Independent Monitor
COMMUNITY REPORT

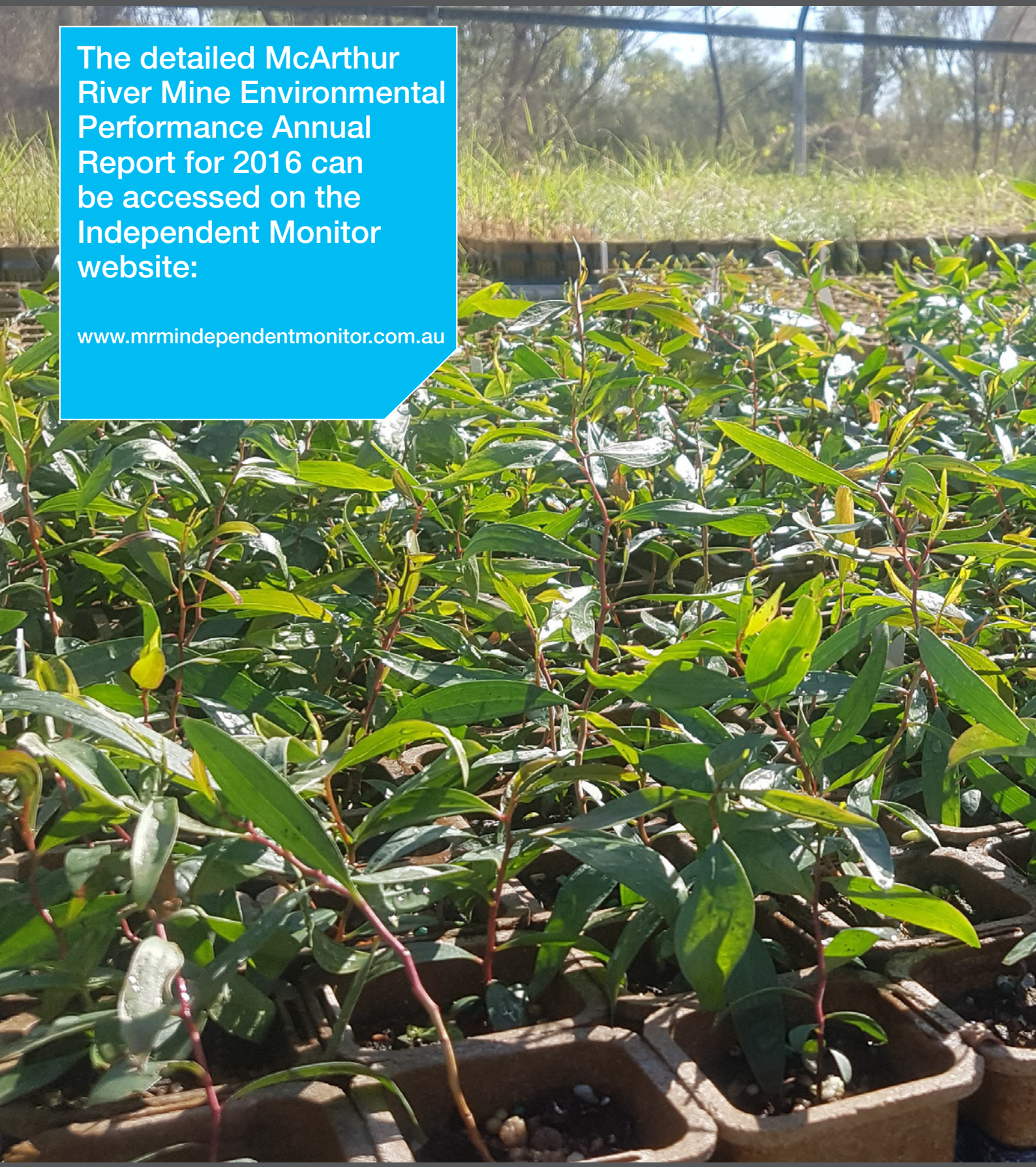
McARTHUR RIVER MINE

December 2017

ERIAS GROUP

The detailed McArthur River Mine Environmental Performance Annual Report for 2016 can be accessed on the Independent Monitor website:

www.mrmindependentmonitor.com.au



Plants in MRM nursery

Environmental Performance 2016

Introduction

The Independent Monitor (IM) has prepared this community report to summarise the findings of the IM review of the McArthur River Mine environmental performance for the 2016 Operational Period (from October 2015 to September 2016).

Improvements noted during this period include:

- Improved understanding of geochemical properties of waste rock and tailings materials at the mine site.
- Development of improved waste rock classification criteria.
- Improvements in the understanding of groundwater across the site.
- Continued improvements in management of tailings.
- Improved quality control in constructing the northern overburden emplacement facility.
- Increased monitoring of metals in freshwater fauna and flora in Barney Creek (including monitoring of freshwater macrophytes).
- Continued declining levels of contamination in biota (sampled from SW19) (e.g., Lead has declined six fold since 2014).
- Planting of over 25,000 tubestock, including over 20,000 along the McArthur River diversion channel.
- Placement of large wood debris into downstream end of McArthur River diversion channel.

A number of areas for improvement have been identified which are detailed in this report.

McArthur River diversion channel

The Key Issues in this Operational Period

Waste Rock	The long term management of waste rock remains a key issue at the mine site given its potential to generate acid, saline and metalliferous drainage
Tailings Storage Facility	Management continues to improve but seepage issues are ongoing
Water Quality	There is limited impact on downstream water quality to date, however, mine-derived contaminant loads for Barney Creek are shown to be significant and should be assessed with regard to potential downstream impacts
Barney Creek Haul Road Bridge	Water and sediment quality remain at risk from poor quality seepage and surface runoff, as such fish and plants are susceptible to contamination
McArthur River Diversion	A wholesale shift in channel position has occurred immediately upstream of the diversion channel offtake with potential impacts to the diversion channel and integrity of the mine levee wall.
DPIR Performance	The DPIR should improve the tracking of issues observed during site visits, even where an instruction is not warranted

South east PAF runoff dam

Scope of this Report

The role of the IM is to assess the environmental performance of the McArthur River Mine by reviewing environmental assessments, monitoring and audits undertaken by McArthur River Mining (MRM) and by the Department of Primary Industry and Resources.

Issues relating to mine safety, community and social issues, and mine administration matters are not included in the assessment.

The scope of the assessment includes the mine itself and Bing Bong Loading Facility.

Waste Rock

While management of waste rock continues to be a key environmental risk, MRM has expended considerable effort to better define the risks associated with mine materials in order to improve operational and long-term management of waste rock.

NOEF foundation preparations showing a compacted clay base followed by low salinity non acid forming waste rock

The risk of AMD generation and the associated potential adverse impacts both on site and downstream remains the most significant environmental issue at the mine.

Improvements

In the 2016 operational year, the IM noted continual improvements in MRM's management of waste rock, particularly with regard to minimising potentially acid-forming (PAF) rock issues, including:

- Completion of geochemical testing and investigations that have resulted in a comprehensive dataset of the geochemical properties of waste rock at the mine site.
- Use of kinetic data to develop improved waste rock classification criteria.
- Completion of a number of studies and assessments including:
  - To address information gaps related to waste rock composition (at the northern, southern and wester overburden facilities).
  - Cover design modelling and assessment.
  - Groundwater modelling to better understand seepage pathways for OEFs.
  - Erosion modelling to better understand potential impacts on long-term dump cover integrity.
  - Testing and assessment of tailings surface oxidation potential and lag times.
  - Pit water quality modelling.
- Commissioning an independent consultant to investigate whether the placement and containment of mining waste at the NOEF is causing, or may cause, environmental harm to the receiving environment.
- Placement of newly-mined PAF waste rock in 2 m high layers which are then compacted by trucks.
- Construction of a minimum 35 m wide metalliferous/saline-non acid forming (MS-NAF) halo zone around the west, south and east (in progress but almost complete) side of the older West Stage of the NOEF to help control movement of oxygen into PAF materials in this older part of the NOEF.

What is Acid Rock Drainage?

Acid rock drainage, also called acid and metalliferous drainage, is the outflow of acidic water from rock. A related process is the drainage of saline water from rocks.

'Potentially acid-forming' (PAF) rocks occur naturally in the environment and are harmless when below the groundwater table or deep below the ground surface where oxygen levels are low. When PAF rocks are exposed to air, they can break down, causing acidity.

Similarly, salt and metals are a natural part of rocks and soil, which can leach out when some types of rocks break down in response to air and water. Following rainfall, water containing salt, acid and/or metals can run off into creeks or leach into groundwater.

Acid rock drainage and saline drainage may be controlled by covering rocks with a 'cap' of clay and rock, protecting them from air and water. In some locations, the rock is placed under water, which excludes air and prevents the breakdown of rock.

Environmental Impact Assessment

Significant progress has been achieved in further understanding the waste rock and development of management strategies. The Overburden Management Project Draft Environmental Impact Statement (EIS) incorporates information from the studies and assessments of waste rock issues as well as management options.

The EIS also includes the Overburden Management Project Conceptual Mine Closure Plan. While the revised Closure Plan is yet to be approved, it incorporates the following proposals:

- Revised cover design for overburden emplacement facilities.
- Retreatment and placement of tailings back into the open pit following the cessation of mining.
- Accelerated filling of the open pit and a weir structure to be constructed in the mine levee wall to allow McArthur River to flow through the pit at high flows.

Recommendations

The IM recommends that MRM undertake the following key actions:

- Carry out further investigations to determine the direct seepage contribution from the NOEF to the groundwater system and to confirm the effectiveness of the advection covers.
- Proceed with trial cover designs.
- Complete treatment of acid water in NOEF SPSD/SPROD before the next wet season to avoid uncontrolled release.
- Prepare a tailings kinetic test report for the next IM reporting period.

Seepage collected in the SPROD

Tailings Storage Facility (TSF)

Overall, the TSF has been well managed in terms of operation, inspections and external review during the current reporting period. For the existing TSF designs and configurations, the current minimisation of water storage and planned seepage recovery seem to be the only viable options to control direct impacts on receiving creeks from ongoing and historical process water.

What is the problem with seepage?

Seepage of water from a tailings facility can impact on groundwater quality, for example, making water and soils saltier. There is also potential for release of acidic seepage. This in turn can affect aquatic and terrestrial ecosystems where groundwater is discharged to creeks or the surface.

Seepage at Surprise Creek

Inset 1

TSF Cell 2, showing tailings pipeline

Cell 2 tailings beach

TSF Cell 2

Poor quality leachate from the TSF is present in groundwater and surface drainage due to inadequate management of seepage during operations. Process water appears to be the key source of contamination rather than oxidising pyrite in the tailings.

Closure

The Draft OMP EIS conceptual mine closure plan, outlines a new strategy for the closure of the TSF involving the retreatment of tailings following the completion of mining and placement of this material back into the open pit. The IM believes that this strategy is a considerable improvement on the currently-approved strategy of the tailings remaining in situ with a cover system being implemented over the TSF.

Improvements

New controls for the TSF during the 2016 operational year included:

- Completion of the Stage 3 raising of Cell 2.
- Construction of a new Cell 2 spillway to replace the original and to facilitate safe discharge for the Stage 3 raise.
- Construction of a bentonite cut-off wall at the southern end of the decant access wall to limit TSF water into the rockfill platform.
- Additional investigations and assessments as part of the TSF Life of Mine studies.
- Updated stability assessment based on the results of new site investigations and measured water levels within the TSF embankment.
- An annual dam safety inspection by the TSF designer.
- Updated water balance modelling to account for TSF Cell 2 Raise 3, pond water reclamation, revisions to TSF Cell 1 surface water management and changes to the water management dam operation.

What are tailings? How does the TSF work?

Tailings are the ground-up rock remaining after extracting metal from the ore.

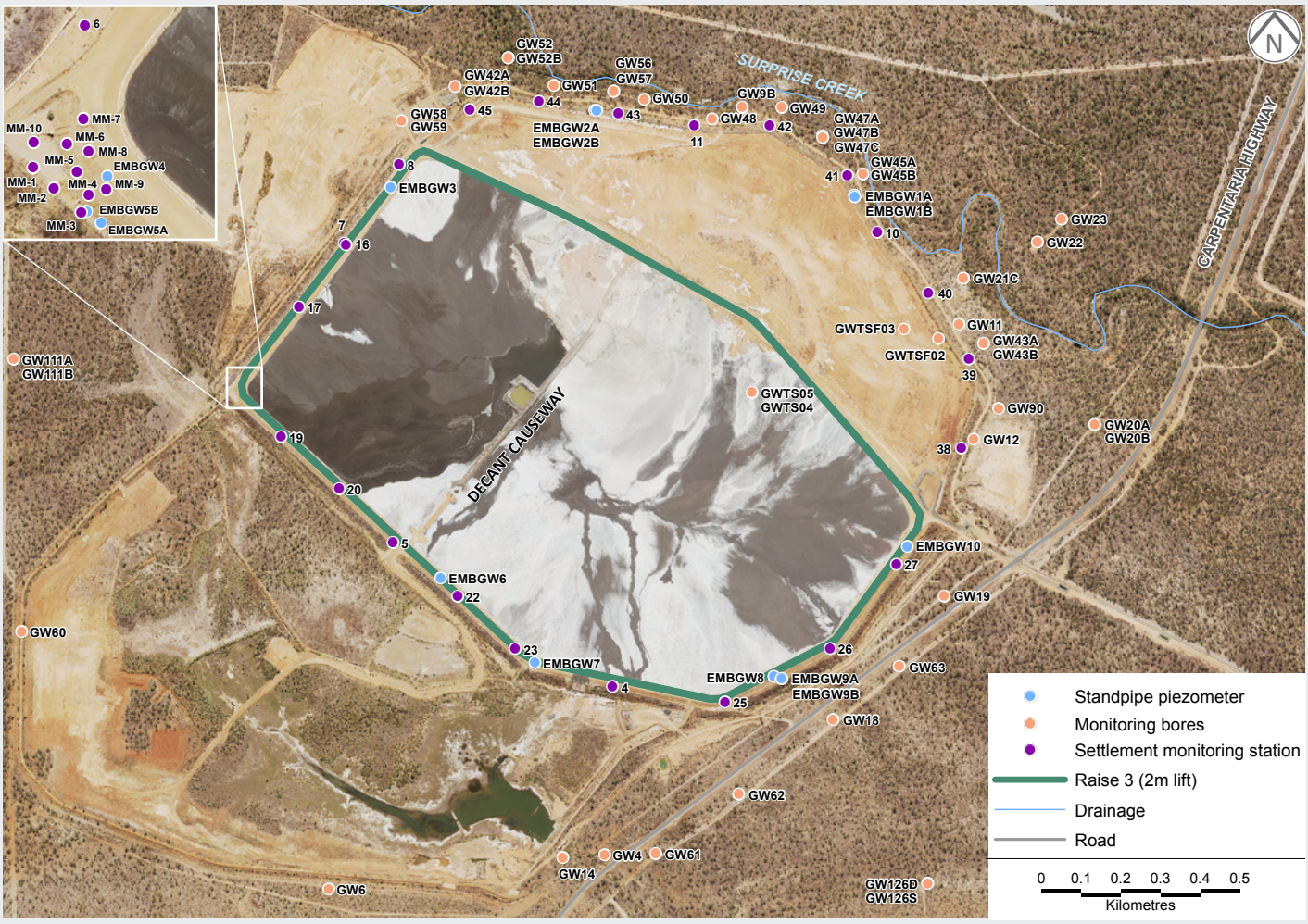
The tailings are piped from the mine's processing plant and deposited around the perimeter of the TSF. Here, the ground rock settles out, while wastewater flows to the centre of the TSF and is recycled.

The tailings are deposited in thin layers which allows them to dry out and consolidate, increasing the strength of the TSF.

Recommendations

The IM recommends that MRM:

- Undertake further investigations of the causes of continued seepage through the TSF Cell 2 embankment and provide options for limiting further seepage and reducing water levels within the embankment.
- Assesses the impact on the mine site water balance should TSF Cell 2 spill to the water management dam thereby contaminating water in the dam and making it unsuitable for off-site release.
- Undertake inspection of the entire tailings pipeline including checking flange bolts to confirm correct assembly.



Overview of TSF showing locations of monitoring sites

Barney Creek Haul Road Bridge

MRM continues to implement monitoring programs and management controls to reduce water and sediment contamination near the bridge.

Dust
Dust monitoring programs and management practices continue to improve. An Air Quality Management Plan is currently being prepared for MRM and will include dust mitigation plans for both the mine site and Bing Bong Loading Facility, targeting the most impacted areas as identified by dust monitoring.

Water and sediment quality
Surface water and sediment quality near the haul road bridge remain at risk from poor quality surface runoff carrying dust generated by mine processing and transport activities.

McArthur River Mining continues to implement water and sediment monitoring programs and management controls. For example, several sediment traps are in operation around the bridge and a new sediment sump is being constructed during the 2017 dry season to capture runoff from nearby haul roads.

A small dam within the Barney Creek diversion channel captures sediment and is cleaned out each dry season, while a roadside berm is maintained adjacent to the bridge during the wet season, diverting runoff to a sediment basin.

Barney Creek haul road bridge

Fish
Fish caught at the Barney Creek haul road bridge continue to contain elevated levels of lead. However, concentrations of lead in fish have generally dropped yearly since 2012, due to controls that MRM have implemented.

New MIA sump under construction

Existing sediment traps and new MIA sediment sump

Water Quality

Surface water quality monitoring indicates that adverse impacts on downstream surface waters due to the mine are currently limited, although some effects are noticeable in watercourses within the mine lease boundaries (and this is not unexpected).

Dewatering pump located in downstream section of the Barney Creek diversion channel

McArthur River Mining continues to devote considerable resources to water management at both the mine site and Bing Bong Loading Facility.

The IM considers that the existing surface water controls at the McArthur River Mine and Bing Bong Loading Facility are generally adequate. However, some deficiencies are still evident in certain aspects of the monitoring program, e.g., determination of mine-derived metal loads within the context of natural loads and assessment of the implications with respect to relevant environmental values

Successes

The IM notes the following successes for the 2016 operational year:

- Results from the monitoring program demonstrate a relatively high level of success in terms of compliance with WDL discharge requirements.
- Elevated sulfate concentrations at SW11 in the latter part of the dry season have been a potential concern in previous years, although this was not evident in the current IM reporting period. McArthur River Mining's use of a dewatering pump in the downstream section of Barney Creek diversion channel late in the 2014 dry season and again in the 2015 dry season remains a useful control measure.
- Reporting of the QA/QC data for surface water monitoring continues to show improvement.

Surface water monitoring sites - McArthur River Mine

Mine-derived Loads

The IM recommended in its review of the 2012 and 2013 operating years (and subsequent reviews) that mine-derived loads of contaminants reporting to the McArthur River should be reported. The IM is pleased to report that MRM has made some progress on this issue.

During the operating year MRM calculated estimated mine-derived loads over the period 2014/15 for zinc, lead, total dissolved solids and sulfate at SW06 (located in Barney Creek). The results indicated that:

- 97% of total zinc was mine derived.
- 80% of total lead was mine derived.
- 99% of sulfate was mine derived.
- 54% of total dissolved solids was mine derived.

Although the loads in McArthur River itself have not been determined by MRM, the estimates given above demonstrate the importance of load calculations and the need to adopt an approach that reflects the entire mine site and the upstream catchment.

The IM's view remains that, until load estimates (and load balances) are available, possible downstream impacts associated with the mine potentially remain unknown to some degree, and quantification and targeting of mine-associated sources remains poorly defined. The IM strongly endorses MRM's commitment to determine mine-derived loads in surface water as a high priority, and MRM has advised that a comparison of mine-derived loads and McArthur River background loads will be completed for the 2016/17 wet season data.

Recommendations

The IM has recommended that MRM:

- Maximises the volume of Class 4 water that is discharged to McArthur River (while still protecting downstream environmental values), thereby minimising the volume of water stored on site.
- Determines the environmental values to be protected in Barney Creek, Surprise Creek and McArthur River diversion channel in conjunction with relevant stakeholders, with the outcomes being used to direct measures to mitigate mine-derived elevated metal and major ion concentrations upstream of SW11 within the mine lease boundaries.
- Implements real-time in situ monitoring at SW11 with the issues observed during the 2015/16 wet season (i.e., burial of the probe by deposited sand) being appropriately addressed.

Fish and Shellfish

The potential for human health impacts from the elevated concentrations of metal in biota from Barney and Surprise creeks are negligible.

Poster used in fish consumption survey. Source: Indo-Pacific Environmental

Exposed sites (sites within close proximity to the mine) on Surprise and Barney creeks have the highest concentrations of lead and zinc, and other metals are elevated in these sites.

There is no evidence of contamination of biota in the McArthur River near the mine site. Overall, evidence suggests that contamination of biota as a result of MRM's operations is limited to the mine site and specifically Surprise Creek below the TSF and Barney Creek adjacent to and downstream of the ROM pad.

Lead
The 2016 assessment sampled sooty grunter, barramundi, bony bream, chequered rainbowfish, spangled grunter as well as freshwater prawns and mussels.

Although there is evidence of contamination in the vicinity of the mine site, the majority of biota collected had concentrations of lead and other metals well below the maximum permissible concentration. Fish with the highest concentration of lead in their muscle tissue were either very small (chequered rainbow fish, generally less than 5 g) or generally very small and unpalatable (bony bream).

The IM noted the following:

- Monitoring of freshwater biota at McArthur River Mine continues to improve. Surveys of local fishing habitats and fish consumption indicate that, for the most part, monitoring of metals in freshwater fauna is well targeted.
- Contamination at SW19 (Barney Creek haul road bridge) is declining likely due to controls implemented by MRM. For example, the mean concentration of lead recorded in bony bream has declined more than six fold since 2014.

Monitoring of exposed sites on Barney Creek and the Barney Creek diversion channel adjacent to and downstream of the ROM pad indicates that mine-derived lead contamination is more widespread in this system than previously recognised.

Acoustic tagging (from sawfish tagging memo). Source: Indo-Pacific Environmental

Successes

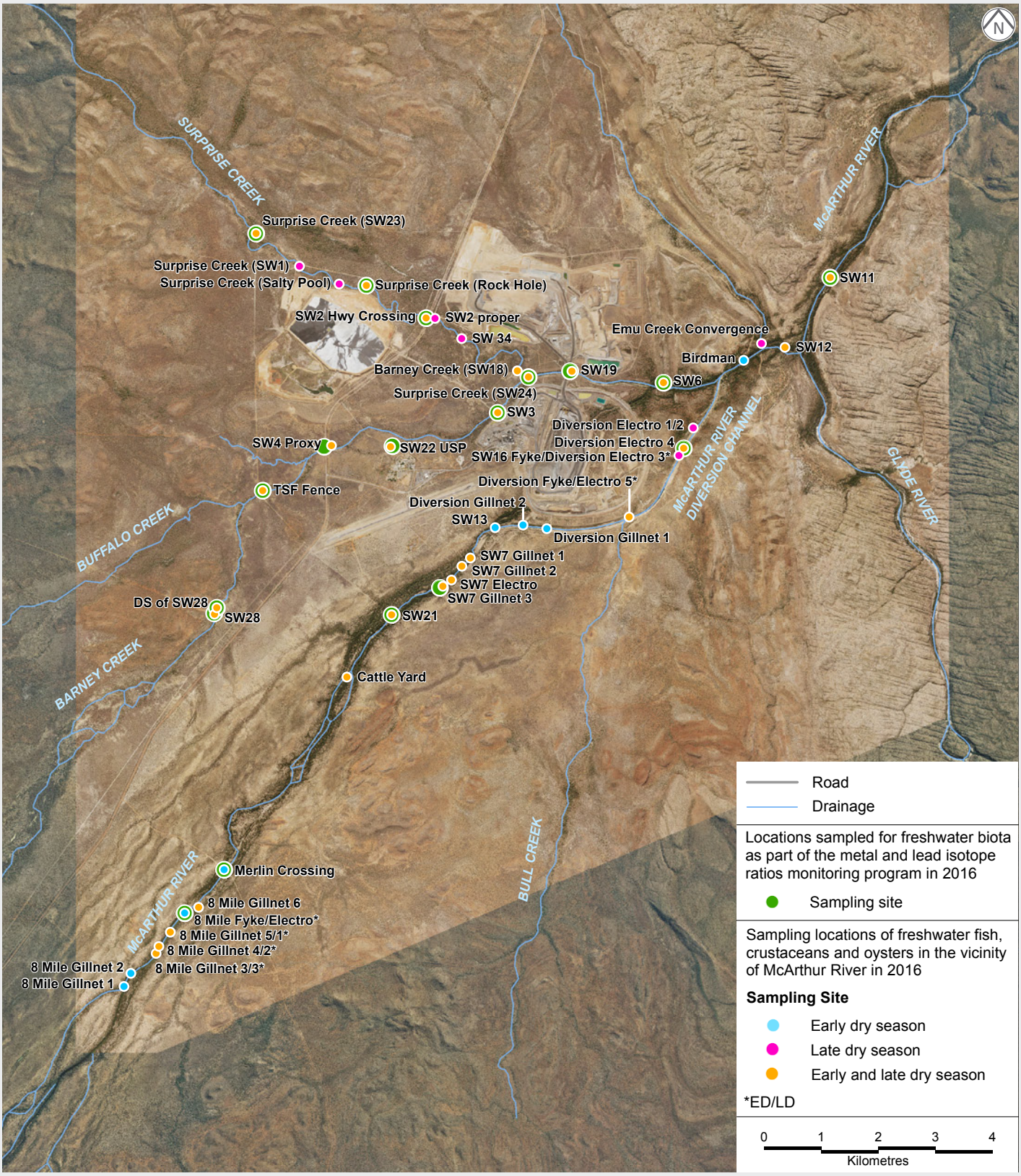
The IM notes the following successes for the 2016 operational year:

- A community survey of fish consumption patterns was conducted. The survey showed that the current monitoring program adequately targets commonly consumed fish and popular fishing spots. However, it also identified new fish and locations to include in the monitoring program. Samples will also be collected in the early and late dry season.
- Improved monitoring of metals in freshwater fauna to include more sites from Barney Creek.
- An acoustic tagging program was established in November 2016 to track the movement of fish in the McArthur River and diversion channel, particularly migratory freshwater sawfish and barramundi.
- The McArthur River diversion channel is performing better as more habitat is provided. Large woody debris was installed at the downstream end of the McArthur River diversion channel with the aim of creating complex habitats to increase the abundance and diversity of freshwater fauna.

Recommendations

The IM recommends that MRM:

- Assess and mitigate the potential ecological impact of proposed flow monitoring stations on McArthur River and Surprise/Barney Creek to understand how physical barriers may affect fish movement and thereby potentially alter fish communities upstream of the structure.



Sampling location of freshwater fish, crustaceans and oysters in the vicinity of McArthur River in 2016 and locations sampled for freshwater biota as part of the metal and lead isotope ratios monitoring program in 2016

McArthur River Diversion Channel

The rehabilitation of the McArthur River diversion channel has continued with the planting of tens of thousands of seedlings in recent years.

What is large woody debris?

In natural rivers, LWD consists of logs and branches that have fallen into the river or been washed downstream. In artificial channels like the river diversion, LWD is missing, but it can be added back.

LWD can improve channel stability by slowing river flow and reducing erosion. It is also important to river ecology, providing habitat and protection for fish and water bugs.

Revegetation and Weeds

The rehabilitation of the diversion channel remains a concern, with very little change observed since the previous IM visit despite the planting of a significant number of seedlings in recent years.

The upstream end of the diversion channel has areas of good coverage; however, despite planting in other locations along the diversion channel, much of the tubestock has been washed out during the wet season, although some tubestock survival has been seen next to LWD piles where sediment has collected and is shielded from high flows.

In 2017, MRM plan to change their focus to planting grasses rather than trees and shrubs. Native grasses will be planted in the first year to stabilise the bank, followed by flora that are more susceptible to flooding and mid and upper storey species.

The current revegetation monitoring program is considered insufficient for aiding rehabilitation beyond determining the presence of vegetation and noting the qualitative impact from disturbances such as erosion and feral herbivores.

Stability of the diversion channels is of utmost importance if the diversion channel banks are to be revegetated and the current program fails to address the underlying issue that causes revegetation to fail, which is the loss and reduced quality of soil substrate as a result of high flow rates and bank instability and the removal of planted tubestock as a result of high flow rates.

McArthur River Mining are aware of the issues and are in the process of redesigning the revegetation monitoring program to allow progress to be quantitatively measured and success and failures to be determined.

Assessment of Diversion Channel

Due to lack of revegetation and flooding/high flow rates during the wet season, erosion of the banks of the diversion channel (as well as immediately upstream) continues to be an issue.

A geomorphological assessment of the McArthur River and Barney Creek diversion channels was completed.

An active wholesale shift in channel position immediately upstream of McArthur River diversion channel offtake was identified with potential impacts to the diversion stability and integrity of the mine levee wall. The IM agrees with the recommendations in the report that the following is required:

- Revision of the existing hydraulic model to incorporate the present day topography.
- An options assessment into mitigation options regarding the shift in channel position.

Monitoring of diversion channel and bank erosion should continue on an annual basis using ALS complemented by photograph monitoring and visual inspection. An annual report on observed erosion should then be completed.

Large Woody Debris

A substantial amount of large woody debris (LWD) has been placed into the downstream end of the McArthur River diversion channel.

Large woody debris is essential for the rehabilitation of the diversion channel as it provides important refuge habitat for fish species, helps to slow flow rates and acts as a sediment trap providing substrate for vegetation to grow in.

MRM plans to create a ‘permanent’ access ramp into the ‘gorge’ section of the diversion channel to allow placement in currently inaccessible areas.

Revegetation in the middle to upper part of the McArthur River diversion channel

Middle to downstream section of the diversion channel showing extensive erosion of banks

Downstream section of the diversion channel

Downstream showing revegetation on far bank and installation of large woody debris

Bing Bong Loading Facility

MRM continues to implement adequate monitoring and controls to minimise risk to marine life at the Bing Bong Loading Facility.

MV Aburri ready for loading

New smaller roller doors of the concentrate storage shed

Observations

During the 2015-2016 reporting period no dredging was undertaken in the swing basin or navigation channel.

MRM continues to implement a number of monitoring programs covering surface water, marine water, sea grass, sediments and dust.

Overall impacts to the marine environment at the Bing Bong Loading Facility are almost exclusively restricted to the shipping channel and the area immediately west of the facility.

While there are ongoing issues relating to dust in the vicinity of the loading facility, results are generally stable or improving due to implementation of monitoring programs and good management practices.

Successes

An air quality management plan is being developed to provide overarching support, analysis and evaluation for management of air quality at the loading facility.

The IM commends the initiation of duplicate sampling at the loading facility as an improvement to the quality assurance and quality control of the dust monitoring program.

More detailed dust data is being collected via equipment installed near the loading facility camp in early 2016. Data will be analysed during the 2017 operational period.

Other successes include:

- Continued implementation of annual seagrass monitoring to ensure seagrass communities, and seagrass-dependent fauna (e.g., Dugongs and some fish species) are not impacted by project activities at the facility.
- Addition of a new control site to the monitoring program in 2015 to better understand the movement of contaminants around the Bing Bong Loading Facility.
- Realignment of one of the control sites in the seagrass monitoring program in the October 2016 survey to improve its suitability as a control site.
- MRM has replaced the four smaller roller doors of the concentrate storage shed to reduce dust emissions.
- Impacts of the facility on coastal water quality and marine fauna continue to be relatively low and localised.

Opportunities for Improvement

- The bitumen surface surrounding the loading facility needs to be repaired to avoid future contaminated soil, water and/or dust management issues. MRM plan to do this during 2018.
- The two large roller doors of the concentrate storage shed have not been replaced and are a likely cause of dust issues in the local area. The IM recommends they be repaired as soon as possible.

Recommendations

The IM recommends that:

- Long-term datasets from sediment monitoring are included in future reports so consistent patterns and inconsistencies can be more easily identified.
- Seagrass monitoring should include assessment of macroalgae cover. Additionally, a desktop study should be conducted to identify the potential cause of increased macroalgae cover.

Air quality monitoring station at Bing Bong Loading Facility

Review of Department of Primary Industry and Resources

The IM commends the DPIR on continuing site visits and the comprehensive reports that are prepared.

Western PAF runoff dam

McArthur River Mine open pit

The IM has also reviewed DPIR's performance in regulating the McArthur River Mine. During the 2016 operational period, the DPIR continued a series of field inspections that were aimed at:

- Informing DPIR mining officers in their assessment of the 2013-2015 MMP and amendments.
- Providing an update to management on the status of operations and assessing compliance with DPIR conditional approvals.

Observations

During the operational period (October 2015 to September 2016), the DPIR issued a series of instructions to MRM. A number of these related to requesting additional information to assist in the assessment of MMP amendments or as a result of site inspections or incidents that occurred at the operation.

In reviewing the incidents which MRM reported to DPIR, there appears to be confusion regarding what incidents are required to be reported. The IM was advised by DPIR that all environmental incidents must be reported to the department in accordance with Section 29 of the Mining Management Act.

It would not appear practical for all environmental incidents at operations throughout the Northern Territory to be reported to the department.

An incident reporting system based on the impact of the incident and potential risk would reduce the number of incidents being reported to a manageable level. This would then enable the department to direct its resources to those incidents with a high environmental impact or potential impact. There also appears to be inconsistency regarding incident classification.

Opportunities for Improvements

Since commencing in the role as IM in 2014, a number of specific recommendations to improve the performance of DPIR have been made by the IM. Progress on implementing these recommendations has been slow and the IM would like to see DPIR place a higher priority on appropriate action.

About the Independent Monitor (IM)

At the end of 2013, the DME engaged ERIAS Group Pty Ltd to assess the environmental performance of the McArthur River Mine for a five-year period.

2017 is the fourth year that ERIAS Group has prepared the environmental performance report, as well as this community report.

The IM is supported by a team of specialists that brings together the required skills and experience to fulfil the role, including:

- ERIAS Group (environmental impact assessment, risk and management, water quality, soils, dust and closure planning).
- Hydro Scientia (site water management).
- Pells Sullivan Meynink (geotechnical engineering and TSF operating strategies).
- Groundwater Resource Management (groundwater modelling and monitoring).
- Environmental Geochemistry International (geochemistry, TSF and waste rock cover design).
- Low Ecological Services (terrestrial, aquatic and marine ecology).
- Cambium Group (geographic information system).

For more information, go to the IM website:
www.mrmindependentmonitor.com.au

www.eriasgroup.com

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