



ABN 97 009 377 619

## Fimiston Operations

# Seepage and Groundwater Management Plan



*Greening the Golden Mile*

Prepared by: KCGM

Date: 31st October 2007

|               |   |
|---------------|---|
| Distribution: | KCGM Internal   |
|               | Department of Environment and Conservation                                  |
|               | Department of Industry and Resources  |
|               | KCGM External Stakeholders  |
|               | KCGM Website – <a href="http://www.superpit.com.au">www.superpit.com.au</a> |

## TABLE OF CONTENTS

|     |  |    |
|-----|--|----|
| 1.  | INTRODUCTION .....   | 1  |
| 2.  | STANDARDS .....  | 3  |
| 2.1 | Licence Conditions .....                                   | 3  |
| 2.2 | Construction of Monitoring Bores and Production Bores..... | 3  |
| 2.3 | Collection and Analysis of Groundwater Samples.....        | 4  |
| 3.  | OBJECTIVE.....   | 4  |
| 4.  | GROUNDWATER LEVEL MANAGEMENT.....                          | 5  |
| 4.1 | Establish Historic Groundwater Level Distribution.....     | 5  |
| 4.2 | Management of TSF Supernatant Pool Size .....              | 6  |
| 4.3 | Operation of Eastern Borefield Bores.....                  | 6  |
| 4.4 | Semi-Continuous Monitoring of Groundwater Levels .....     | 7  |
| 4.5 | Groundwater Level Trends .....                             | 7  |
| 5.  | GROUNDWATER QUALITY MANAGEMENT .....                       | 9  |
| 5.1 | Monitoring .....   | 9  |
| 5.2 | Groundwater Recovery.....                                  | 10 |
| 6.  | VEGETATION MONITORING .....                                | 10 |
| 7.  | REVIEW .....   | 12 |
| 8.  | DELIVERABLES.....  | 12 |
| 8.1 | TABLE OF SGMP GOALS .....                                  | 13 |
| 8.2 | TABLE OF SGMP SPECIFIC ACTIONS .....                       | 13 |
|     | GLOSSARY OF TERMS.....                                     | 13 |

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page i           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

## 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.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 1           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

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. 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 will be 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 consists of a number of components which can be 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.

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 first revision of the Seepage and Groundwater Management Plan – originally drafted September 2005.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 2           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

## 2. STANDARDS

### Licence Conditions

The Department of Environment and Conservation (DEC) Licence 6420/11 requires that KCGM;

- Operate the Fimiston I and Fimiston II TSFs in line with Conditions W3 (freeboard), W4 (bundling of pipelines), W5 (visual inspections), W6 (stormwater diversion), W11 (groundwater monitoring), W12 and W13 (SGMP) and W14 (vegetation monitoring)
- Notify the DEC if the above conditions can not be met as soon as practicable
- Prepare quarterly reports presenting the results of the monitoring program required by Condition W11.
- Prepare an Annual Environmental Report as required by Condition G2. This report is to include a discussion of the vegetation monitoring program required by Condition W14.

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

- Operate the Eastern Borefield in accordance with conditions specified and 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*.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 3           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

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 for the region. These targets have been developed in consultation with the Department of Environment and Conservation and are based upon an assessment of the historical data, reasonable hydrogeological estimations, practicability and intent.

The minimum target depth to groundwater below ground surface (BGS) is currently four (4) metres with a stretch target of six (6) metres. These targets will be re-evaluated with each annual review of the SGMP with the ultimate aim of progressing towards the historical target levels.

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 the target depth. Once it is confirmed that the groundwater level will remain at the target depth without active management, the Eastern Borefield will be decommissioned. It is

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 4           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

anticipated that the groundwater will naturally deepen back to a new equilibrium. 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 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 4m BGS while the TSFs are operational and so this area is not considered as part of the primary goal of the SGMP. Groundwater levels inside the Operational Area are considered in the annual review of the SGMP and these may require exemption with respect to target depths applied beyond the Operational Area.

The following actions are directed towards achieving the primary goal of groundwater level management beyond the Operational Area of the TSFs.

##### **Establish Historic Groundwater Level Distribution**

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.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 5           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

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 most recent version of this document, *Estimation of Groundwater Level Distribution Prior to the Commencement of the Fimiston Tailings Disposal Operations by KCGM*, dated May 2007, is currently pending DEC approval.

The data from this study will be used to refine the objectives of this SGMP.

The precise historical groundwater level distribution is difficult to determine given that there is limited information pre-dating these facilities. 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.

The development of an agreed contour plan is being completed in consultation with the DEC to achieve an outcome that is considered both a reasonable estimate and that will protect the environment in the long term.

### **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

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 6           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

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.

### **Semi-Continuous Monitoring of Groundwater Levels**

To confirm that the current level of monitoring is sufficient to identify possible cyclic effects related to such aspects as the region of tailings deposition or rainfall events, select bores are monitored at an increased frequency rate. Five (5) monitoring bores have been equipped with groundwater level sensors and data loggers. The sensors have been located in various areas around the TSFs with the logic for selection being:

- to identify the impact of the deposition cycle within 100 m of the TSF; and
- to identify rainfall recharge rates near the floodway both between and upstream of the TSFs.

The record collection interval is set at 10 minutes. Records are downloaded from the loggers and presented in the quarterly reports to the DEC, and in the annual report on groundwater monitoring to the DoW.

During the annual audit report consideration will be given - on a bore by bore basis - whether to leave the groundwater level sensor and data logger in place or to move it to another location. This decision will be reached in consultation with the DEC.

### **Groundwater Level Trends**

Groundwater levels and trends 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 additional groundwater pumping capacity is required according to the criteria in the following table:

| <b>Groundwater Level and Trend</b> | <b>Action</b> |
|------------------------------------|---------------|
|------------------------------------|---------------|

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 7           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

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

Since its inception the development of the Eastern borefield has been 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.

This inconsistent nature of the ground can mean an extended period of time is required to firstly find a suitable location, construct and subsequently equip new bores. This is then followed by an extended 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 BGS >6m 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 in view of findings from the historic groundwater level study.

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

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

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 8           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

Infiltration following high rainfall has been observed to make the depth to groundwater shallower by up to two (2) metres in some locations. Following such events, higher rates of bore recharge mean that the overall extraction rate from the Eastern Borefield will increase before the system returns to equilibrium. This may however, take some months as the volume infiltrating over the catchment could be quite large. The Eastern Borefield is a high priority water source for mineral processing so water extraction will be as high as practicable thus lowering the groundwater in the shortest possible time. Additional installed pumping capacity is not necessarily triggered by these events as they are infrequent.

## 5. GROUNDWATER QUALITY MANAGEMENT

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

### Monitoring

To confirm that the 2004/5 DEC licence level of monitoring is sufficient to identify spikes during the discharge of tailings, select monitoring bores continue to be sampled at an increased frequency rate.

Sampling for pH, Electrical Conductivity (EC), cyanide (Total, WAD and Free) from about one third of all monitoring bores (20) is being performed on a monthly basis (previously sampled quarterly). These bores have been selected from across the entire monitoring bore network with the aim of obtaining representative coverage.

Sampling for pH, Electrical Conductivity (EC), cyanide (Total, WAD and Free) and Trace Elements (Cu, As, Zn, Fe, Hg) will be performed on a quarterly basis for all monitoring bores.

Results from the sampling will be presented in the quarterly reports to the DEC, and in the annual report on groundwater monitoring to the DoW.

This increased sampling frequency commenced in the fourth quarter of 2005. Data were assessed in the 2006 annual review *Fimiston I and II tailings storage Facilities Review of Groundwater Monitoring Data 2006* (April 2007). Recommendations were made to remove the requirement for trace element analysis of monitoring bores. It was also recommended to reduce the sampling frequency of monitoring bores to six monthly for determinations of pH, electrical conductivity and cyanide concentrations. These requests will be applied for at DEC Licence renewal September 2008

Should monitoring not be completed in accordance with the DEC licence then KCGM will make notification to the DEC as soon as practicable once any failure is detected.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 9           |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

Exception will be given where bores are knowingly dry and have previously been reported to the DEC. The reasons behind the failure will be identified and appropriate measures will be taken to prevent reoccurrence. The failure to monitor, reasons for, and measures to prevent reoccurrence will be re-iterated in the next relevant quarterly report.

### **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 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 groundwater management plan is protecting the environmental value of the area (i.e. vegetation), KCGM undertakes a vegetation monitoring programme around the Fimiston I and Fimiston II tailings storage facilities (TSFs). This is in accordance with DEC Licence requirements.

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 Community Reference Group meeting on 1 February 2007.

The revised programme includes:

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 10          |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

- Photographic Monitoring at all Historical Vegetation Monitoring Sites (A-Q)
- Photographic monitoring at 5 additional monitoring sites (R-V)
- Landscape Function Analysis at 14 Sites (annually)
- Photographic Monitoring at 16 LFA sites along transect direction at 0m, 100m, 200m, 300m

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.

During the next 12 months, KCGM will give consideration to the Tree Root Study as recommended by the DEC in the 2006 Annual Audit response. This will entail community consultation via the Community Reference Group (CRG) as well as advice from local environmental consultancy services. This will first aim to establish the requirement for such a study and, if so determined, the final form of the study.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 11          |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

## 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 Jims Weeds, Seeds and Trees 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.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 12          |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

### 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 borefield.                                       | >90% of bores operating over a full calendar month.   |
| Groundwater Level Trends       | Establish increased pumping capacity to lower water levels.              | Progressively increase the no. of groundwater bores that have a depth to groundwater BGS >4m.                               |
| Groundwater Quality Monitoring | Establish increased pumping capacity to increase seepage recovery.       | Recover seepage in areas of high priority based on potential impact on the vegetation or Beneficial Use of the groundwater. |
| Vegetation Monitoring          | Confirm that the SGMP is protecting the environmental value of the area. | Undertake vegetation monitoring in accordance with agreed programme.  |

### 8.2 TABLE OF SGMP SPECIFIC ACTIONS

| Item   | Objective   | Actions   | Timing                |
|--|---|---|-----------------------|
| Historic Groundwater Level                       | Reach agreement on historical groundwater model.                  | • Complete revision of the estimate of historic water levels.         | Completed (Feb 2007)  |
|  |   | • Obtain CRG and DEC agreement  | Feb 2008              |
| Vegetation Monitoring Programme                  | Reach agreement on final vegetation monitoring programme.         | • Complete revision of vegetation monitoring programme                | Completed (Feb 2007)  |
|  |   | • Obtain CRG and DEC agreement  | Completed (Mar 2007)  |
| Semi-Continuous Monitoring of Groundwater Levels | Confirm if the 2004/5 DEC licence sampling frequency is adequate. | • Evaluate data from semi - continuous monitoring bore depth loggers. | Ongoing (Implemented) |
|  |   | • Submit results to DEC via Quarterly Reports                         | Ongoing (Implemented) |

|  |                    |                  |
|--|--------------------|------------------|
| Prepared by: KCGM  | Revision No: Final | Page 13          |
| Document Name: KCGM Seepage and Groundwater Management Plan 071031_Final.doc |                    | Date: 31/10/2007 |

| Item                                | Objective   | Actions   | Timing  |
|-------------------------------------|---|---|---|
|                                     |   | <ul style="list-style-type: none"> <li>Analyse trends and consider moving semi - continuous monitoring bore depth loggers to different bores in Annual Review.</li> </ul>   | Apr 2008  |
| Groundwater Quality Monitoring      | Confirm if the 2004/5 DEC licence sampling frequency is adequate.   | <ul style="list-style-type: none"> <li>Review data surrounding increased monitoring frequency and additional analytes</li> <li>Submit report to DEC</li> <li>Consider decreasing sampling frequency at licence renewal</li> </ul> | Completed (Apr 2007)<br><br>Completed (Apr 2007)<br>Sept 2008 |
| SGMP Annual Review                  | SGMP performance to be reviewed annually                            | <ul style="list-style-type: none"> <li>Review to be undertaken by external consultant and report submitted to DEC</li> </ul>  | Aug 2008  |
| Vegetation Monitoring Annual Review | Vegetation monitoring aspect of SGMP to be reported annually        | <ul style="list-style-type: none"> <li>Review to be undertaken by external consultant and report submitted to DEC as part of the AER</li> </ul>   | Mar 2008  |
| Tree Root Research                  | Depth of eucalypt tree roots study, specific to the Goldfields Area | <ul style="list-style-type: none"> <li>Consult with CRG regarding implementation of tree root study</li> <li>Obtain DEC agreement on whether to proceed with Tree Root Study</li> </ul>   | Apr 2008<br><br>Oct 2008                                      |

## 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.

**BGS:** Is the groundwater level or depth below ground surface.

**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. This is typically used as a measure of the potential toxicity to fauna if ingested. The typical guideline value of 50ppm is used. Concentrations above this value may be harmful to fauna.
- Total is a measure of all forms of cyanide in solution. This value includes the WAD cyanide concentration. This is not used as an indicator of toxicity as it may include stable and therefore non toxic cyanide salts.

**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

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 15          |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

**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.

**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.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 16          |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

**Operational Area:** The area of the 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.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 17          |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |

**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.

|   |                    |                  |
|---|--------------------|------------------|
| Prepared by: KCGM   | Revision No: Final | Page 18          |
| Document Name: KCGM Seepage and Groundwater Management Plan<br>071031_Final.doc |                    | Date: 31/10/2007 |