



DEPARTMENT OF MINES AND ENERGY

***Independent Monitor's Audit of
the McArthur River Mine for the
2011 Operational Period***

**DEPARTMENTAL RESPONSE TO
THE AUDIT REPORT**

November 2012

Executive Summary

The *Independent Monitor's Audit of the McArthur River Mine for the 2011 Operational Period* ("the 2012 Audit Report") was submitted to the NT Government on 1 October 2012. A review of the Audit Report's findings was undertaken by the Department of Mines and Energy ("DME" or "the Department").

The departmental review focused on the compliance and technical issues raised by the appointed Independent Monitor (IM) relating to the environmental condition, management and monitoring of the McArthur River Mine ("MRM") by McArthur River Mining Pty Ltd ("the Operator"), as well as the regulatory overview of the mine by DME.

In relation to assessing the regulatory performance of DME, in its 2012 Report the IM reported that the Department continues to demonstrate thorough administrative procedures to regulate the environmental aspects of the MRM operation. Further, that the Department's assessment of the Operator's annual Mining Management Plan (MMP) is both thorough and technically appropriate, as is DME's procedures for undertaking check-monitoring of surface and ground water at and surrounding the MRM site.

In its Audit Report the IM also stated that while DME's assessment of MRM's annual MMP was thorough, it noted that the time lag for approving the MMP was a potential issue. On this point the Department agrees that the approval process, in some circumstances, has taken a considerable length of time. Delays in approvals can be due to a number of factors including the need for the Department to regularly seek additional information from operators to clarify details and/or correct inaccuracies contained in their submitted MMP, including Water Management Plans (WMPs) which form part of an operator's MMP for larger sites. The Department is currently exploring options to try to reduce timeframes for the assessment of lodged MMPs, WMPs and other operator documents.

In the 2012 Audit Report the IM stated that the Operator MRM "*...had demonstrated a high level of procedural compliance with their commitments made in the 2010/2011 Mining Management Plan.*" Of the 81 environmental commitments given by the Operator in the 2010/11 MMP, only two were assessed to be non-compliant. These related to: the sub-aqueous deposition of tailings in the Tailings Storage Facility (TSF); and a spill of hydrocarbons at the mine site which took place in May 2011 (resulting in the current prosecution action against the mine Operator). Six other commitments were considered to be partially compliant.

With regards to the outcomes of the technical audit of the MRM operation, in its 2012 Audit Report the IM commended the Operator for improving its environmental performance in many areas during the audit period including:

- flora and fauna monitoring both at the mine and at the Bing Bong Port;
- surface water and fluvial sediment monitoring;
- dust monitoring and mitigation at the mine site;
- structural monitoring of the river diversions; and
- improvements in the general reporting for many monitoring programs.

However, a number of on-going issues were highlighted in the 2012 Audit Report that require addressing, including the:

- volume of water stored in Cell 2 of the TSF;
- delineation of seepage at the TSF, and its effect on Surprise Creek;

- progress of acidification of the tailings and identification of the treatment options;
- identification and management of Potentially Acid Forming (PAF) rock waste at the Overburden Emplacement Facility (OEF) i.e. the waste rock dump; and
- progress of re-vegetation on the McArthur River diversion.

Like most mines of a similar size and complexity to that of the MRM operation, a range of potential risks from high to low were identified as part of the IM's applied risk assessment process contained in its 2012 Audit Report. As in last year's report, the IM identified what it considered two *extreme risks* associated with the TSF, these being: the risk of overtopping of the TSF cells leading to an embankment failure; and the potential for acid leachate migration from the TSF into Surprise Creek which is in close proximity to the facility. The IM also identified what it considered to be another four *high risks* which were also associated with the TSF and these include:

- Dry Season discharge of seepage containing salt and metals entering Surprise Creek and causing flora to die and/or bioaccumulation of metals in flora;
- Wet Season discharge as per the above potential impact;
- TSF Cell 2 embankment failure due to instability; and
- TSF Cell 2 embankment failure due to scouring at the toe of the embankment.

Issues regarding the TSF remain a strong focus for examination by DME through the Operator's annual MMP assessment process, as well as through departmental visits, inspections and audits of the MRM site.

In light of the IM's on-going concerns relating to the TSF raised in its previous 2011 report, the then Minister for Primary Industry, Fisheries and Mines directed MRM to undertake a third-party review of the stability, structural integrity, fitness for purpose and management of the TSF. The outcome of this report found that the TSF embankments are geo-technically stable under long-term and seismic conditions. The erosional stability of the embankments is considered to be medium, subject to on-going maintenance of vegetation and slope protection works. The third-party reviewer considered that under such conditions, the water retaining structures will continue to remain stable to the effects of erosion, and thus represents a lower risk of failure.

It is important that risk assessments, as conducted by the IM, are undertaken and reviewed routinely. It is also important to note that such risks are able to be reduced and mitigated over time in line with the application by the Operator of best practice methods, systems and processes.

DME welcomes the IM's 2012 Audit Report finding that MRM continues to demonstrate proactive efforts to improve their environmental performance. The Department is also supportive of the majority of the recommendations for further improvement put forward in the 2012 report. Information provided in the report will be used by the Department in its review of the Operator's MMP covering the 2012/2013 operational period, and in DME's upcoming annual audit of the mine which is scheduled to take place in early December 2012. Having reviewed the findings of the 2012 Audit Report, DME is satisfied that issues highlighted will, or are, being addressed by the Operator through a process of on-going continual improvement. Further, that the IM's review supports DME's assessment that mining and related operations at MRM are not impacting significantly on the surrounding environment.

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1 OUTPUT

The *Independent Monitor's Audit of the McArthur River Mine for the 2011 Operational Period* ("the 2012 Audit Report") was submitted to the NT Government on 1 October 2012. A review of the Audit Report's findings was undertaken by the Department of Mines and Energy ("DME" or "the Department").

The departmental review focused on the compliance and technical issues raised by the appointed Independent Monitor (IM) – Environmental Earth Sciences VIC - relating to the environmental condition, management and monitoring of the McArthur River Mine ("MRM") by McArthur River Mining Pty Ltd ("the Operator"), as well as the regulatory overview of the mine by DME.

The period examined by the 2012 Audit Report was from October 2010 to September 2011 ("the 2011 operational period"), which represented those activities covered by the Operator's 2010/11 Mining Management Plan (MMP) and Water Management Plan (WMP). The 2012 Audit Report also includes information from a site inspection of the MRM operations undertaken by the IM between 28 and 29 May 2012, as well as updated information provided by both the Operator and DME.

2 OBJECTIVES AND OVERVIEW OF THE INDEPENDENT MONITOR'S 2012 AUDIT REPORT

The stated objectives of the 2012 Audit Report are listed below.

1. Review the environmental assessments and monitoring activities undertaken by MRM.
2. Review environmental assessments and audits undertaken by DME.
3. Report to MRM and DME any urgent issues requiring investigation and reporting.
4. Provide an annual Audit Report to the Minister for Mines and Energy that:
 - assesses the environmental performance of MRM operations; and
 - recommends improvement measures to increase environmental performance.

The approach taken by the IM to evaluate these aspects included:

- a review of the MRM monitoring data, management systems, and assessments undertaken during the 2011 operational period via:
 - a statutory compliance assessment;
 - a technical review of data and procedures;
 - a site inspection; and
 - interviews with personnel;

- an annual update of the IM's risk assessment and gap analysis relating to the MRM operation;
- a review of environmental audits, assessment, management systems, and environmental monitoring undertaken by the DME pertaining to the 2011 operational period;
- community consultation and presentations; and
- provision of an annual report to the Minister for Mines and Energy regarding the environmental performance of the MRM operations.

The primary areas of focus for the 2012 Audit Report were:

- the performance of the tailings storage facility (TSF), particularly in terms of:
 - excess water storage in TSF Cell 2;
 - current and likely future seepage migration from TSF Cell 1 and Cell 2 into Surprise Creek;
 - geochemical assessment/hazard classification of tailings; and
 - effectiveness of the progressive rehabilitation of TSF Cell 1;
- rehabilitation and habitat creation along the river diversion channels;
- erosion and structural integrity of the river diversion channels;
- hydrocarbon management at the mine site and Bing Bong Port;
- management and monitoring relating to design and function of the Overburden Emplacement Facility (OEF);
- the ongoing performance of the Bing Bong Port dredge spoil ponds and perimeter drain since the previous audit;
- dust emissions from the Bing Bong Port concentrate storage shed, and the ore-crushing plant area at the mine site (known as the PACRIM);
- weed management along the river diversion channels and mine site;
- scientific robustness of routine monitoring results collected by the Operator MRM;
- issues of environmental concern to the community of Borroloola; and
- the level of detail and quality of reporting of monitoring results.

3 REVIEW OF THE DEPARTMENT'S REGULATORY ROLE

3.1 Background to mining regulation in the Northern Territory

Mining legislation and regulation

Mining activities do impact on the natural environment, and thus the prime role of regulation is to reduce this level of impact to an acceptable standard, while still allowing an activity to occur where the environmental impact can be balanced by the benefits of social and economic outcomes.

Governments' role is to determine what the balance should be with respect to fostering mining activities to further economic development against protecting the environment in its natural state.

The role of DME is to ensure that the activities of mining operations authorised under the Northern Territory's *Mining Management Act* (MMA) are undertaken in accordance with provisions of the Act.

DME uses the MMP, which includes the WMP, and the broader MMA to facilitate the incorporation of best practice methods, systems and processes in operational activities. This in turn facilitates continuous improvement and is consistent with the Act's co-regulatory approach.

Under section 82(c) of the MMA, the Minister, in exercising a power or performing a function under the Act, must have regard to the outcomes of any environmental assessment of mining activities undertaken under the *Environmental Assessment Act*. This provides the direct linkage between the authorisation and on-going regulation of mining activities undertaken by DME and the environmental assessment process now undertaken by the newly formed Environment Protection Authority (EPA).

Under the MMA any authorised mining activity that is likely to cause a substantial disturbance requires the posting of a 100 % rehabilitation security.

A *Memorandum of Understanding* (MoU) exists between DME and EPA for the formal referral of proposed new or amended mining activities that trigger agreed referral criteria. Routine discussions occur between agencies on relevant matters (e.g. water management on mine sites). The off-site discharge of water is regulated by the EPA under the *Water Act* (WA) via the issuing of Waste Discharge Licences. Environmental offence provisions in the MMA are aligned to those in the WA, with penalties for breaches set by the *Environmental Offences and Penalties Act*.

In relation to the activities of the MRM, DME reviews the Operator's MMP on an annual basis. Further, as part of this process DME also reviews the level of rehabilitation security applied to the site and this security is held in the form of bank guarantees.

Inspections, audits and check monitoring activities

DME periodically undertakes site visits, inspections and audits of mine sites in the Northern Territory. During the 2011 operational period – October 2010 to September 2011 - DME undertook the below activities with respect to MRM's mine site operations and its port loading facility located at Bing Bong.

- A mine site compliance audit was undertaken between 13 and 16 December 2010. Note: the next annual DME audit of the MRM site was conducted on 7 and 8 December 2011.
- Water quality check-monitoring activities by DME's Environmental Monitoring Unit (EMU) took place between 12 and 18 May 2011. Note: a further visit by the EMU team also took place on 13 December 2011.
- A site visit to investigate a spill of hydrocarbons at MRM took place on 23 and 24 June 2011.
- A field visit of the MRM site took place on 3 and 4 August 2011.

So far in the 2012 calendar year, DME officers have undertaken the following visits to the MRM site.

- A field visit which took place on 3 February 2012.
- An annual water quality check-monitoring activity by EMU which took place between 16 and 27 May 2011.

Note: The annual compliance audit for the MRM site is scheduled to take place in early December 2012.

Check monitoring programs undertaken by EMU of MRM and other large NT mining operations involve the collection of surface and groundwater samples for field measurements and subsequent analysis by a National Association of Testing Authorities (NATA) approved laboratory. The water quality monitoring points selected and the analytical suites examined are designed to provide a representative sample of an operator's environmental monitoring program to ensure a meaningful comparison of DME's data to that of the operator. The analytical suite is selected on a mine-by-mine basis with recognition of the dominant analytes in that water body reflective of mining process and surrounding geochemistry. Water quality results from the EMU monitoring are then compared against water quality data supplied by the operator to check that the operator's data are comparable and provide the DME with confidence regarding the overall site data supplied by the operator.

The check monitoring also enables interpretation of trends for validation against the operator's reported performance in comparison with appropriate standards, such as the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines (2000) and appropriate waste discharge licensing criteria. DME reviews the suite of elements annually during the mine site environmental monitoring program review, and periodically when results returned from a sampling event (DME or operator) indicate significant changes in water quality.

Assessment of both the operator's and DME's analytical data is undertaken as it is received throughout the year and a formal annual review of all data forms part of DME's annual mine site review and monitoring program assessment. Additional formal review is undertaken with the review of the Operator's annually submitted MMP.

3.2 Independent Monitor's assessment of departmental process and regulation

In relation to assessing the regulatory performance of DME, in its 2012 Report the IM reported that the Department continues to demonstrate thorough administrative procedures to regulate the environmental aspects of the MRM operation. Further, that the Department's assessment of the Operator's annual MMP is both thorough and technically appropriate, as is DME's procedures for undertaking check-monitoring of surface and ground water at and surrounding the MRM site.

In its Audit Report the IM also stated that while DME's assessment of the MRM's annual MMP was thorough, it noted that the time lag for approving the MMP was a potential issue. On this point the Department agrees that the approval process, in some circumstances, has taken a considerable length of time. Delays in approvals can be due to a number of factors including the need for the Department to regularly seek additional information from operators to clarify details and/or correct inaccuracies contained in their submitted MMP, as well as within Water Management Plans which form part of a MMP for larger sites. After submitting an annual MMP for assessment, often operators will also submit additional amendments for separate assessments. Operators frequently request that the Department prioritises assessment of their newly submitted amendments, ahead of their MMPs, which may further delay the assessment and approval of earlier lodged annual MMPs. The assessment of MMPs submitted late in the year is sometimes affected by reduced DME staffing numbers over the Christmas/New Year period. The Department is currently exploring options to try to reduce timeframes for the assessment of lodged MMPs, WMPs and other operator documents.

Under section 7.3.6 (Review of the DME's check monitoring), the IM in its 2012 Audit Report stated that it had previously reviewed DME's procedures for the check-monitoring of surface and ground water at the MRM site, and considered the department's activities were both comprehensive and appropriate.

In its 2012 Audit Report, the IM provided comments and recommendations with respect to:

- Quality Control (QC) procedures adopted by DME's Environmental Monitoring Unit (EMU) during its 2011 Field Report of the MRM site; and
- the chemical analysis of samples taken.

The Department acknowledges the IM's comments regarding the lack of Quality Assurance (QA)/QC details within the 2011 field report. However omission from the report itself does not suggest a lack of QA/QC in EMU's procedures. The Department will ensure future EMU reports contain QA/QC reporting and discussion, including Electrical Conductivity (EC) ratios and relative percentage differences (RPDs) for duplicate samples.

With respect to the IM's comments on analysis of samples, laboratory measured pH is not feasible due to extended travel times. The Department has confidence in the procedures that EMU use when measuring pH in the field due to the below-listed procedures being implemented.

- Meters are calibrated every day.

- Separate meters are used for alkalinity and acidity titrations as well as field pH.
- Several spare probes and a spare meter are present in the lab truck.
- The field pH meter is calibrated during the day if high or low pH values are anticipated.
- Titration pH meters can be used to cross check the field pH meter should unexpected results occur.
- Checks are done at the end of each day using standard solutions to check for creep in pH.
- All field staff are well-trained and operate under the philosophy that no procedural short cuts are to be taken.

For the last two years the Department has analysed all samples collected for major ions e.g. calcium, sodium, magnesium, potassium, chloride, sulfate, carbonate and bicarbonate. The inclusion of ammonia, nitrate, nitrite, phosphate and fluoride is only helpful in circumstances where they are present in high enough concentrations proportional to the other major ions analysed to have a significant impact on ion ratios. After a brief review of the departmental data, it does not appear that there are substantial numbers of ionic balances greater than 5%, nor do concentrations of major ions appear sufficiently low enough for these additional ions to substantially influence ratios or ionic balances. This was only a brief review and the Department commits to undertaking further analysis in order to justify their inclusion/exclusion.

In relation to other recommendations made by the IM under heading 7.3.6 in its 2012 Audit report, below is a summary of DME's responses.

- The Department agrees with the IM's recommendation to include selenium in the analytical suite.
- The Department does not agree with the assertion that filtration practices are in error due to elevated dissolved aluminium concentrations at pH values 5.5 to 8.5. Should suspended clay particles be smaller than 0.45 μm then it can be expected that acidification of a filtered sample for preservation will release aluminium contained within these particles and suspended colloids.
- The Department does not agree with the IM's comments regarding sending unpreserved samples to the laboratory. Filtration is designed to remove suspended particles that may act as adsorbents for metals as well as a source of metals. Preservation is intended to reduce adsorption with suspended particles and the sample bottle itself. Should particles be smaller than 0.45 μm then they will remain in the sample. It is likely that fine suspended clays smaller than 0.45 μm will release aluminium upon preservation however this is considered a conservative approach to the assessment of mobility of metals. Sending duplicate filtered samples, one preserved, the other unpreserved is almost certain to produce different results as the preserved sample will release metals from suspended particles less than 0.45 μm while the unpreserved sample will potentially reduce the concentration of metals due to adsorption by the sample container and suspended particles during transport. Adsorption during transport may increase particle size sufficiently so that laboratory filtration removes these particles. The Department will consider alternative methods such as using 0.1 μm for duplicate samples to better understand elevated aluminium concentrations between pH values of 5.5 and 8.5.

- It is likely that as turbidity increases so too does the quantity of suspended particles less than 0.45 µm. The Department does not agree with allowing sampling to settle before extracting a filtered sample. During the settling metals can be adsorbed by suspended particles, potentially skewing the results.
- The Department welcomes a review of bore construction logs. However the Department stands by the EMU groundwater sampling methodology.
- The Department will review EMU field reporting and change the format and data analysis undertaken should it be appropriate.

4 RISK ASSESSMENT

4.1 Outcomes of Risk Assessment

The stated purpose of the risk assessment in the 2012 Audit Report is to:

1. identify environmental risks associated with the MRM operations, which are considered significant in the opinion of the Independent Monitor team; and
2. evaluate whether environmental monitoring and assessment practices undertaken by MRM are adequate and appropriate to mitigate the risk of potential environmental impacts.

In the 2012 Audit Report the IM assessed 70 environmental risk items and classified the risk levels as follows:

- 2 *extreme* risks (same as in the 2011 report);
- 13 *high* risks (5 less than the 2011 report);
- 36 *moderate* risks (6 less than the 2011 report); and
- 19 *low* risks (an increase of 11 from 2011).

As in the previous 2011 Audit Report, the *extreme* risks in this year's report were again identified as:

- the potential overtopping of TSF cells leading to an embankment failure; and
- the potential acid leachate migration from the TSF into Surprise Creek.

The more significant *high* risk issues identified by the IM in its 2012 Audit Report included:

- Dry Season discharge of seepage containing salt and metals entering Surprise Creek and causing flora to die and/or bioaccumulation of metals in flora.
- Wet Season discharge of seepage containing salt and metals entering Surprise Creek and causing flora to die and/or bioaccumulation of metals in flora.
- TSF Cell 2 embankment failure due to instability.

- TSF Cell 2 embankment failure due to scouring at the toe of the embankment.

The IM's risk assessment register detailing all the identified risks for the MRM site is located in Appendix A (Table 20) of the 2012 Audit Report.

Issues and risks identified regarding the TSF remain a strong focus for examination by DME. Oversight takes through the annual assessment process of the Operator's MMP, as well as through departmental visits, inspections and audits of the MRM site.

In light of the IM's previous concerns relating to the TSF raised in its 2011 report, in December 2011 the then Minister for Primary Industry, Fisheries and Mines directed MRM to undertake a third-party review of the stability, structural integrity, fitness for purpose and management of the TSF. This review was undertaken by waste and water management consultants Allan Watson and Associates on behalf of MRM, and was provided to government on 14 September 2012.

The main findings of this report concluded that the TSF embankments are geotechnically stable under long-term and seismic conditions. The erosional stability of the embankments is considered to be medium subject to on-going maintenance of vegetation and slope protection works. The third-party reviewer considered that under such conditions, the water retaining structures will continue to remain stable to the effects of erosion, and thus represent a lower risk of failure.

It is important that risk assessments, as conducted by the IM, are undertaken and reviewed routinely. It is also important to note that such risks are able to be reduced and mitigated over time in line with the application by the Operator of best practice methods, systems and processes.

The outcomes of the IM's 2012 risk assessment will be considered by DME as part of its review of the Operator's 2012/13 MMP.

5 GAP ANALYSIS

5.1 Background

The purpose of undertaking a gap analysis is to identify gaps in the environmental monitoring and assessment of an operation that may require improvement. The definition of a gap is defined by the IM as a discrepancy between what is taking place, and what should be taking place, in order for an activity to be maintained at an industry best practice standard. Typically gap analysis includes a comparison of environmental performance against:

- best practice industry standards;
- expert assessment and recommendations; and
- the operator's statutory obligations.

5.2 Outcomes of Gap Analysis

In the 2012 Audit Report the IM identified a number of gaps in the Operator's ongoing monitoring program which are detailed in the Gap Register. DME concurs with the recommendation of the IM that the Operator use the Gap Register to demonstrate how the identified gaps will be addressed or have been closed.

The gaps identified in the IM's 2012 Gap Register will be examined by DME as part of its review of the Operator's 2012/13 MMP.

6 REVIEW OF MCARTHUR RIVER MINE'S COMMITMENTS

The 2012 Audit Report reviews the key procedures and systems, and selected commitments and conditions, associated with the annual MMP for the MRM operations. In the 2011 Audit Report one non-conformance was identified by the IM, which has been resolved for the 2012 Audit Report.

Of the 81 environmental commitments given by the Operator in its 2010/11 MMP, the IM found:

- 61 commitments were compliant;
- 12 commitments could not be verified;
- 6 commitments were partially-compliant; and
- 2 commitments were non-compliant.

The assessed non-compliances with MRM's MMP were in relation to the following commitments given by the Operator:

- *"No environmental fines, penalties or prosecutions."* This commitment appears to have been breached with the mine Operator being charged for offences under environmental provisions of the MMA arising from a significant spill of hydrocarbons which occurred at the mine site in May 2011. Currently this prosecution matter is before the NT Court of Summary Jurisdictions.
- *"The tailings will be deposited sub-aerially in thin layers to maximise the density of the tailings beach against the embankment, providing a low permeability beach of tailings between the decant water pond and the perimeter embankment."* During both the 2011 and 2012 site inspections, the IM observed tailings being deposited aqueously, but noted that sub-aerial deposition occurs once the tailings beach has risen above the spigot height.

The complete list of commitments assessed by the IM is contained in Appendix C of its 2012 Audit Report.

Overall, the IM noted that the Operator displayed a high level of compliance with the environmental commitments in the MMP 2010/11, which was also observed by DME during its 2011 compliance audit.

7 OUTCOMES OF THE TECHNICAL AUDIT OF MCARTHUR RIVER MINE'S ENVIRONMENTAL MONITORING PROGRAMS AND TECHNICAL REVIEW

The key areas focussed on by the IM during its technical audit undertaken in 2012 included:

- surface water and artificial water monitoring;
- groundwater monitoring and management;
- dust monitoring;
- soil monitoring;
- fluvial sediment monitoring;
- marine monitoring - seawater and sediment;
- flora and fauna monitoring;
- geotechnical monitoring;
- geochemical monitoring; and
- surface water hydraulics.

The following section is DME's commentary on the outcomes of the technical audit of the 2012 Audit Report.

7.1 Surface water and artificial water monitoring

In its 2012 Audit Report the IM concurs with the presentation and interpretation of surface water monitoring and management by MRM in the reporting period, and welcomes improvements made by the Operator in its monitoring activities. DME agrees with the IM's statements acknowledging these improvements.

The IM has recommended that:

- adjustments to the surface water monitoring program should be implemented by adding sampling points on the drainage line where seepage from the Overburden Emplacement Facility (OEF) was reported. In addition, seepage from the western toe of the OEF observed during the May 2012 inspection should also be included in the monitoring program for surface waters; and
- a discussion on the quality, precision, accuracy and reproducibility of results should be included in discussion within the WMP.

DME agrees with the IM's above recommendations.

7.2 Groundwater monitoring and management

The general conclusions and extensive recommendations for groundwater monitoring and management put forward by the IM are detailed on pages 47 and 48 of their 2012 Audit Report.

DME acknowledges the majority of the IM's recommendations and supports the inclusions of more detailed reporting by the Operator with regards to the groundwater monitoring and management at the MRM site.

However while the Department agrees with the IM recommendation to re-process TSF Cell 1 and the placement of a liner (as detailed on page 46 of the Audit Report), DME disagrees with the IM recommendation – also contained in the Golder Associates' TSF hydro-geochemical study report - to construct a diversion of Surprise Creek and use the existing channel as an interception trench.

In the Department's opinion this recommendation will disturb Surprise Creek unnecessarily and it is potentially difficult to separate the old and new channel hydraulically. A more satisfactory approach would be to:

- re-process TSF Cell 1;
- move Cell 1 back from Surprise Creek;
- construct an interception trench between Cell 1 and Surprise Creek; and
- line Cell 1.

It is not clear how both a permeable reactive barrier and an impermeable barrier can be installed together surrounding the TSF. The performance of these is also uncertain considering comments earlier in the IM report suggesting that high porosity, preferential pathways exist beneath the TSF.

7.3 Dust monitoring

In the 2012 Audit Report the IM commended the Operator for responding to recommendations made during previous audits with respect to dust mitigation controls, which in turn has resulted in improvements in this area of environmental performance. To continue with these improvements the IM recommends that the Operator:

- continues to increase dust mitigation measures at Bing Bong and PACRIM/ROM pad;
- ensures that QA/QC documentation is always obtained from laboratory conducting dust analyses; and
- address identified minor reporting issues.

DME supports the IM's recommendation for the ongoing development and improvement of dust management strategies. The Department will consider the recommendation provided by the IM during the evaluation of the Operator's dust monitoring as part of the review of the Operator's 2012/13 MMP.

7.4 Soil monitoring

In the 2012 Audit Report the IM noted that MRM had made significant improvements to its soil monitoring program with the provision of much more detailed information contained within its submitted 2010/11 MMP. However the IM also states that there is still a way to go before efforts in this area mirror that noted in the Operator's much improved dust monitoring and management plan.

In order to increase the Operator's performance in its soil monitoring program the IM recommends that MRM should:

- refine the analytical suite and interpretation of data;
- increase spatial density of the sampling program (at least every five years), or alternatively undertake delineation sampling of areas with increased metal concentrations; and
- develop site-specific trigger levels.

DME supports the recommendations put forward by the IM and will use information contained in the 2012 Audit Report in its examination of MRM's MMP for the 2012/13 operating period.

7.5 Fluvial sediment monitoring

In the 2012 Audit Report the IM considered that the fluvial sediment monitoring program was generally appropriate and acknowledges the comprehensiveness of the laboratory analytical program undertaken by the Operator. DME concurs with the IM's commendation of the Operator. However the IM, as with the Department, remains concerned about possible effects that elevated heavy metals in sediments may have on macro-invertebrate communities, particularly in portions of Barney Creek.

The IM recommends that the Operator:

- pays urgent attention to prevent the ongoing ingress of dust/runoff sediments entering creeks and rivers close to the mine;
- addresses elevated concentrations within Barney Creek sediments by implementing the planned mitigation measures;
- includes a discussion for all parameters analysed in reporting documentation;
- includes QA/QC samples (namely duplicates and splits) to add robustness to data; and
- incorporates background sediment levels determined by the macro-invertebrate assessment as long-term targets.

DME supports the IM's recommendations for the ongoing improvement of the analytical program and reporting of the fluvial sediment monitoring program. The recommendations by the IM will be considered during the review of the fluvial sediment monitoring program by DME.

7.6 Marine monitoring – seawater and sediment

In its 2012 Audit Report the IM stated that there has been a considerable improvement in the clarity and organisation in the presentation of the seawater and marine sediment monitoring program in the most recent 2011/12 WMP.

Further, that concentrations with respect to potential seawater and sediment contamination has either decreased or remained below levels of concern which in its view most likely reflects improvements in the management of dust at the Bing Bong Port facility. It is expected that with further planned improvements for the management of fugitive dust emissions from the facility, heavy metal concentrations in seawater and particularly sediments within the swing basin will decrease even further.

Key recommendations made by the IM for further improvement of the seawater and marine sediment monitoring programs are as follows:

- include QA/QC samples (namely duplicate and splits) in the regular seawater and sediment programs;
- upgrade DGT monitoring QA/QC procedures;
- include presentation of trends for sediment monitoring results;
- include assessment of sediment samples from transects outside the swing basin; and
- include lead isotope analysis of suspended sediments from the water column in the McArthur River delta region.

DME supports the recommendations presented in the IM's review of the seawater and marine monitoring programs.

7.7 Flora and fauna monitoring

In the 2012 Audit Report the IM noted that the flora and fauna monitoring and management at MRM is largely moving in a positive direction. However, the IM reports that a number of monitoring gaps still exist and these include:

- vegetation monitoring has not been expanded to cover the entire section of the McArthur River diversion channel;
- a suitable reference site for the Barney Creek revegetation program has yet to be established; and
- control sites remain absent from the seagrass monitoring program making it more difficult to interpret causes and trends in seagrass distribution.

In response to the review of the flora and fauna monitoring program, the IM recommends the following activities be undertaken:

Mine site flora monitoring recommendations

- More focus on planting of targeted species Freshwater Mangrove *Barringtonia acutangula* and Native Cane Grass *Chionachne cyathopoda* along the river diversions;
- increase planting on bank slopes of river diversions;
- expand vegetation monitoring on the McArthur River diversion channel to include additional sites to allow representation of the entire length of the channel;
- incorporate additional analogue sites into the survey design for vegetation monitoring at Barney Creek. The current analogue site located on Surprise Creek is unsuitable due to its location on a different system and its position downstream of the tailings dam;
- increase weed control on the opposite bank of the McArthur River diversion channel;

- conduct trials on the survival of different riparian species at different levels on the bank slopes to allow selective planting;
- conduct monitoring on heavy metals in vegetation in McArthur River and Barney Creek to investigate uptake of metals as a result of mine operation;
- Investigate the possibility of conducting a combined weed control program with pastoral properties on the McArthur River, upstream of the mine. This will help to stop the reinfestation of weed controlled areas from infestations further upstream (outside of operational areas) and will promote community relations;
- consider relocating the remainder of the cattle exclusion fencing along the McArthur River diversion to higher ground to decrease chances of it being breached during the Wet Season;
- replace barbed wire in fencing with plain wire as barbed wire catches debris in high flood periods, weighing the fence down and causing it to become dislodged;
- remove old cattle exclusion fencing along the McArthur River diversion channel as it poses a hazard to fauna and staff;
- conduct bi-annual vegetation monitoring at Surprise Creek to evaluate effects of tailings leachate;
- if TSF Cell 1 is relocated in the future, intensive monitoring of the flora and fauna of Surprise Creek should be conducted before, during and after works due to the likelihood of short term increased seepage during disturbance of the cell;
- expand information regarding rehabilitation in Table 3.1 in the 2011/2012 MMP to include areas which will require rehabilitation in the future; and
- improve the topsoil map to make it clearer where topsoil is stockpiled.

Bing Bong flora monitoring recommendations

- Investigate alternative options for a dredge spoil rehabilitation trial as a monitoring gap has now existed for a number of years;
- conduct monitoring of vegetation surrounding the dredge spoil spoon drain experiencing vegetation dieback;
- spoon drain maintenance works should be carried out annually to remedy damage caused by erosion and cattle;
- exclude cattle from the dredge spoil area; and
- continue with the weed control program in place.

Bing Bong Fauna recommendations

- Include monitoring of mosquito larvae in artificial ponding areas, three days after large wet season rains in the annual mosquito monitoring program (Department of Health, 2011);
- incorporate the insertion of drainage holes in waste tyres into the Waste Tyres and Conveyor Belt Procedure;
- rectify ground depressions by inserting drains and/or infilling, where possible;
- if not already in place, an insecticide spraying register should be kept to assess areas and times of year that spraying is conducted; and
- extend the survey area to the Limmen Bight River in bi-annually migratory bird surveys as it appears to be a significant area for migratory species.

Marine Monitoring recommendations

- Establish control sites for seagrass monitoring;
- use data from the Yanyuwa IPA, Barranyi National Park and Limmen Bight Marine Park as control data in the marine monitoring program particularly in the sea grass monitoring;
- in the annual marine report, categorise oysters as bivalves and *Telescopium telescopium* and *Terebralia semistriata* as gastropods as both as molluscs and this can cause confusion; and
- continue to observe trends regarding the presence of heavy metal in sediments on the beach west of the load-out facility.

DME concurs with the majority of the IM's recommendations and encourages the Operator to consider these during its review of the flora and fauna monitoring programs.

7.8 Geotechnical monitoring

In its 2012 Audit Report the IM identified a number of areas of geotechnical monitoring that require modification, including at the TSF, OEF and at the Bing Bong dredge spoil ponds. For each structure the IM has provided detailed recommendations for the Operator to consider and these are detailed below.

Recommendations from TSF embankment inspection 2012

- Monitoring bores should be installed around the perimeter of both Cell 1 and Cell 2 to ascertain the level of the phreatic surface within the embankments;
- monitoring bores along Surprise Creek should be monitored to include an interpretive assessment of the seepage to investigate the likely source;
- a number of piezometers have been installed during the monitoring period, however they are limited to a single line across the embankment of Cell 1 and do not provide sufficient monitoring locations to gain an adequate understanding of the hydrogeological conditions present within the embankment. It is recommended that at least 6 lines of piezometers be installed in each of the TSF Cells (Cell 1 and Cell 2) with vibrating wire piezometers installed within the foundation material and tailings within three boreholes in each line;
- investigate the origin of seepage at locations south of the Water Management Dam (WMD) and towards Surprise Creek. Investigation should assess the presence and likely effect of a paleochannel on the seepage as well as the source (WMD, Cell 1, or Cell 2) of the seepage, and seepage flow direction;
- additional seepage control measures are recommended for seepage from Cell 1 into Surprise Creek, which include lowering the phreatic surface in the TSF to reduce seepage escaping to the environment. Furthermore, the system should be designed to allow seepage recovery to occur year round and consideration of a subsurface seepage recovery system with submersible pumps should be made; and
- install a seepage recovery system downstream of the water management dam (WMD) embankment at the intersection between the WMD and Cell 2 to recover seepage in this area. To allow for subsurface collection during the Wet Season, the seepage system should be designed to allow subsurface collection of seepage year round.

Recommendations from TSF Cell 2 observations

- Installation of piezometers along the southern embankment to fully define the location of piezometric surface within the embankments;
- a full design and stability review of the southern embankment; and
- consideration should be given to relocating the decant pond to the common embankment between Cell 1 and Cell 2 where the increased phreatic surface will less likely effect the stability of the embankment as it is supported by the tailings stored within Cell 1. Furthermore this would allow any embankment raises along this common wall to be easily designed as water retaining embankments with appropriate design features (such as filter drains and drainage blankets) to be constructed.

Recommendations for OEF geotechnical monitoring and management

Based on the inspection of OEF, the following list of recommendations were made by the IM in relation to geotechnical aspects observed during its 2012 Audit.

- A layer of Potentially Acid Forming (PAF) waste should be immediately paddock dumped over the completed basal clay liner, as specified in the design report, to prevent desiccation of the basal clay liner;
- exposure of the completed clay cover on the batters to the elements should not be allowed, as this has the potential to desiccate the clay leading to cracking which increases the permeability of the clay. Furthermore the exposed clay on the batter is susceptible to erosion during rainfall events. A layer of Non-Acid Forming (NAF) waste should be immediately dumped over the completed clay cover on the batter to protect the cover;
- a cover should be constructed on the top surface of the OEF when it reaches design height and prior to each Wet Season to minimise infiltration of rainfall and runoff into the waste;
- implement and report on the QA/QC procedures for testing the clay liner as drafted and approved by MRM, and ensure the level of QA/QC in the MRM procedures is on par or better than the suggested URS [engaged consultant] procedures, so that the clay liner is being constructed in accordance with the design; and
- for all future cell constructions, ensure that the clay liner is placed under Level 1 supervision, or apply the specifications as drafted by MRM, if required in conjunction with URS.

Geotechnical recommendations for Bing Bong Dredge Spoil monitoring

Based on the inspection of Bing Bong dredge spoil, the following recommendations were put forward by the IM.

- As there is no piezometric or crest settlement monitoring being conducted at Bing Bong, it is recommended that piezometers are installed around the facility and survey monuments are installed on the embankment crest, and both the piezometer and survey monuments should be monitored on at least a quarterly basis and after heavy rainfall events;
- the existing drain around the facility needs to be cleaned out to allow free flow of water. It may also be beneficial to install a subsurface drainage system at a deeper depth to allow the phreatic surface at the embankment toe to be lowered further

than can be achieved by the open drain; this should be assessed as part of the geotechnical review recommended in the previous comment; and

- at present, stormwater is allowed to drain from cell to cell. However, an engineered spillway should be designed and constructed to allow excess water to be discharged from the facility in a safe manner in the event of heavy rainfall or excess water from dredging activities.

In its report the IM also identified a number of modifications that it felt needed to be commenced prior to the 2012/13 Wet Season and these are detailed below.

Tailings Storage Facility

- Installation of piezometers in embankments and comprehensive dam safety review including stability analysis of the embankments, especially the Southern Embankment of Cell 2 where water is ponding against the embankment;
- a review of available capacity to store tailings, process water and rainfall runoff whilst maintaining sufficient freeboard also taking into account the initiative to increase evaporation by using a larger part of the WMD. A review of the water balance including detailed water balance modelling should be carried out;
- following a water balance review, excess water is to be removed from the facility;
- the pipeline on the ramp to TSF should be bunded or a secondary containment pipe installed; and
- as part of the proposed 4m raise, detailed stability analyses needs to be carried out, which includes monitored (as opposed to estimated) information regarding the phreatic surfaces in the tailings and embankments.

Overburden Emplacement Facility

- Technical specification for clay placement is required and a higher level of supervision for clay placement;
- application of the MRM standards and correlation of those standards to the original URS design requirements. Confirmation that the testing density and sample density is adequate and in line with best practice and standards;
- inclusion of liner testing in the geotechnical reporting; and
- construction of a top cover over the OEF prior to Wet Season.

Bing Bong Dredge Spoils

- A geo-technical review of embankment stability is required prior to the Wet Season (this is assumed to be taking place in the latter half of 2012);
- installation of piezometers and survey monument and a geotechnical monitoring program to be instigated; and
- the installation of an engineered spillway is required before the Wet Season.

DME concurs with the majority of the IM's conclusions and recommendations on these issues detailed in its 2012 Audit Report. The Department also emphasises that it is imperative for relevant information and contingency measures to be explored by the Operator prior to undertaking works and monitoring at the MRM operations.

In light of the IM's previous concerns relating to the TSF raised in its 2011 report, the then Minister for Primary Industry, Fisheries and Mines directed MRM to undertake a third-party review of the stability, structural integrity, fitness for purpose and management of the TSF. The conclusion of this report, undertaken by Allan Watson

Associates – commissioned by the mine Operator - found that the TSF embankments are geo-technically stable under long-term and seismic conditions. The erosional stability of the embankments is considered to be medium, subject to on-going maintenance of vegetation and slope protection works. The third-party reviewer considered that under such conditions, the water retaining structures will continue to remain stable to the effects of erosion, and thus represents a lower risk of failure.

All aspects of the Tailings Storage Facility continue to be a strong focus of DME's regulatory oversight of MRM's mining and associated operations.

7.9 Geochemical monitoring

In its report the IM states that planning for the long term acidification of the tailings and mitigation of acid seepage is likely to be the most significant issue for mine closure relating to the TSF. DME concurs with this observation.

The IM's recommendations for the geochemical monitoring of the tailings are outlined below.

- The Operator needs to correct errors in the existing conceptual model of seepage from TSF cell 1;
- accelerate leaching trials on the current tailings needs to be undertaken to establish the number of pore volumes required to confirm buffering capacity;
- there is a need to evaluate and design a tailings seepage and closure management system, including in the evaluation the possibility of recovering the tailings from TSF Cell 1; and
- there is also a need to investigate and discuss when and where seepage will occur from TSF Cell 2, and what the likely impacts will be.

DME agrees with the IM's recommendations regarding the requirement for the Operator to better understand the geochemical characteristics of wastes and materials at the MRM operations. There is also a need to improve the management and monitoring of seepage and quantity issues, in line with industry best practice such as recommended in the ANCOLD guidelines for tailings storage facilities. DME supports the IM's view that the Operator needs to undertake further waste rock characterisation and hydrogeological modelling to better understand the risk and closure/remediation options for the MRM operation. DME has and will continue to evaluate these issues as part of the review of the Operator's MMP submissions.

7.10 Surface water hydraulics

In the 2012 report the IM stated that no significant signs of recent or new erosion were visible at either the McArthur River or Barney Creek diversion channels during its May 2012 site inspection. The IM also reported that the Operator's 2010/11 WMP was far more complete than the previous WMP report. However an ongoing issue for the IM is the apparent reluctance of the Operator to include previously recommended aerial photography to assist with the reporting of on-going, or new, erosion areas.

Matters relating to surface water hydraulics will be reviewed as part of the department's assessment of the operators 2012/13 MMP, as well as during DME's upcoming audit of the MRM site scheduled for early December 2012.

8 CONCLUSION

DME welcomes the IM's 2012 Audit Report finding that MRM continues to demonstrate proactive efforts to improve their environmental performance. The Department is also supportive of the majority of the recommendations for further improvement put forward in the 2012 report. Information provided in the report will be used by the Department in its review of the Operator's MMP covering the 2012/2013 operational period, and in DME's upcoming annual audit of the mine which is scheduled to take place in early December 2012.

Having reviewed the findings of the 2012 Audit Report, DME is satisfied that issues highlighted will, or are, being addressed by the Operator through a process of on-going continual improvement. Further, that the IM's review supports DME's assessment that mining and related operations at MRM are not impacting significantly on the surrounding environment.