

Notice of Intent

MCARTHUR RIVER MINE OVERBURDEN MANAGEMENT PROJECT

Health, Safety, Environment & Community
June 2014



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Introduction

Objectives

This Notice of Intent (NOI) documents the intention of McArthur River Mining, a Glencore Company, to obtain environmental approval for the re-design of the approved Northern Overburden Emplacement Facility (NOEF) and other approved overburden management structures at the McArthur River Mine (MRM). The redesign is required to adequately accommodate increased volumes of non-benign overburden to be excavated during mining operations following improved and revised overburden characterisation and assessment.

This NOI has been prepared in consideration of the Northern Territory Department of Environment Protection Authority (NT EPA) Draft Guidelines for Preparing a Notice of Intent (NT EPA, 2014) and the Northern Territory Department of Mines and Energy Environmental Assessment of Mining Proposals Advisory Note (NT DME, 2011). This Notice of Intent is submitted for determination under the Northern Territory *Environmental Assessment Act 2012*.

The objectives of this NOI are to:

- Provide formal notification to the Northern Territory Government and other interested parties, of McArthur River Mining's intention to modify the approved overburden management at MRM;
- Identify and describe any potential environmental impacts associated with the proposed Project;
- Describe high-level management and mitigation measures to address the potential adverse environmental impacts of the Project; and
- Outline the proposed baseline and impact assessment studies for the Project.

Given that the proposed project only varies some of the Project components approved as part of the MRM Phase 3 Development Project, this NOI focuses on the key areas where project infrastructure or potential environmental risk profiles are proposed to change. Therefore some aspects of the Project are not assessed in this NOI and are not considered to be part of the assessment or approval process.

Proposed Project Summary

MRM is located in the Northern Territory and is accessed by sealed road from Daly Waters to the west and from the Barkly Highway 350km to the south. The MRM site has built on the successful transition from an underground mine (from 1995 to 2006) to an open pit mining operation (approved via EIS process in 2006). The Phase 3 Development Project expansion of the open pit was approved in July 2012, extending the life of the existing open pit operation and increasing MRM's minable ore reserves and mine life.

The Phase 3 Development Project increased MRM's mineable reserves from 53 million tonnes (Mt) to 115 Mt, extending the life of mine by a further nine years from 2027 to 2036 at a higher production rate.

The current NOEF design was approved as part of the MRM Phase 3 Development Project. Following further overburden geochemistry investigations, it has been identified that the previously proposed and approved overburden management infrastructure is not suitable for life-of-mine (LOM) overburden management at MRM. Therefore redesign of the approved overburden management infrastructure is required. The redesign of the NOEF and other overburden management infrastructure may potentially

incorporate an increased footprint, extending beyond that of the current approved design. The previously approved methodologies and design criteria will be revised to address a significant reduction in the available volume of benign non-acid forming (NAF) overburden material and improved understanding of clay characterisation and performance. The revised NOEF design is proposed to be implemented in approximately 18 months' time.

Legislative Framework

Environmental permitting of mining activities is regulated in the Northern Territory under both the *Mining Management Act 2013* and the *Environmental Assessment Act 2012*. A decision on the appropriate permitting process for new mining proposals in the Northern Territory is initiated by the proponent's submission of an NOI (i.e. this document) to the Northern Territory Government through the Environmental Assessment Unit of the NTEPA. If assessment under the *Environmental Assessment Act 2012* is required, the NOI is referred to the Minister for determination of the appropriate level of assessment.

Following completion of the assessment and approval process under the *Environmental Assessment Act*, by the NTEPA, the Department of Mines and Energy manages the approved operation under the *Mining Management Act 2013* through submission and approval of a Mining Management Plan.

Mining Management Act 2013

The principal legislation for the regulation of mining proposals in the Northern Territory is the *Mining Management Act 2013*, which is administered by the Department of Mines and Energy.

The objectives of the *Mining Management Act 2013* are to ensure that the development of mineral resources is in accordance with best practice in health, safety and environmental standards and to protect the environment and health and safety of all persons on mining sites.

Under the *Mining Management Act 2013*, an application for an authorisation to carry out mining activities must be accompanied by a Mining Management Plan.

A Mining Management Plan includes information relating to the description of mining activities, the management system to be implemented for the management of health, safety and environmental aspects, costing of closure activities and particulars of organisational structure.

Plans of any existing or proposed mine workings and infrastructure must also be included. The Mining Management Plan is required to be reviewed at intervals specified in the authorisation to carry out mining activities.

Environmental Assessment Act 2012

The *Environmental Assessment Act 2012* and the Environmental Assessment Administrative Procedures establish the framework for the assessment of potential or anticipated environmental impacts of development, and provide for protection of the environment. The Northern Territory Minister for Lands, Planning and the Environment is responsible for administering the act.

The minister also determines the appropriate level of assessment for new developments or material changes to existing operations, based on the sensitivity of the local environment, the scale of the proposal and its potential impact upon the environment.

Other Relevant Legislation

Other legislation relevant to the proposed Project includes the following acts and their associated amendments and regulations:

- *Waste Management and Pollution Control Act, 2013;*
- *Territory Parks and Wildlife Conservation Act, 2006; and*
- *Heritage Act, 2012.*

Notice of Intent Structure

The NOI comprises six sections and is structured as follows:

- Section 1 – Introduction, legislative framework and purpose of the NOI.
- Section 2 – Background information, proponent details and project history.
- Section 3 – Description of the Project.
- Section 4 – Description of environmental values.
- Section 5 – Identification of potential environmental impacts, management and mitigation measures to address these impacts.
- Section 6 – References.

Background

Proponent

McArthur River Mining Pty Ltd (MRM) is a company wholly owned by the international Glencore group and is the operator of the McArthur River Mine.

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MET Serve Pty Ltd will assist MRM with the environmental approval process and assessment of the Project.

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Location

MRM is located 60 kilometres south west of the township of Borroloola in the Gulf Region of the Northern Territory, approximately midway between Darwin and Mount Isa. **Figure 1** shows the general location of MRM and Darwin.



Figure 1 MRM General Location Plan

Tenements and Tenure

MRM spans seven individual mineral leases. The mine site is contained within five contiguous mineral leases (MLN1121, MLN1122, MLN1123, MLN1124 and MLN1125), located on the McArthur River Station Pastoral Lease, which is made up of the McArthur River Pastoral Lease (PL860), the Tawallah Pastoral Lease (PL864) and the Bing Bong Pastoral Lease (PL868). The Pastoral Leases were combined and now exist as the McArthur River Station. The property lease is 100% owned by Colinta Holdings Pty Ltd, a Glencore subsidiary.

Also contained on the McArthur River Station Pastoral Lease is the minor mineral lease MLN582. The mining operations encompass MLN 1121, MLN 1122 and MLN 1124 (the Overburden Emplacement Facility). The Tailings Storage Facility, camp accommodation and part of the airport are located on MLN 1123.

MRM Project History

MRM is a major open cut operation mining one of the largest known sedimentary stratiform zinc-lead-silver deposits in the world. The ore bodies making up the deposit, named 'Here's Your Chance' (HYC), were discovered by Mount Isa Mines Limited geologists in 1955, but development did not commence until 1995. This gap in time between the deposit's discovery and development resulted from the unusual structure and extensive faulting of the ore bodies and the extremely fine-grained nature of the ore which combined to make commercial development of the resource unfeasible for many years.

A number of technological advancements in mining, ore treatment and concentrate transport were necessary before the project could proceed on an economic basis. Trial work failed to develop an economically viable technique of ore beneficiation in the 1960's and 1970's.

A small decline and pilot plant were constructed on site in 1975, with the consequent preparation of a feasibility study and environmental report in 1979. That study was based on a high-tonnage, open pit operation. In addition to poor recovery rates, no market existed at that time for the low-grade lead and zinc concentrates produced by the pilot plant.

Subsequent metallurgical developments in fine grinding technology and the emergence of a market for high-grade bulk concentrate for use by smelters using the Imperial Smelting Process (ISP) technique enabled MRM to become a viable project. Construction of the current project commenced in 1994, with the first shipment of concentrate loaded in mid-1995. MRM produces bulk concentrate (containing payable zinc, lead and silver) for overseas and domestic markets.

In 2003, MRM announced its intention to convert the underground zinc-lead mine at McArthur River to an open pit operation to enable the mine to continue production. An Environmental Impact Statement (EIS) was lodged as part of a formal assessment process administered by the Northern Territory Government based on the Terms of Reference issued in 2003. This was followed by the submission of an EIS Supplement (December 2005), Public Environmental Report (July 2006) and Mining Management Plan (September 2006).

The Northern Territory Government approved MRM's open pit development in October 2006. Later that same month, the Australian Government provided its consent under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The \$110 million open pit development which combined with an expansion of the concentrator, extended the mine's life by an estimated 21 years to 2027.

While the environmental assessment process was conducted, MRM commenced operating a test open pit. The first stage of this pit commenced in August 2005. This contributed ore for sampling and for processing as underground operations reduced. The test pit was subsequently extended in April 2006 when underground mining ceased.

After the approval for the open pit development, site works were undertaken over a two year timetable and were completed in late 2008. Key development milestones achieved were:

- construction of the Southern Anabranch to a temporary bund wall to allow the open pit to be expanded and support an increase in production rates;
- completion of new benchmark studies into local and migratory birds, fish populations and movement and macroinvertebrates; and
- the development of the McArthur River channel and the Barney Creek/Surprise Creek channels which were opened for waterflow in the 2009 wet season.

In March 2007, MRM announced an AUD50 million expansion of its concentrator to increase its capacity from an annual throughput of 1.8 million tonnes of ore to 2.5 million tonnes. Since then, further technological advances to the concentrator have enabled MRM, for the first time to produce a new zinc concentrate. This is supplied to electrolytic smelters and has opened a new market for MRM concentrate.

The current total workforce is currently 440 permanent personnel and contractors. Production employees work a 7 days on/ 7 days off roster, with most support and management staff working a 5/2,4/3 roster.

The Phase 3 Development Project expansion of the existing pit was approved in July 2012, extending the life of the existing open pit operation and increasing MRM's minable ore reserves and mine life. The Phase 3 Development Project increased MRM's mineable reserves from 53 million tonnes (Mt) to 115 Mt, extending the life of mine by a further nine years from 2027 to 2036 at a higher production rate.

Project Description

The Overburden Management Project has been necessitated by improved understanding of the overburden geochemistry at the MRM. Previously, Potentially Acid Forming (PAF) material was estimated to be approximately 35% of the total overburden material to be excavated during the life of the mine, with the remaining 65% being Non Acid Forming (NAF) benign material. Improved geochemical analysis of the overburden material has indicated that of the approximately 65% NAF material, a large proportion of the material is non-benign and may have environmental implications if not appropriately managed, including the potential to generate acid mine drainage, metalliferous mine drainage or saline drainage.

The improved understanding of MRM geochemistry has necessitated revision of the overburden classification system. A summary of the six new overburden classifications is provided below:

Benign overburden

- **Alluvium** - This is the soils, sands, gravels and clays overlying the rock.
- **Low Salinity Non Acid Forming rock (High Capacity) [LS-NAF(HC)]** - This type is highly acid-consuming with low potential for saline and metalliferous drainage.

Non-benign overburden

- **Metalliferous Saline Non Acid Forming rock (High Capacity) [MS-NAF(HC)]** - This is NAF rock with a Net Potential Ratio (NPR) greater than 2:1, but with high enough concentrations of metals and/or pyrite to potentially generate saline and/or metalliferous drainage.
- **Metalliferous Saline Non Acid Forming rock (Low Capacity) [MS-NAF(LC)]** - This is a lower category of NAF rock where the NPR is between 1 and 2, but with high enough concentrations of metals and/or pyrite to potentially generate saline and/or metalliferous drainage.
- **Potentially-Acid-Forming rock (High Capacity) [PAF(HC)]** - This is PAF waste where NPR is less than 1.
- **Potentially-Acid-Forming rock (Reactive) [PAF(RE)]** - This is PAF that has a high potential to spontaneously combust when mined and stockpiled.

As a result of the increase in the percentage of overburden to be treated as non-benign material, the availability of benign NAF material for utilisation in encapsulation and protection of PAF material has significantly decreased. Therefore the design of the NOEF is required to be significantly altered. The redesign of the NOEF will seek to minimise potential for air and water to contact the non-benign material to reduce the potential for acid mine drainage, metalliferous mine drainage or saline drainage.

The previous design ensured that PAF material would be encapsulated within the NOEF and would be positioned above the 100 year ARI flood level. Given constraints on benign NAF material availability, it is likely that insufficient material will be available to construct an entirely benign NAF material base to ensure non-benign material will be positioned above the 100 year ARI flood level. Therefore other material is likely to be required to be used (for example MS-NAF(LC)). Alternative strategies for base preparation and flood protection are being investigated. Furthermore existing design constraints on the NOEF will be reviewed to maximise environmental performance.

The NOEF will be developed in accordance with the previous flood mitigation design (constructing below the 100 year ARI flood level utilising benign NAF only) throughout 2014 and 2015, however beyond that time, a revised design will be implemented (the proposed project subject of this NOI). Approval for development of the NOEF for the 2014 - 2015 period is being sought through an amendment to the MRM MMP and is not included in the proposed project presented in this NOI.

As design work continues, it is also likely that the South and East Overburden Emplacement Facilities (SOEF and EOEF) proposed and approved as part of the Phase 3 Development Project, will not proceed as part of the ongoing LOM overburden management strategy at MRM. These emplacements were approved on the understanding that only NAF material would be placed within them. Given that the volume of benign NAF material has significantly reduced, it is likely that all of this material will be utilised in the construction of the NOEF. Depending on the development schedule, temporary stockpiling of some benign NAF material within the previous SOEF or EOEF footprints may be required.

Furthermore, revised capping and encapsulation strategies are being investigated following investigation of clay performance and geochemistry in both the construction and closure phases of the NOEF. Clay layer thicknesses, specifications, and positions will be revised considering the effects of heat and geochemical performance of the clay, seepage modelling and cover modelling. Alternative low permeability layers to compacted clay will be investigated. Design work is ongoing. Clay performance also has implications for rehabilitation of other operational areas of the mine, for example the Tailings Storage Facility, which will also be reviewed.

The NOEF redesign has also necessitated redesign of the surface water management system surrounding the NOEF, as all contact water during the construction phase of the NOEF stages must be contained in the contaminated water system. **Figure 2** identifies the current approved NOEF footprint, including the previously approved water management infrastructure and an approximate footprint of the proposed initial conceptual redesigned NOEF, also including initial revised surface water management infrastructure. The current initial redesign concept would increase the footprint of the NOEF and its associated water management infrastructure. This conceptual design work is ongoing and it is likely the footprint, shape and water management infrastructure requirements will change from the concept presented in **Figure 2**.

Figure 2 Initial Concept - Northern Overburden Emplacement Facility

The scheduling of the open pit development will also be reviewed to maintain, where practicable, production of the required volumes of benign NAF material while maintaining viable development of the ore body.

Geochemical characterisation investigations are ongoing to increase confidence in predicting the occurrence and behaviour of PAF material as part of the Project. Additional drilling campaigns will collect more detailed information in advance of the planned mine extents, with approximately 3,000 m per year of drilling budgeted throughout the mine life until the end of bulk waste mining. Further detailed technical studies including site monitoring, OEF lysimeters, geochemical testwork, surface and groundwater modelling are being prepared and undertaken to inform the NOEF design process.

Existing Environment

Geology

The McArthur Basin comprises Carpentarian and Adelaidean rocks extending from the Alligator River in the Northern Territory to the Queensland border including the greater part of Arnhem Land and the Gulf of Carpentaria drainage region.

The sediment hosted stratiform HYC deposit has similarities with ore-bodies at Mount Isa and Hilton in Queensland. It is about 1.5km long and 1.0km wide with an average thickness of 55m. The HYC deposit occurs near the base of the HYC pyritic shale member, within the Middle Proterozoic McArthur Group. The member comprises a sequence of inter-bedded pyritic bituminous dolomitic siltstones, sedimentary breccias and volcanic tuffs.

The HYC deposit has been folded and eroded along its western margin, which is covered with 30m of soil. This western margin contains the Hinge ore zone, which is sub-vertical with a strike length of 1.0km and vertical height of 200m. The northern margins inter-finger with sedimentary breccias and the southern margin grades into thinned nodular barren pyritic siltstone. On the eastern margin the ore-body thickens and is folded to form the Fold Zone, which has a strike length of over 600m. The south-eastern corner is down faulted 110m by the north-eastern trending Woyzbun Fault.

Land units in the region are susceptible to erosion due to the physical and chemical characteristics of the soils, the intensity of seasonal monsoonal rainfall and seasonal inundation from the McArthur River. Within the surrounding Project area, the majority of soils are of low to moderate dispersivity, though areas of highly dispersive soils do occur.

Surface Water

The mine site is situated adjacent to the McArthur River in the middle reaches of the river's catchment, between the confluences of the Kilgour and Glyde Rivers. The catchment area of the river above the mine site is approximately 10,000km². The 100 year average recurrence interval (ARI) flood level at the mine site is 39.5m. All major infrastructure on the site is located above this level, including the industrial area which contains the concentrate storage shed. With the exception of some spring fed tributaries, most of the flow of the McArthur River comes from wet season rains.

The river ceases to flow in some dry seasons, and most stretches, particularly in the vicinity of the mine area, can dry to a series of large isolated pools. During the wet season the river can become extremely turbid when in flood. Flow data for the McArthur River in terms of ARI is 7,250 (m³/s) for 1 in 100 year event (RL 40m), whilst 1,000 (m³/s) for 1 in 2 year event.

The main creek systems which bound the TSF and mine site are Barney and Surprise Creeks. Barney Creek has a catchment area of 600km² at the mine site. The creeks are dry throughout most of the year. This is particularly the case for Surprise Creek, which has a catchment size of only 85km², and normally flows for only a few days each wet season.

The McArthur River has been affected by the mining activity, namely, the McArthur River Diversion Channel that was constructed as part of the mine's conversion from an underground to open cut operation.

Background water quality includes elevated levels of lead and zinc due to mineralisation containing these metals upstream of the mine site. Extensive environmental monitoring is undertaken of surface water, both upstream and downstream of the McArthur River Channel.

Mining development has had minimal impact on the physical aspects of the region, with the disturbance area being a small proportion of the McArthur River catchment.

Groundwater

The MRM area has two main aquifers in the immediate vicinity of operations: the alluvial aquifer and the lower fault aquifer. The alluvial aquifer is readily linked to the McArthur River and contains good quality fresh water. The faults in the dolomite and shales contain groundwater that is linked to the alluvial aquifer in part. Dewatering of the current mining operation has had no observable impact on the hydrology or ecology of the McArthur River.

The dominant relief is low escarpments, plateaux and ridges, with limestone or dolomite rocks of Palaeozoic age or older in the western part of the McArthur River catchment upstream of the Project site, and sandstone and conglomerate rocks in the eastern sub-catchments, including the Kilgour and Glyde Rivers.

Land Use

Land use in the MRM region is predominantly cattle grazing on large pastoral properties and occasional mining activity. McArthur River Station encompasses all of the MRM leases. McArthur River Station is 100% owned by Colinta Holdings, a Glencore subsidiary. Other regional pastoral enterprises are owned by private persons, companies, and Aboriginal groups.

McArthur River Station stocks approximately 10,000 head of cattle over 8,000 km², utilising approximately one third of the area for grazing. Cattle are excluded from the mining and processing areas where possible.

MRM is located in one of the more sparsely populated areas of Northern Australia. Populations of townships fluctuate with people leaving outstations in the wet season. Borroloola Township has a total population of approximately 900 with the majority of the workforce employed in fishing, retail or government sectors. The rural workforce is mainly employed in the pastoral industry and in mining.

Terrestrial Flora

The botany of the MRM site is characterised as being complex, with a high number of community types, with relatively low numbers of constituent species.

Nine distinct vegetation communities occur within the MRM area. Four of these are upland communities on sandstone or rocky hills, three are lowland woodland communities, and two are riparian or riverine communities. Riverine communities along the McArthur River are dominated by tall *Melaleuca spp* and *Eucalyptus papuana*.

Previous flora surveys identified a total of 364 plant species from 84 families and 215 genera. The most speciose plant families were Poaceae (53 species); Fabaceae (31 species); Myrtaceae (24 species) and Cyperaceae (20 species). Speciose genera included *Acacia* (14 species); *Eucalyptus* (8 species) and *Ficus* (7 species).

The surveys undertaken revealed no plants of rare or endangered status on site. There has been no additional significant species found to date.

Weeds are common on the mining leases including Noogoora Burr, Devil's Claw, Bellyache Bush, and Parkinsonia, particularly in those areas disturbed by grazing.

Terrestrial Fauna

Since 1976, several comprehensive fauna surveys have been undertaken at MRM and the wider region. The site fauna is well understood. Vertebrate fauna recorded includes 114 bird, 44 reptile, 17 mammal, 16 frog and 18 freshwater fish species.

Riverine habitats are the richest areas for fauna, and include some specialist birds such as the Purple-crowned Fairy-wren (*Malurus coronatus*) and White-browed Robin (*Poecilodryas superciliosa*). Common fauna of the open woodland habitats includes honeyeaters, Grey-crowned Babbler (*Pomatostomus temporalis*), Varied Lorikeet (*Psittenteles versicolor*) and Agile Wallaby (*Macropus agilis*).

Some species are restricted to the stony hills habitats, including reptiles such as Hosmer's Skink (*Egernia hosmeri*) and Storr's Monitor (*Varanus storri*). Freshwater crocodiles (*Crocodylus johnsoni*) and the turtle *Emydura worrelli* are abundant in the McArthur/Glyde River systems.

Identified feral animals particularly of note are pigs, feral cats, donkeys, horses, buffalo and cane toads.

The Gouldian Finch (*Erythrura gouldiae*) is currently listed as 'Vulnerable' under the NT *Parks and Wildlife Conservation Act* (PWC Act) and 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act) and has recently been observed on the mining leases. No mammals of conservation significance have been identified on the mining leases.

Aquatic Ecology

The McArthur River has an apparent low species richness of freshwater fishes when compared to other systems in the Gulf drainage division. The low species richness is possibly due to the ephemeral nature of the system and the low diversity of habitats available.

There are four broad aquatic habitats in the region: the McArthur River and its tributaries, permanent spring-fed refuge pools (particularly the Glyde River headwaters), off river Billabongs (such as Caranbirini Waterhole), and ephemeral streams.

The Freshwater Sawfish (*Pristis pristis*) - Vulnerable under the PWC and EBPC Acts) has been recorded from a number of locations in the upper McArthur, Glyde and Kilgour Rivers. It has been recorded from the vicinity of the MRM area, with extensive surveys undertaken. The species also occurs in many other coastal rivers throughout the Northern Territory, Kimberley and northern Queensland. While little is known of the biology of this species, it is essentially a marine fish which lives extensively in freshwater habitats. Monitoring undertaken by MRM has identified that this species is utilising and travelling through the McArthur River Channel.

Most of the fish species recorded to date have widespread distributions. Downstream, in the McArthur River, fish are exploited for commercial and recreational purposes.

Aboriginal and Cultural Heritage Sites

The MRM is located on lands traditionally used by the Gudanji, Binbinga, and Yanyula people. Although areas of land are identified as belonging to particular language and family groups, other groups may have important traditional interests in that land.

Borrooloola and its immediate surrounds have residents from a number of Aboriginal groups and include the Garawa, Mara, and Alawa people.

Not all of these groups are traditional owners of lands likely to be directly affected through mine development. A number of Aboriginal site investigation studies have been undertaken and agreements made with the traditional owners for the current mining lease approvals.

MRM holds Authority Certificates referenced #C2004-007 to 023 issued by the Aboriginal Area Protection Authority (AAPA). These certificates include all operational areas in accordance with Section 22 of the *Northern Territory Aboriginal Sacred Sites Act 1989*.

A number of Aboriginal site investigation studies have been undertaken and agreements made with the Traditional Owners for the current mining lease approvals. Site investigations were also undertaken for the areas affected by the open pit development including archaeological and ethnographic surveys of all land to be disturbed.

This work was undertaken in cooperation with Traditional Owners and other local Aboriginal elders to ensure sites of cultural significance are protected. Access by mine personnel is prohibited.

As a further safeguard in normal operations, any employee or contractor needing to undertake any ground disturbing activity must first obtain approval from both MRM's Community Relations and Environmental Departments in order to ensure actions are checked against the AAPA authority certificates for cultural heritage sites.

Potential Environmental Impacts and Management

Geology

Improved geochemical characterisation of overburden has identified additional waste types requiring management at MRM (refer **Section 3 – Project Description**). Technical studies to inform improved overburden characterisation and identification are underway. These studies will also inform revised selective handling requirements and the redesign of the NOEF with the objective of maximising environmental performance of the OEF. This will largely focus on minimisation of air and water ingress into the OEF, maximisation of stability, capture and management of any water that does come in contact with non-benign material and exclusion of 'clean' surface waters from disturbed areas.

Geochemical analysis of the Project overburden material will increase confidence in predicting the occurrence of non-benign material during mining and to improve the efficiency with which the material can be separated from benign material. Sulphur content and speciation will be included in the investigation to distinguish acid-forming sulphides from other material containing sulphur. Other tests include ANC, Net Acid Generation (NAG), paste pH and EC, Acid Buffering Characteristic Curves (ABCC), Kinetic Net Acid Generation (KNAG), carbon speciation, and elemental analysis of solid material and water extracts.

Geochemical data will be used to determine the nature of overburden materials prior to Project mining using exploration drill core and/or active bench face samples. Acquired data will be used to block model overburden materials in advance of Project mining and to facilitate the implementation of proactive waste management strategies and procedures (i.e. selective handling, placement and clay encapsulation).

The following management measures will be implemented to maximise the environmental performance of the NOEF during both construction and following closure:

- All overburden types will be selectively handled and the NOEF will be constructed in accordance with the various properties of each overburden type;
- Exposure time of non-benign material to the surface will be kept to a minimum to reduce the potential formation of mine affected drainage and soil dispersion;
- Surface of the NOEF will be contoured so that run-off is shed from the landform; and
- Final landform will incorporate soil covers, designed to protect the NOEF adequately from potential wind and surface water erosion and moisture infiltration. Drainage works will be designed to maintain long-term stability of the soil cover.

Significant technical assessment and investigation is underway to develop a detailed suite of design, management and mitigation measures for the management of overburden at MRM. These works will be completed prior to the revised construction of the NOEF and will be incorporated into the design.

Surface Water

Based on identified management measures below, residual surface water risks/impacts associated with the Project are expected to be low. Management measures are expected to protect surface water environmental values and reduce risks to an acceptable level.

The Project will require a review of the existing mine site water management system to accommodate increased areas of runoff if the NOEF is expanded. The overarching philosophy of mine water management will remain the same as the existing system and will be updated over time in accordance with on-going industry improvements in best practice for mine water management.

The existing operations are managed via a Water Management Plan (WMP) within the Mining Management Plan. The Plan outlines how water will be monitored and managed to facilitate environmental best practice and maximise the environmental sustainability of the site. It is also a planning document outlining objectives for water management moving forward and reporting on water management activities from the previous operational period.

The general surface water management objectives for the Project are as follows:

- Design and develop the NOEF to minimise impacts to surface water via mine affected drainage or runoff from non-benign material;
- Separate clean, dirty and contaminated water runoff as much as possible;
- Minimise the area of surface disturbance, thus minimising the volume of 'dirty' and/or 'contaminated' runoff;
- Treat all 'dirty' water on site via containment storages or sediment ponds, dependant on the levels of contaminants likely to be generated;
- Controlled release of 'dirty' water treated in proposed sediment dams, provided water quality is within the MRM Waste Discharge Licence water quality release limits;
- Segregate, collect and contain all 'contaminated' runoff on site via adequately sized containment storages;
- Implementation of pumping infrastructure to allow transfer of 'contaminated' runoff between containment storages as required, minimising the potential for overflows;
- Minimise 'raw' water consumption and maximise reuse of 'contaminated' water within the mine site (e.g. for ore processing) without releasing it off-site;
- Maximise evaporation of on-site excess 'contaminated' water from available dams in order to minimise the risk of off-site releases and/or reliance on external water demands.

Groundwater

Based on identified management measures below, residual groundwater risks/impacts associated with the Project are expected to be low. The potential groundwater impacts associated with the Project are primarily linked to the varying geochemistry of overburden and how these types of overburden are identified, handled and placed with the overburden management facilities. The following management measures will be implemented to maximise the environmental performance of the NOEF during both construction and following closure:

- All overburden types will be selectively handled and the NOEF will be constructed in accordance with the various properties of each overburden type;
- The redesign of the NOEF will seek to minimise potential for air and water to contact the non-benign material to reduce the potential for acid mine drainage, metalliferous mine drainage or saline drainage.
- Exposure time of non-benign material to the surface will be kept to a minimum to reduce the potential formation of mine affected drainage;
- The surface of the NOEF will be contoured so that run-off is shed from the landform; and

- The final landform will incorporate soil covers, designed to protect the NOEF adequately from potential wind, surface water erosion and moisture infiltration. Drainage works will be designed to maintain long-term stability of the soil cover.

Significant technical assessment and investigation is underway to develop a detailed suite of design, management and mitigation measures for the management of overburden at MRM. These works will be completed prior to the revised construction of the NOEF and will be incorporated into the design.

The groundwater monitoring program will be revised to place improved focus on the performance of the NOEF. A site wide groundwater model will be prepared to predict potential contaminant flow paths and concentrations.

Land Use

Based on identified management measures below, residual land risks/impacts associated with the Project are expected to be low. Management measures are expected to protect land based environmental values and reduce risks to an acceptable level.

The existing NOEF covers a gently inclined alluvial plain with deep grey and brown cracking clay soils. An extended NOEF footprint will cover more of this soils unit, as well as some yellow mottled loamy duplex soils and gradation massive yellow earth soils to the north and the west, red earth soils to the north-east and shallow gravelly loams to the north.

The potential land use impacts associated with the Project are land disturbance and potential erosion through clearing along with potential land contamination from the inadequate management of potential contamination producing materials (refer Section 3).

Project design, construction and operation will be consistent with the objectives for developing the region in a manner that preserves its rural nature while allowing continued development at a sustainable level.

This will be achieved by:

- Restricting vegetation clearing to the project footprint, undertaking progressive rehabilitation where applicable, utilising erosion controls where appropriate and controlling surface water runoff;
- Ensuring construction material brought to site is clean (i.e. free of weeds and hydrocarbons);
- Ensuring site personnel have a high level of competency and diligence;
- Assessing soils prior to mine closure for contamination and undertaking appropriate remediation measures where necessary; and
- Continued consultation and negotiation with Traditional Owners.

Erosion and Sediment Control

Based on identified management measures below, erosion and sediment control risks/impacts associated with the Project are expected to be low. Management measures are expected to protect land environmental values and reduce risks to an acceptable level.

Potential impacts of erosion and landform instability at the Project site include:

- Impacts on water quality (suspended solids);
- Impacts on surface water channels (sedimentation);
- Rehabilitation failure;
- Loss of structural stability;

- Compromise of waste material capping; and
- Increased infiltration and potential leaching.

Potential impacts due to erosion, runoff and sediment control will be managed by:

- Revegetating disturbed areas as soon as practicable;
- Minimising continuous slopes where scouring can occur, lining drainage lines with crushed rock, appropriately designing mine roads, installing baffles to reduce water-flow velocities and installing sediment control structures, e.g., sediment fences;
- Constructing and maintaining clean water drains around disturbed areas; and
- Incorporating soil covers, designed to adequately protect the overburden emplacement facility from potential wind and surface water erosion, and moisture infiltration. Drainage works will be designed to maximise long-term stability of the soil cover.

Additionally, erosion and sediment control measures will be employed which are consistent with the practices described in the Northern Territory Erosion and Sediment Control Guidelines.

The existing erosion and sediment control practices will be reviewed and implemented throughout construction and operation phases of the Project.

Terrestrial Flora

Based on identified management measures below, residual terrestrial flora risks/impacts associated with the Project are expected to be low. The NOEF will be designed and managed to minimise potential impacts to ecological values and therefore reduce the risk to an acceptable level.

A search of the Northern Territory Herbarium (IUCN, Holtze), NRETAS databases and SEWPAC's EPBC Act Protected Matters databases revealed no records of threatened flora species from within the Project area, nor within a search area of 20 km surrounding the mine.

Almost the entire NOEF is located within Coolibah open woodland and no plant species of conservation significance were identified within this vegetation community or any other vegetation community within the Project Area.

Without appropriate mitigation and management, land clearing and mining activities associated with the Project may increase soil erosion, inadvertently causing downstream silting, sedimentation or contamination of riverine habitats and waterholes. Potential for mine affected drainage from the NOEF could potentially affect adjacent riparian vegetation communities and downstream habitats, particularly freshwater aquatic flora, however the management of these potential impacts is a key focus of the Project design.

Current management measures that will be applied to the Project to reduce or avoid impacts associated with loss of vegetation, introduction of weeds and reduced conditions favourable for plant growth, include:

- As a first preference, avoiding areas with vegetation communities of conservation significance, should they be identified;
- Managing weeds in the Mineral Lease;
- 'no-go' zones are marked to ensure areas to be protected are clearly defined, identified and avoided and that clearing and ground disturbance only occur within designated areas;
- The development and implementation of vegetation clearance protocols (including an internal clearance procedure) and assessing performance against them;
- Progressively rehabilitating disturbed areas and avoiding unnecessary future disturbance of these areas;
- Monitoring and maintaining progressively rehabilitated and revegetated areas;

- Ensuring that vehicles and project equipment arrive on site free of vegetative matter, seeds and mud;
- Implementing targeted weed control measures for any observed significant increase in the distribution or density of existing weeds, or new populations of weeds;
- Regularly monitoring areas with a high potential for, or susceptibility to, weed invasion, such as along roadsides, recently cleared areas and permanently wet areas such as the banks of the drains, particularly following rainfall events;
- Controlling or preventing weed infestations in topsoil stockpiles to minimise the likelihood of weed introduction or increased distribution during respreading of topsoil;
- Monitoring of ground and surface water will continue throughout the life of the Project and after mine closure, to identify any changes in water quality that may affect riparian and aquatic flora; and
- Progressive rehabilitation of disturbed areas to reduce the potential for weed species to become established.

Terrestrial Fauna

Based on identified management measures below, residual terrestrial fauna risks/impacts associated with the Project are expected to be low. The NOEF will be designed and managed to minimise potential impacts to ecological values and therefore reduce the risk to an acceptable level.

Terrestrial fauna species occurring in the NOEF area are common and wide-ranging forms, with no species restricted to the open woodland habitat in the area. Threatened species including yellow-spotted monitors and Australian bustard occur in this area and emu may occasionally be present. The Project will remove a minor amount of habitat for these species leaving large areas of similar habitat available in the region.

Management measures to reduce or avoid impacts associated with habitat loss and fragmentation, reduced species abundance and impacts to threatened and common species include:

- Minimising the area of vegetation clearance;
- Consolidating areas of vegetation to be cleared for access tracks and infrastructure pathways so that large blocks of habitat, rather than small fragments, are preserved;
- Rehabilitating cleared land both progressively during the life of the project and following project completion; and
- Limiting the number of roads constructed in the project area.

Management measures to reduce the potential impacts of introduced fauna include:

- Minimising the potential for water to pool in areas around the overburden emplacement facility and where it is applied as a dust suppressant (e.g., along unsealed haul roads) to reduce the attraction for animals.
- Ensuring that water pipelines are kept in good condition without leaks to minimise the potential for attraction of grazing animals.
- Continuing to follow the fauna management procedure.
- Ensuring that waste management procedures are diligently followed to reduce the attraction of the project area for these species.
- Regularly monitoring areas with a high potential for, or susceptibility to, increases in abundance of introduced species (e.g. water sources, waste storage areas and around water sources).
- Measures specific to identified EPBC Act-listed fauna occurring in nearby areas will be continued, and potentially further developed during the preparation of the EIS.

A fauna management procedure has been implemented to control vertebrate pest animals on and adjacent to the Project site. Included in this plan should be species-specific management and, where practicable,

eradication methods for terrestrial vertebrate pest animals on site in accordance with best practice. The procedure feral vertebrate species and unmanaged cattle.

Aquatic Ecology

Potential impact on aquatic ecology through ineffective overburden management is a potential risk associated with this project. Given that this risk has been identified, the NOEF will be designed and managed to minimise potential impacts to surface and ground waters and therefore to aquatic ecological values.

Potential impacts on aquatic ecology will be minimised through identification, selective handling and placement of the various overburden classifications, in a purpose built NOEF, minimising impacts on surface and ground waters. Surface water management infrastructure will be revised to manage runoff. The NOEF will be designed to limit air and water ingress and to limit mine affected drainage.

The management and mitigation measures presented in Sections 5.1 - 5.3 are relevant to the protection of aquatic ecology values. Monitoring of key species is currently undertaken by MRM and will continue.

Aboriginal and Cultural Heritage Sites

Based on identified management measures below, residual Aboriginal and cultural heritage risks/impacts associated with the Project are expected to be low. Management measures are expected to protect Aboriginal and cultural heritage environmental values and reduce risks to an acceptable level.

Three archaeological sites were identified within the Project site; MRM3, MRM4 and MRM5. Numerous artefact scatter sites, deemed to be of low cultural significance, have also been identified around the archaeological sites.

The Aboriginal Areas Protection Authority (AAPA) has previously issued Authority Certificates for MRM in accordance with Section 22 of the Northern Territory Aboriginal Sacred Sites Act 1989. The Proponent, employees and contractors will adhere to the AAPA requirements. The Proponent has established internal processes, such as the requirement for a land clearance permit to ensure activities potentially affecting sacred sites receive approval by representatives of the community relations, environment and survey sections.

Mt Stubbs (Barramundi Dreaming) is a culturally sacred site which is located directly to the East of the Project site. The Barramundi Dreaming sacred site falls under AAPA Authority Certificate C2004/084 which outlines the maximum height restriction for the NOEF to be a maximum of 80m over the life span of the Project. Should the redesign of the NOEF necessitate any modification to the conditions of the AAPA Certificate, this will be facilitated through consultation with the Traditional Owners and the AAPA.

Measures to minimise potential impacts on sacred sites are included as special approval conditions of the AAPA certificates for the Project components.

The approval conditions may require the following mitigation measures be taken:

- Prevention of entry to sacred sites;
- Prevention of ground-disturbing works at sacred sites;
- Prevention of damage to vegetation at sacred sites other than for purposes specified in the condition;

- Prevention of storage of material and parking of machinery within areas of sacred sites, or within a certain radius of sites;
- Erection of highly visible temporary protective fences in specified areas (e.g. along the outer perimeter of work areas in the vicinity of sacred sites) and maintenance of fences while construction works are in progress; and
- Notification of the Aboriginal custodians of the sacred sites and providing them with the opportunity to supervise any restoration works carried out on the site.

As is current practice at the existing operation, all employees and contractors will undergo Cultural Heritage awareness training and be made aware of the presence of archaeological and sacred sites in and surrounding the Project area. As a part of this training, employees will also be made aware of their legal obligations regarding the protection of archaeological and sacred sites through the relevant legislation and the penalties for breaching the legislation.

During all Project phases, all archaeological sites and sacred site areas should be regularly monitored to determine whether any site boundaries have been breached and to verify effectiveness of the management measures.

Matters of National Environmental Significance

A referral (2014/7210) under the *Environment Protection and Biodiversity Conservation Act* (EPBC) has been submitted to the Australian Government outlining the proposed action and describing the likelihood of impacts on Matters of National Environmental Significance (MNES). Also, a description of management measures to minimise the potential for impacts to flora and fauna have been provided as part of the referral. On the 16th June 2014, a referral decision was made that confirmed the proposed action is a controlled action (one that needs to be assessed and approved by the Commonwealth Minister for the Environment before it can proceed).

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