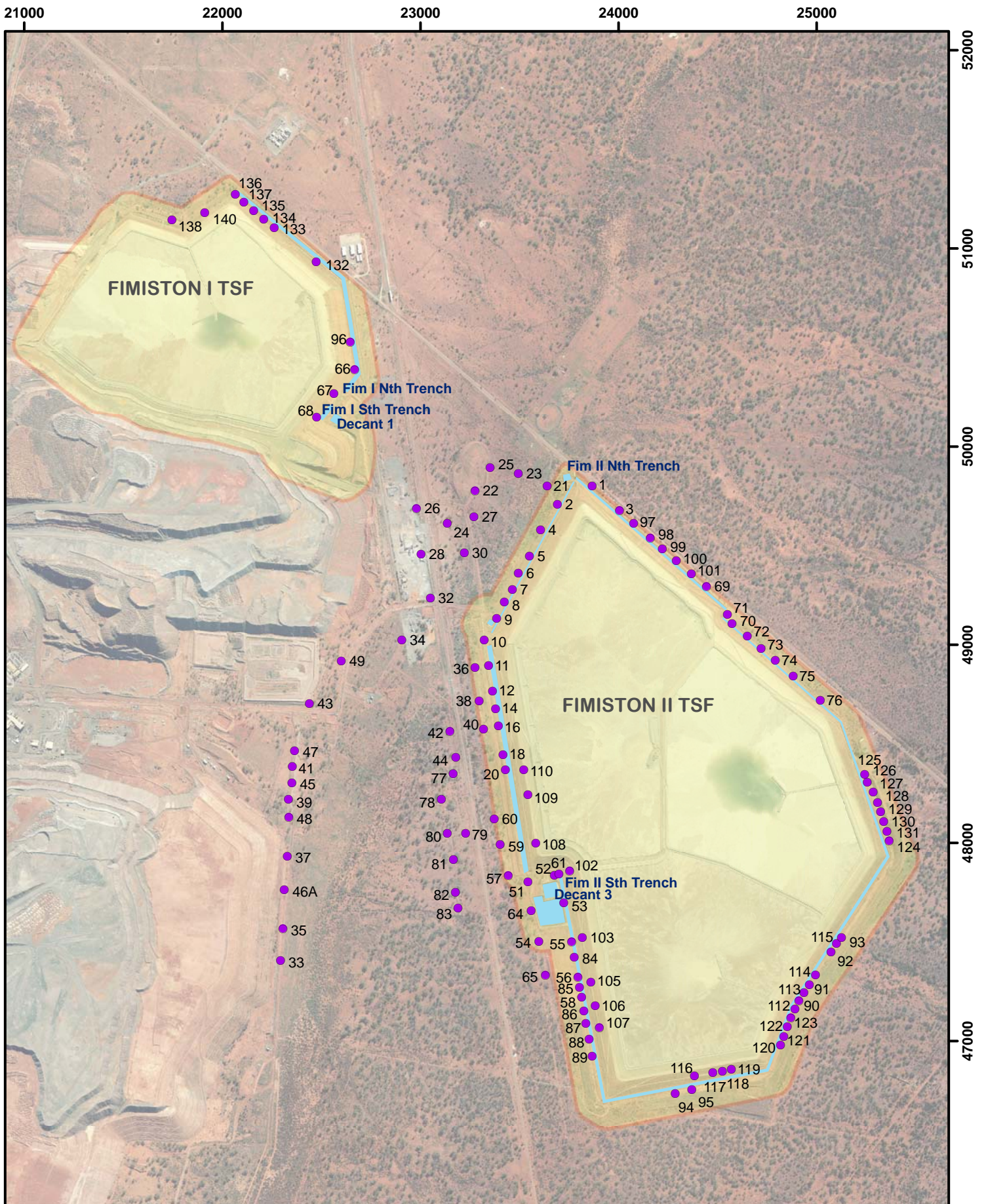
## EASTERN BOREFIELD MONITORING BORES



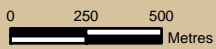
Data Source: KCGM GIS Datasets  
 Aerial Photo: KCGM\_RSS\_APH\_rd\_FIM\_LSA\_09Jul\_1m  
 Grid Coordinates: Oryoa East  
 Scale: 1:35,000  
 Date: November 2009  
 Project ID: Eastern Borefield SGMP



- Monitor Bore, "MB F" series
- Monitor Bore, "NTD" series
- Monitor Bore, other
- TSF Operational Area
- Dams & Trenches



# EASTERN BOREFIELD PRODUCTION BORES



Data Source: KCGM GIS Datasets  
 Aerial Photo: KCGM\_RSS\_APH\_rd\_FIM\_LSA\_09Jul\_1m  
 Grid Coordinates: Oryoa East  
 Scale: 1:25,000  
 Date: November 2009  
 Project ID: Eastern Borefield SGMP



- Production Bore, "PB F" series
- Dams & Trenches
- TSF Operational Area

**ATTACHMENT 2**

***Estimation of Groundwater Level Distribution Prior to the Commencement of the Fimiston Tailings Disposal Operations by KCGM.***

***ATTACHMENT 3***

***Fimiston TSF Vegetation Monitoring Programme***



ABN 97 009 377 619

# Fimiston TSF Vegetation Monitoring Programme



*Greening the Golden Mile*

Prepared by: KCGM  
Date: March 2007

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## 1 Introduction

In 1999 Kalgoorlie Consolidated Gold Mines (KCGM) established a photographic vegetation monitoring programme consisting of 17 transects with 32 photo points around the Fimiston Tailings Storage Facilities (TSFs). The objective of the monitoring programme is to identify any impact on vegetation that may be related to changes in groundwater levels in the immediate vicinity of the TSFs.

On advice from the Minister for Environment, KCGM developed a Seepage and Groundwater Management Plan (SGMP) in September 2005. The primary focus of the SGMP is groundwater level management around the TSFs to protect vegetation. This 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 (i.e. vegetation), KCGM undertakes a photographic vegetation monitoring programme around the TSFs. The SGMP included a commitment to undertake a professional review the vegetation monitoring programme to ensure that it adequately represents vegetation surrounding the Fimiston TSFs. This review was completed in December 2005 and publicly released for comment in January 2006.

This Fimiston TSF Vegetation Monitoring Programme was revised based on the findings of the review and feedback from stakeholders.

## 2 Vegetation Monitoring Programme

The Fimiston TSF Vegetation Monitoring Programme includes both photographic monitoring and Landscape Function Analysis (LFA) of the vegetation surrounding the Fimiston TSFs. Specific details of the monitoring programme are outlined below:

Site Name	Monitoring Points	Number of Photos	Number of LFA Sites
A-V	Photo monitoring	76	0
1-14	LFA and photo monitoring sites	54	14
Analogue 1-2	Analogue Sites	8	2
<b>Total</b>		<b>138</b>	<b>16</b>

Photographic and LFA monitoring shall 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.

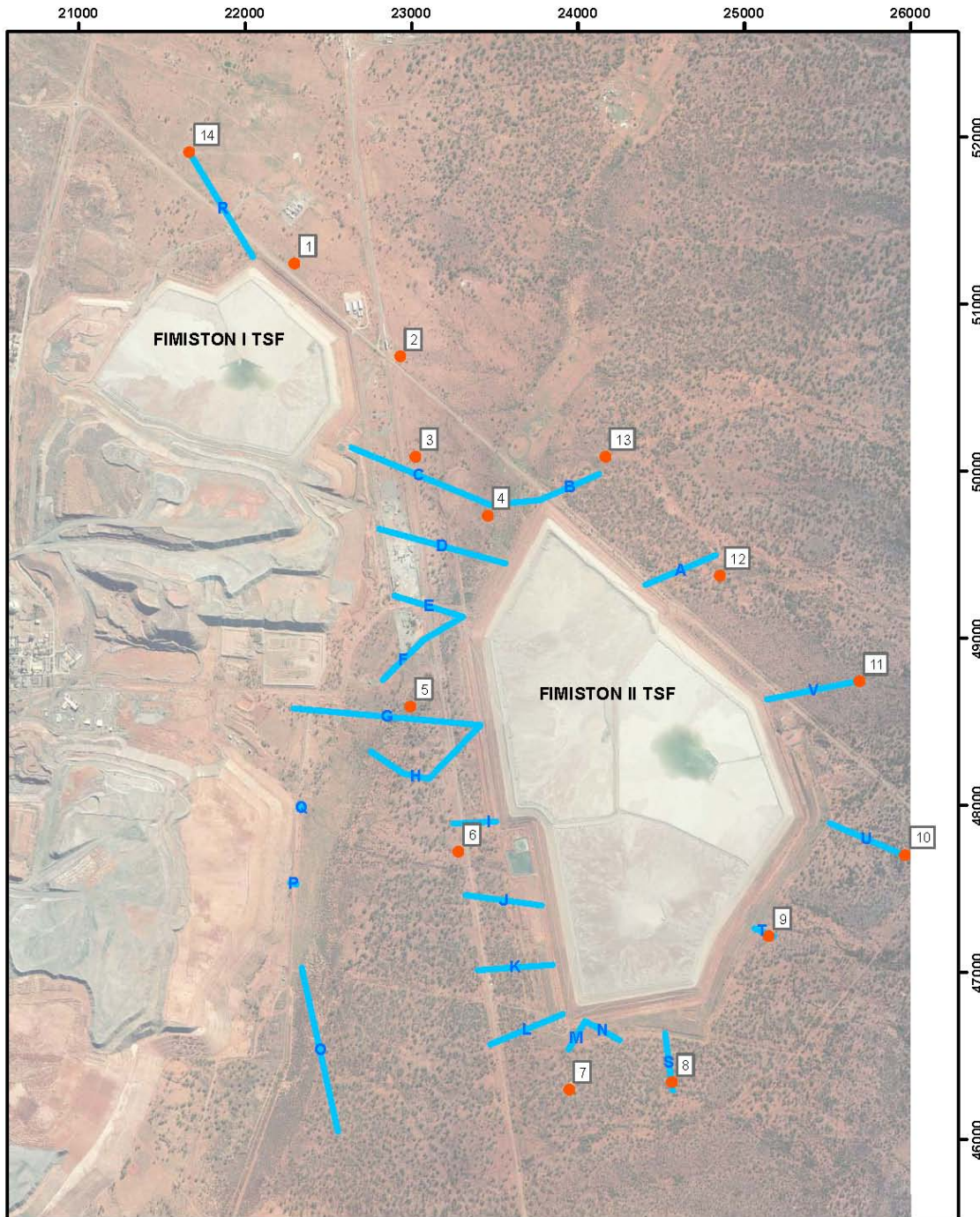
The monitoring program is outlined in Appendix 1. The table indicates the specific monitoring undertaken at each site.

A map of the vegetation monitoring program is shown in Figure 1.

### 3 Appendix 1: Revised Vegetation Monitoring Programme

Transect	Associate Bores - Photo Direction and Distance	Photo Monitoring	LFA Monitoring
A	<u>NTD1</u> - N (0m) : <u>MB F1</u> - N (0m); S (0m)	3	0
B	<u>NTD 2</u> - W (0m) : <u>MB F4</u> - N (0m); S (0m)	3	0
C	<u>NTD 2</u> - NW (0m) : <u>MB F6</u> - E (0m); W (0m) : <u>MB F5</u> - SE (0m)	4	0
D	<u>NTD 3</u> - W (0m) : <u>AMG 358537:6597384</u> - E (0m)	2	0
E	<u>NTD 4</u> - NW (0m) : <u>AMG 358884:6597023</u> - E (0m)	2	0
F	<u>NTD 4</u> - SW (0m) : <u>MB F32</u> - E (0m); W (0m) : <u>Neves Dam</u> - E (0m); W (0m)	5	0
G	<u>NTD 5</u> - SW (0m) : <u>MB F24</u> - E (0m)	2	0
H	<u>NTD 5</u> - SW (0m) : <u>MB F19</u> - SW (0m); NE (0m) : <u>MB F33</u> - W (0m); E (0m) : <u>MB F31</u> - W (0m); E (0m)	7	0
I	<u>NTD 6</u> - SW (0m) : <u>MB F54</u> - W (0m); E (0m)	3	0
J	<u>MB F51</u> - SW (0m) : <u>MB F55</u> - SW (0m); NE (0m)	3	0
K	<u>MB F 50</u> - SW (0m) : <u>MB F56</u> - SW (0m); NE (0m)	3	0
L	<u>MB F48</u> - SW (0m) : <u>MB F57</u> - SW (0m); NE (0m)	3	0
M	<u>MB F46</u> - SW (0m) : <u>MB F47</u> - N (0m); S (0m); E (0m); W (0m)	5	0
N	<u>MB F46</u> - E (0m) : <u>MB F45</u> - N (0m); S (0m); E (0m); W (0m)	5	0
O	<u>MB F30</u> - N (0m); S (0m); E (0m); W (0m)	4	0
P	<u>MB F26</u> - E (0m)	1	0
Q	<u>MB F25</u> - E (0m)	1	0
R	<u>MB F72</u> - ESE (0m, 100m, 200m) : <u>MB F12</u> - WNW (0m, 100m, 200m)	6	0
S	<u>MB F78</u> - NW (0m, 100m, 200m)	3	0
T	<u>PB F112</u> - W (0m)	1	0
U	<u>MB F76</u> - WSW (0m, 100m, 200m, 500m) ; NNE (100m)	5	0
V	<u>MB F75</u> - SW (0m, 100m, 200m) : <u>MB F37</u> - NE (0m, 100m)	5	0
1	<u>PB F111</u> - N (0m, 100m, 200m, 300m)	4	1
2	<u>MB F81</u> - NE (0m, 100m, 200m, 300m)	4	1
3	<u>MB F82</u> - NE (0m, 100m, 200m, 300m)	4	1
4	<u>MB F6</u> - WSW (0m, 100m, 200m, 300m)	4	1
5	<u>MB F83</u> - SW (0m, 100m, 200m, 300m)	4	1
6	<u>PB F82</u> - SW (0m, 100m)	2	1
7	<u>MB F79</u> - S (0m, 100m, 200m, 300m)	4	1
8	<u>MB F78</u> - SE (0m, 100m, 200m, 300m)	4	1
9	<u>PB F112</u> - SE (0m, 100m, 200m, 300m)	4	1
10	<u>MB F76</u> - NE (0m, 100m, 200m, 300m)	4	1
11	<u>MB F75</u> - NE (0m, 100m, 200m, 300m)	4	1
12	<u>MB F1</u> - NE (0m, 100m, 200m, 300m)	4	1
13	<u>MB F4</u> - NE (0m, 100m, 200m, 300m)	4	1
14	<u>MB F72</u> - NW (0m, 100m, 200m, 300m)	4	1
Analogue 1	<u>MB F74</u> - NE (0m, 100m, 200m, 300m)	4	1
Analogue 2	<u>MB F80</u> - NE (0m, 100m, 200m, 300m)	4	1


**4 Figure 1: Photographic and LFA Monitoring Point Location Plan**



**LOCATION MAP - FIMISTON VEGETATION MONITORING**

0 250 500 1,000 1,500 2,000 Metres

Data Source: KCGM GIS Datasets  
 Aerial Photo: KCGM\_RSS\_APH\_rd\_FIM\_LSA\_09Jul\_1m  
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**Legend**

- PHOTO
- LFA TRANSECT

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