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**McArthur River Mine
Overburden Management Project**

Introduction

Draft Environmental Impact Statement

1 Introduction

1.1 Overview

This chapter provides a brief overview of the McArthur River Mine (MRM) Overburden Management Project (the Project) and McArthur River Mining Pty. Ltd. (McArthur River Mining), the Proponent. It also includes a description of the Project location, regional context, historical development and approvals history, objectives and climatic characteristics. A detailed Project Description is provided in **Chapter 3 – Project Description and Justification**.

This chapter also discusses the requirement for the Environmental Impact Statement (EIS), its structure and provides information on the team of people that contributed to its development.

The Project is located approximately 65 kilometres (km) by road southwest of the township of Borrooloola and 120 km south of the Bing Bong concentrate storage and ship loading facility (Bing Bong) in the Gulf of Carpentaria, Northern Territory (NT). The regional location of the Project is presented on **Figure 1-1**.

1.2 Background and History

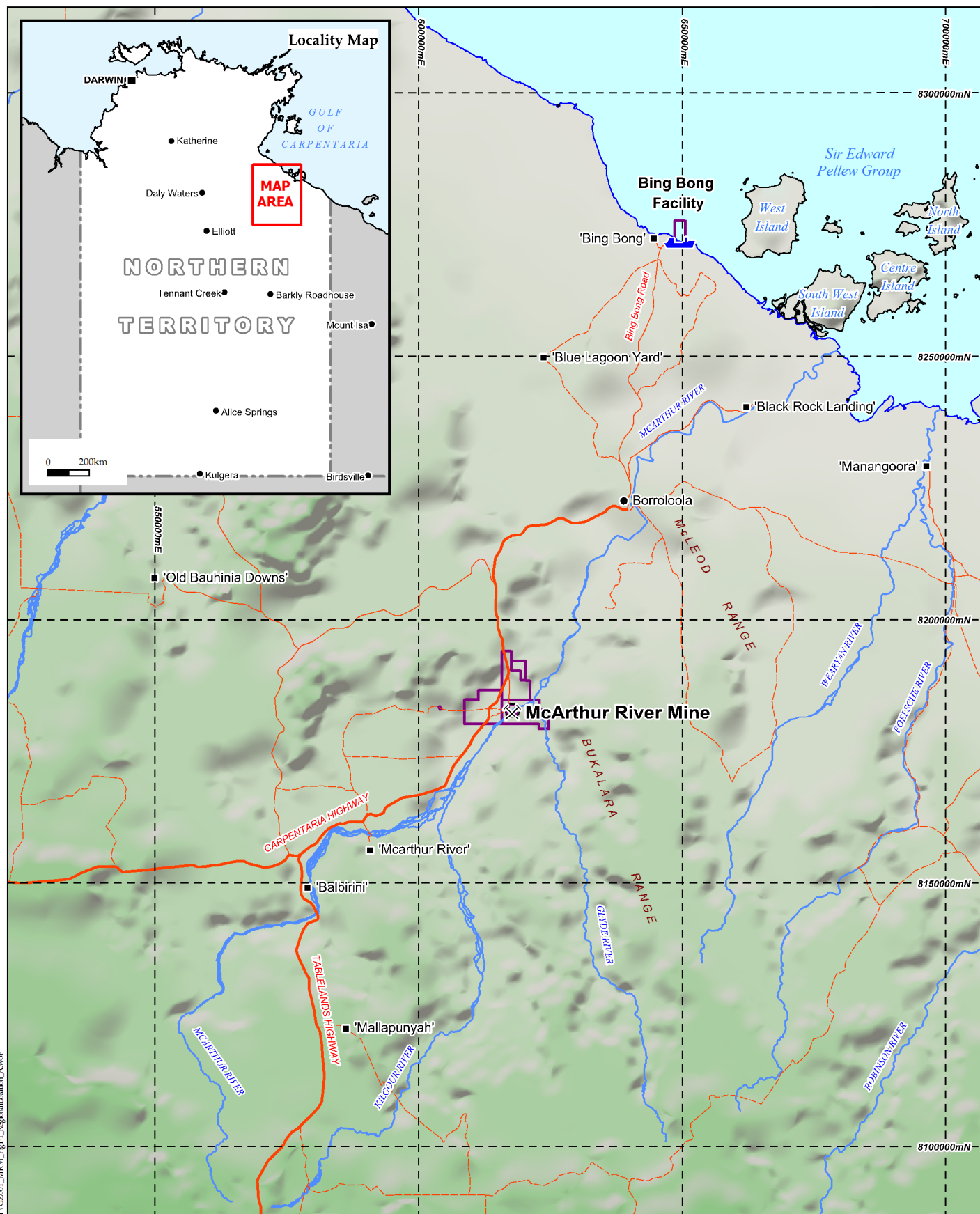
MRM is a major open cut operation that mines one of the largest known sedimentary stratiform zinc-lead-silver deposits in the world. The orebodies making up the deposit, named *Here's Your Chance* (HYC), were discovered by Mount Isa Mines (MIM) geologists in 1955, but commercial production did not commence until 1995.

This gap in time between the deposit's discovery and development resulted from the unusual structure and extensive faulting of the orebodies, 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 in the 1960s and 1970s failed to develop an economically viable technique of ore beneficiation. A small underground mine decline and pilot plant were constructed on site in 1975, with the consequent preparation of a feasibility study and environmental report in 1979, based on a high-tonnage, open cut operation. However, 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 and so no development was approved by MIM.

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

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



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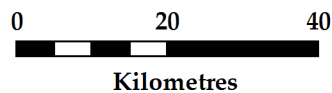
LEGEND

- Town
- Homestead
- ⊗ Mine
- Bing Bong Concentrate, Storage and Ship Loading Facility
- Principal Road
- Road (sealed)
- - - Road (unsealed)
- Watercourse
- Project Tenement

Data Source: Topography - Geoscience Australia; Tenement - NT Gov.

**McArthur River Mine
Overburden Management Project EIS**

Regional Location



Scale: 1:1,000,000 (A4)

10/02/2017



Datum: GDA94
Projection: MGA53

FIGURE 1-1

Whilst the environment assessment process was being undertaken, McArthur River Mining commenced a test-pit open-cut development in August, 2005. This contributed ore for sampling and processing during scaling-back of the underground operations. The test-pit was subsequently extended in April, 2006 when underground mining ceased.

The NT Government approved the large scale open cut development in October, 2006. Later, during the same month, the Australian Government provided its consent under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). In March, 2007, McArthur River Mining announced it would proceed with the \$110 million open cut development and a \$50 million expansion of its concentrator to increase its capacity from an annual throughput of 1.8 million tonnes (Mt) of ore to 2.5 Mt. These projects extended the life of mine by an estimated 21 years to 2027.

After the approval of the open cut development, site works were undertaken over a two year period and were completed in late 2008. A number of key development milestones were achieved, including:

- construction of a temporary flood protection bund wall allowing the open cut to be extended and support an increase in production rates;
- completion of new benchmark studies of local and migratory birds, fish populations and movement of macroinvertebrates; and
- development of the McArthur River and Barney Creek Channels, which were opened for water flow in the 2008/09 wet season.

The Phase 3 Development Project (Phase 3) (studied from 2011-2012) aimed to enhance project economics and operational life by increasing the processing rate, which would also enable economic extraction of a larger proportion of the resource. This relied upon further technological advances to the processing facilities to produce a new zinc concentrate, opening up a new market for MRM concentrate. The EIS Process was completed in July, 2012 with the provision of the EIS Assessment Report. The assessment report documents the Northern Territory Environmental Protection Authority (NT EPA) approval recommendations and the commitments made by McArthur River Mining. The assessment report is available on the NT EPA website.

The Phase 3 EIS authorised in 2013, increasing mineable reserves from 53 Mt to 115 Mt, and extending the life of mine by a further nine years from 2027 to 2036 at a higher production rate.

Since the approval of Phase 3, McArthur River Mining has significantly improved its understanding of the overburden geochemistry at MRM. The changes required as a result of this, have necessitated the completion of this EIS. Key aspects of the advanced understanding have included the development of a revised overburden classification system, as described in **Chapter 6 – Materials Characterisation**, and a redesign of the overburden management processes and facilities. Furthermore, and as part of the proposed Project, McArthur River Mining has revised the site-wide mine closure plan and long term management proposals.

1.3 MRM Environmental Management

McArthur River Mining has invested significant resources into improving its understanding of environmental factors potentially affected by the operations. It has also placed significant effort on the communication of environmental information to the local community and broader stakeholder groups.

The redesign of the Overburden Emplacement Facilities (OEFs) at MRM has been executed via a comprehensive risk based approach, completed in consultation with Project stakeholders. This risk based approach to the identification, evaluation, management and monitoring of environmental hazards has extended for over two years. This process, in the context of the Project design is summarised in further detail in **Section 1.5.2**, and extensively documented in **Chapter 7 – Project Risk Assessment**. The process has resulted in a significant change and improvement to the way in which overburden is identified, classified and managed on site. **Chapter 3 – Project Description and Justification** provides a detailed description of the revised overburden management practices to be employed at MRM through operations, decommissioning and closure phases. A key component of this has been the focus on closure in the North Overburden Emplacement Facility (NOEF) design process. McArthur River Mining plans to construct the NOEF in a manner that significantly reduces environment risks associated with the closure phase.

McArthur River Mining has been operating for over 20 years and during that time has developed a comprehensive understanding of the local environment and community values, and the potential impacts of the operation on those values. It has made significant contributions to the local community and economy and provides funding to local community and infrastructure projects, as discussed in **Chapter 12 – Socio-Economic Environment**.

McArthur River Mining has also committed to the Independent Monitor Program which facilitates an independent and publically available annual review of the operation's environmental performance and regulatory environment. McArthur River Mining has been active in addressing areas of improvement identified by the Independent Monitor and has been transparent in its communication of issues to the workforce and community. Recent Independent Monitor reports have noted considerable improvement in a number of areas of the operation and McArthur River Mining will continue to address areas identified for improvement.

A number of operational issues have arisen over recent years that have been reported in the media that have caused some stakeholder concern (refer to **Section 1.13**). These issues have been acknowledged and addressed by McArthur River Mining in consultation with regulatory agencies and the local community. Significant emphasis has been placed on robust scientific investigation of these issues and the timely presentation of this information to stakeholders. The potential for these issues to occur as a result of future proposed operations at MRM has been addressed in this EIS.

McArthur River Mining is committed to a significant number of environmental management and mitigation measures in this EIS. These are collated and summarised in **Appendix AB – EIS Commitments**.

1.4 EIS Scope and Approach

The Final TOR (refer **Appendix A – Final Terms of Reference**) governing the assessment requirements of the Project EIS were provided to McArthur River Mining in September 2014. The TOR broadly defines the scope of the EIS by the following statements:

“This TOR document will address those aspects of the Project that have significantly changed since the assessment of the Phase 3 EIS in 2012 and the Phase 3 authorisation in 2013”

and;

“Henceforth, where the term ‘the Project’ is used in this document, it refers to the components of the mine that have been, are being or will be altered from the 2012 assessment or would otherwise be affected by the alterations to those components and are defined as being within the scope of these TOR”.

The TOR also states that those mine activities that continue, with a similar risk profile, in accordance with the Phase 3 authorisation, may not require further assessment. This is communicated via the following statement:

“In order to continue with activities associated with the previously authorised Phase 3 Project, the Proponent will need to provide justification for not including aspects of Phase 3 activities within this EIS”.

Chapter 3 – Project Description and Justification provides a detailed breakdown and justification of MRM components considered to be excluded from the Project and therefore subject to this EIS.

The MRM Phase 3 EIS is publicly available on the NT EPA website at:

<https://ntepa.nt.gov.au/environmental-assessments/register/mcarthur-river-mine-phase-3>

This webpage includes links to all the relevant Phase 3 EIS documentation and includes the NT EPA Assessment Report which summarises the key outcomes and commitments of the Phase 3 EIS process.

McArthur River Mining is currently operating in accordance with its Phase 3 EIS approval conditions, an approved Mining Management Plan (MMP) and associated amendments covering the operating period 2015 to 2018. For the purposes of this EIS, the term “current operations” has been used to describe the combination of activities that have been approved under both the Phase 3 EIS and the subsequent MMP and associated amendments. The operation defined in the current MMP and associated amendments is in accordance with the Phase 3 EIS; however, it includes some environmentally insignificant changes from the concepts presented in the Phase 3 EIS - further information is provided in **Section 1.5.2**. These insignificant changes have been assessed and approved, subject to specific instructions by the Department of Primary Industry and Resources (DPIR) in accordance with the *Mining Management Act (2001)*. The mining operation (including these environmentally insignificant changes), is approved through to approximately mid-2018 and is considered to be excluded from the scope of this EIS.

Through consultation with the relevant regulatory agencies, McArthur River Mining has been advised to complete an assessment, within this EIS, of the potential environmental impacts associated with the Project over a 1,000 year period. This requirement extends beyond industry standard practice for environmental impact assessment and contains potential inherent uncertainties associated with predicting Project outcomes for extended periods into the future. The focus of the EIS has remained on the Project operational period and the shorter term closure period (the next 100 years or so); however, where practicable and meaningful to do so, this EIS has made an assessment of potential impacts for up to a 1,000 year period. It should be noted however that this approach has necessitated different modelling approaches between short-term and long-term assessments, with differing levels of confidence in the predictions presented by those approaches. Further detail on the limitations of long-term impact assessment modelling is provided in the relevant technical chapters and appendix reports.

The assessment of a 1,000 year period has necessitated a long term view of the MRM site and has influenced mitigation and management approaches proposed by McArthur River Mining in this EIS.

The TOR has also required McArthur River Mining to approach this EIS from a risk identification and management perspective; hence the assessment of the Project is focussed on the key risks assessed in **Chapter 7 – Project Risk Assessment**. This provides an assessment of Project risks in accordance with the Glencore Corporate Risk Management Framework and ISO 31000 *Risk Management – Principles and Guidelines* and is supported by the technical assessment chapters.

1.5 Project Definition and Assessment

The project definition process commenced in 2014, and has been an extensive and iterative process of risk assessment and environmental evaluation. A number of alternative design approaches were identified during the process and were assessed prior to further developing and establishing a preferred design (refer **Chapter 5 – Project Alternatives**).

1.5.1 Project Definition Process

The Project has been necessitated by improved understanding of the overburden geochemistry at MRM and the consequent alterations to the Project operations and management. Previously, as part of Phase 3, it was estimated that approximately 35% of the total overburden material to be excavated during the life of mine would be Potentially Acid Forming (PAF) material with the remaining 65% being Non Acid Forming (NAF) benign material. Improved geochemical sampling and analysis of the overburden material has indicated that this ratio is still approximately the same, however of the approximately 65% NAF material, a large proportion is non-benign and may have environmental implications if not appropriately managed. This includes the potential to generate metalliferous mine drainage or saline drainage under neutral pH conditions. This improved understanding of the overburden geochemistry has necessitated a redesign of the overburden management facilities at MRM and an update of the associated environmental management system. Refer to **Chapter 6 – Materials Characterisation** for further information on overburden and materials classification at MRM.

The TOR requires a number of site-wide assessments, primarily associated with water management. During the EIS, this site-wide view determined additional opportunities for potential improvement. This process has resulted in further project changes, additional to the management of overburden. These changes are addressed in this EIS and are summarised in **Section 1.5.2**. Detailed descriptions of Project alterations are provided in **Chapter 3 – Project Description and Justification**.

1.5.1.1 Baseline Assessments and Investigations

Following the finalisation of the TOR, a number of technical assessments were required to inform the Project definition and design process. These primarily focussed on further characterisation of the overburden but also addressed improving the understanding of the receiving environment. The following studies were undertaken to identify constraints and opportunities for the development of the Project and lead to the development of key design criteria:

- continued overburden drilling and testing;
- kinetic and static geochemical characterisation of overburden;
- geotechnical and hydrogeological characterisation of overburden;
- geotechnical, geochemical and hydrogeological characterisation of cover materials;
- clay resource drilling, mapping and characterisation;
- geotechnical, geochemical and hydrogeological characterisation of tailings;
- extensive hydrogeological investigations;
- erosion modelling of cover system materials and slope options;

- installation of long-term erosion and cover treatment trials on site;
- implementation of a drilling investigation into the existing NOEF;
- additional aquatic ecology baseline assessments;
- additional terrestrial ecology baseline assessments;
- air quality monitoring;
- community consultation and social assessment; and
- continuation of a range of on-going environmental monitoring programs (surface water, groundwater, air quality, soil, ecology).

These baseline assessments informed a suite of predictive modelling and assessment programs that are presented in this EIS.

1.5.1.2 Establishment of Project Closure Objectives

Site-specific closure objectives have been developed, and are summarised in **Chapter 3 – Project Description and Justification**. These were developed to guide the project definition process and facilitate a focus on successful closure, throughout the design process.

1.5.1.3 Establishment of Project Domains

Three primary Project domains were established to focus design processes on key areas of the operation. The domains were defined as the open cut, the NOEF and the Tailings Storage Facility (TSF). A brief summary of the key project attributes within each domain is provided in **Section 1.5.1.3** below. A detailed discussion is provided in **Chapter 3 – Project Description and Justification** and **Chapter 4 – Decommissioning, Rehabilitation and Closure**.

1.5.1.4 Identification and Assessment of Project Alternatives

A number of alternatives were considered for the design, construction, operations, decommissioning and rehabilitation phases of the Project. **Chapter 5 – Project Alternatives** outlines the process adopted to assess alternatives in order to identify and develop preferred Project proposals. **Chapter 5 – Project Alternatives** also provides a detailed discussion and assessment utilising multi-criteria analysis of each of the key project alternatives considered. Selected designs were then subject to optimisation and refinement processes, with the current proposed design presented in **Chapter 3 – Project Description and Justification**.

Further consideration was also given to design alternatives that present viable contingencies and alternatives to specific operational and management practices proposed in the EIS. These contingencies and alternatives are presented throughout the EIS where relevant.

1.5.1.5 Project Risk Identification and Assessment

The Project risk identification and assessment process adopted by McArthur River Mining formed a key component of the Project impact assessment methodology. This process incorporated all relevant Project domains and phases of activity (i.e. a whole-of-project approach). A key feature of this approach was the management of the project domains in accordance with MRM closure objectives and design philosophy. The design philosophy was driven by the closure objectives, and focussed on managing and mitigating potential long term environmental risks as part of Project design and operations, not only at the end of the mine life. Therefore Project risk identification, analysis and mitigation were, and will continue to be, an integral part of the life of the mine.

A comprehensive risk identification and assessment program was implemented over a three year period to review existing Phase 3 Project risks and identify and assess potential new Project risks.

This was an iterative process that was refined over time as:

- the results of supporting technical study programs were completed; and
- additional risk input data was compiled from external sources (e.g. regulatory agencies and other independent third party auditors).

A series of four risk focussed workshops were conducted, with the objective of:

- finalising the closure objectives;
- refining the Project concepts and establishing the preferred design;
- developing and refining the risk framework; and
- facilitating identification and assessment of all relevant Project risks; with mitigation, management and monitoring measures documented.

A detailed discussion of the Project risk assessment process and its outcomes is provided in **Chapter 7 – Project Risk Assessment**.

1.5.2 Project Changes since the Phase 3 EIS

The scope of the EIS is explained in **Section 1.4** above. The components of the MRM operation that have changed significantly since the Phase 3 authorisation in 2013 and the subsequent MMP and associated amendments are summarised below. These have resulted from the Project definition process discussed above. Detailed discussion of these Project components is provided in **Chapter 3 – Project Description and Justification**.

1.5.2.1 Overburden Classification and Management

Overburden classification and management practices have been significantly refined since the commencement of the EIS. This has included:

- a revised overburden classification system;
- a revised in-field testing and validation methodology;
- an improved overburden block model;
- an improved overburden selective handling and placement methodology;
- an improved design and construction methodology for the development of the NOEF;
- a revised NOEF cover, closure and management approach; and
- omission of the previously proposed South Overburden Emplacement Facility (SOEF) and East Overburden Emplacement Facility (EOEF) between the flood protection levee and the McArthur River diversion channel.

1.5.2.2 Open Cut

Whilst the target areas of the orebody have not changed significantly, a number of the open cut development and closure aspects have been improved. These include:

- revised mine staging and scheduling;
- altered final void geometry, including a benign NAF material quarry (Woyzbun Quarry) as a source of construction and rehabilitation material;
- placement and permanent storage of overburden within the open cut during the final approximate six years of operations;
- relocation of the temporary EOEF and SOEF stockpiles to within the open cut in-pit dump at the cessation of mining operations;
- relocation of the tailings in the TSF to the open cut following cessation of operations; and
- revised final void closure and management strategy.

1.5.2.3 Tailings Storage Facility

During the EIS process, McArthur River Mining has undertaken a review of the life of mine tailings storage strategy and infrastructure requirements. This has also included a review of the TSF closure strategy. Review of the TSF has included:

- an update to the TSF cell configuration including the amalgamation of Cells 1 and 2;
- revised tailings placement and water management strategies;
- revised seepage collection infrastructure; and
- a revised approach to TSF closure.

Approval of the TSF reconfiguration will be applied for through an update to the MMP. The updates have been included in the site-wide assessment completed in this EIS.

1.5.2.4 Water Management System

The redesign of the larger Project infrastructure components has necessitated review of the site water management strategy and infrastructure. This has included:

- revised water management dam configurations;
- proposed water treatment; and
- a revised approach to water handling and storage.

1.5.2.5 Life of Mine and Phases

The above mentioned infrastructure and management improvements have resulted in revised Project scheduling and phasing including:

- an extended Project duration;
- an extended decommissioning phase;
- an adaptive management and monitoring short term closure phase; and
- long-term monitoring and maintenance.

1.6 Current Project Status

As discussed briefly in **Section 1.4**, McArthur River Mining is currently operating in accordance with an approved MMP and associated amendments covering the operating period 2015 to 2018. In summary, the MMP has approved the following development activities:

- temporary storage of overburden in the SOEF adjacent to the open cut;
- construction of a footwall cutback on the western side of the open cut;
- development of the NOEF Central West stage; and
- construction of the Western Perimeter Runoff Dam (WPROD), located immediately adjacent to the western side of the NOEF.

It is anticipated that the updated TSF cell configuration will be approved through the MMP process in 2017.

The components of the ongoing operation that are either considered to be in accordance with the Phase 3 (or prior) EIS approval and authorisation or represent environmentally insignificant changes from this are excluded from the Project that is subject to this EIS. These components include:

- ore processing (including processing facilities, process inputs and outputs);
- operation of the mine site concentrate storage shed;

- concentrate haulage from the mine processing area to the Bing Bong Concentrate Storage and Ship Loading Facility (Bing Bong); and
- product export via Bing Bong, the bulk carrier transit route, ship loading activities, the capacity and number of ship movements and dredging frequency.

The mill operation and processing activities and area will continue to be operated in accordance with the Phase 3 EIS. Mill throughput may alter slightly, however maximum throughputs will not be exceeded. Minor elements of the water circuit have been improved since the Phase 3 EIS; however remain in accordance with the approval.

The following ancillary infrastructure remains in accordance with the Phase 3 EIS:

- potable water supply;
- the power station;
- fuel storage;
- explosives storage;
- sewerage;
- telecommunications;
- the accommodation camp;
- the aerodrome;
- the Mine Infrastructure Area;
- the administration area;
- the mining fleet; and
- key mining consumables.

1.7 Project Benefits and Justification

The Project will secure a substantial and long-term mining operation which will produce significant direct and indirect benefits to the NT and Australia generally (refer to **Chapter 12 – Socio-Economic Environment**). It will facilitate the development of a significant mineral resource and will supply needed metal concentrate to the global market.

The benefits from the proposed Project include:

- continued contribution to the NT and Australian economies: the Project will enable the economic benefits of the mine to continue, and increase;
- maintenance and facilitation of employment opportunities, including opportunities for local and indigenous community members; and
- local economic activity such as direct purchases of equipment, goods and services during Project construction and operational phases supporting a wide array of business support sectors within the NT economy.

This EIS has demonstrated that the Project can be developed to deliver the above benefits with acceptable environmental risks that can be managed through the operational and closure phases to protect humans and the environment.

1.8 Potential Future Development

The known resource extends beyond the boundaries of the proposed final open cut and the existing underground workings. Optimisation results indicate that there is potential for future resource extraction to the north via open cut and limited underground methods. Furthermore McArthur River Mining is aware of another potential resource block called the Woyzbun South which is approximately 150 m below the mineralised zone currently targeted by the open cut. Potential to target this via underground methods exist, but feasibility work has yet to be completed. Both of these potential future options are not sufficiently understood and are subject to future resource optimisation works and mine planning.

As with all mining operations, the feasibility and extent of future resource extraction is dependent on commodity prices, which dictate ore cut-off grades and Project viability. Available MRM resources will continue to be reviewed throughout the Project.

1.9 Project Proponent

The Project proponent, McArthur River Mining Pty. Ltd. (CAN 008 167 815), is the current operator of MRM and a wholly owned subsidiary of the Glencore plc (Glencore). In 2013, Glencore merged with Xstrata plc who was the former owner of McArthur River Mining Pty. Ltd.

The Proponent's contact details for the Project and this Draft EIS are as follows:

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 McArthur River Mining Pty. Ltd.
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 Website: www.mcarthurrivermine.com.au

Headquartered in Switzerland, Glencore is one of the world's largest diversified natural resource companies, and a major producer and marketer of over 90 commodities worldwide. Glencore industrial and marketing activities are supported by a global network of more than 90 offices located in over 50 countries (<http://www.glencore.com>).

Glencore is structured into three distinct business segments. Metals and Minerals focuses on copper, nickel, zinc/lead, alloys, alumina/aluminium and iron ore. The company has interests in assets that include mining, smelting, refining and warehousing operations. Energy Products focuses on oil and coal. Energy Products businesses include coal mining and oil production operations and investments in strategic handling, storage and freight equipment and facilities. Agricultural Products focuses on grains, oils and oilseeds, cotton and sugar. The Agricultural Products group is supported by storage, handling and processing facilities in strategic locations.

McArthur River Mining is one of the world's largest bulk producers of zinc in concentrate form and is a significant supplier of high-grade bulk zinc-lead-silver concentrate. Concentrate is used by Imperial Smelting Process smelters in Europe and Asia to produce zinc and lead metal and alloys.

1.10 Regional Context

1.10.1 Mineral Titles, Land Tenure and Land Use

MRM spans seven individual mineral leases held by MIM, a part of Glencore. The mine site is contained within five contiguous mineral leases (MLN1121, MLN1122, MLN1123, MLN1124 and MLN1125); located on McArthur River Station, Perpetual Pastoral Lease 1051. McArthur River Station is also held by MIM. 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 square kilometres (km²), and uses approximately one third of the area for grazing. Cattle are excluded from the mining and processing areas.

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.

1.10.2 Landmark Features

The topography and landscape character of the Project area is predominantly flat slopes to undulating, low hilly land. Most of the site has been cleared for the improvement of pastures for grazing, leaving small patches of remnant vegetation. In general, the terrain units (topography and geology) across the mineral leases are consistent with, and typical of, the Gulf Region.

Immediately east of the existing MRM site, the Bukalara Plateau, which is the major feature of the region, stands approximately 30 m to 100 m above the surrounding countryside.

1.10.3 Sites of Cultural/Social Significance

MRM is located on lands traditionally used by the Gurdanji and Yanyuwa 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.

Borroloola and its immediate surrounds comprise residents from a number of Aboriginal groups and include the Garawa and Mara people. Not all of these groups are custodians of lands likely to be directly affected through mine development.

McArthur River Mining holds Authority Certificates issued by the Aboriginal Area Protection Authority (AAPA). These certificates are required for all land disturbances on site in accordance with Section 22 of the *Northern Territory Aboriginal Sacred Sites Act*.

A number of Aboriginal site investigation studies have been undertaken and agreements made with the custodians for the current mineral lease approvals.

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 Community Relations and Environmental Departments in order to ensure actions are checked against the AAPA authority certificates for cultural heritage sites.

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 protection, and has been protected by fencing and signage preventing access to the site.

Where required, amendment of current AAPA Certificates will be applied for in consultation with custodians. Further information is provided in **Chapter 11 – Cultural Heritage**.

1.10.4 Regional Community Centres

The Project is located in the Roper Gulf Regional Council (RGRC) in the NT.

The RGRC comprises of 14 key towns, two of which are significant to the Project. These include Borroloola, which is the nearest major town to the MRM and Robinson River which is located 150 km southeast of Borroloola. Borroloola is an important town within the RGRC and is one of ten communities within the RGRC that have an established Local Authority.

There are approximately 26 outstations surrounding Borroloola. An outstation (or homeland) provides the opportunity for Indigenous people in the NT to live on their traditional land, maintaining their cultural heritage. Outstations are located at varying distances from Borroloola, with the furthest outstation that relies on Borroloola services located approximately 260 km away. Residents of these outstations travel to Borroloola to access services.

Robinson River is a small, remote Aboriginal community of approximately 260 people and is inaccessible for part of the year due to the intensive wet season. It is located in the NT near the Queensland border approximately 100 km east of the Project. Robinson River was a cattle station until handed back to custodians in 1992.

The King Ash Bay fishing centre located approximately 52 km north of Borroloola is increasingly popular with tourists, particularly retired and semi-retired people. In the tourism low-season (November to March), it is a small centre consisting of caravan parks, camping grounds and a shop, with a few permanent residents maintaining it year-round. The population is approximately 500 residents, swelling to a significant tourism population of in excess of 10,000 visitors.

1.10.5 Sensitive Environments

There are no national parks in the immediate vicinity of the Project; however, the Caranbirini Conservation Reserve is located approximately 30 km north of the Project area. The Reserve comprises 1,200 hectares and represents a mix of subtropical and semi-arid regions and protects flora and fauna from both these regions.

The Project area includes habitat for threatened terrestrial and aquatic species. Further discussion of these in the context of mining activities is provided in **Chapter 9 – Biodiversity** and **Chapter 10 – Matters of National Environmental Significance**. These chapters are also supported by technical assessment reports provided in the appendices.

The McArthur River also holds cultural, social and recreational value within the region. Further discussion is provided in **Chapter 12 – Socio-Economic Environment** and **Chapter 11 – Cultural Heritage**.

1.10.6 Extent of Resource within the Project area

The McArthur Basin comprises Carpentarian and Adelaidean rocks extending from the Alligator River in the NT 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 orebodies at Mount Isa and Hilton in Queensland. It is about 1.5 km long and 1.0 km wide with an average thickness of 55 m. 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 sediments. This western margin contains the Hinge ore zone, which is sub-vertical with a strike length of 1.0 km and vertical height of up to 200 m. The northern margins inter-finger with sedimentary breccias and the southern margin grades into thinned nodular barren pyritic siltstone. On the eastern margin the orebody thickens and is folded to form the Lower Fold Zone, which has a strike length of over 600 m. The southeastern corner is down-faulted 110 m by the northeastern trending Woyzbun Fault.

1.10.7 Geological Properties of the Project Area

The Umbolooga subgroup of the McArthur River Group is comprised of interbedded cycle dolostones, dolomitic siltstone, sandstone and shale. The Batten subgroup overlies the Umbolooga and is comprised of a succession of shallow marine deposits, chiefly dolomitic siltstone, cherty dolostone, pyritic shale, quartz sandstone and evaporites. The Middle Proterozoic McArthur River Group contains the oldest rocks in the McArthur Basin.

The youngest rocks in the McArthur Basin are found in the Roper Group and occur to the east of the Emu Fault Zone in the northeastern sector of the Project area. They are comprised of a Proterozoic succession of quartz arenite, quartz sandstone, siltstone and shale.

The east side of the Project area contains the Early Cambrian Bukalara Sandstone formation, a fine to very coarse grained, cross-bedded friable quartz to lithic sandstone with minor shale beds and basal pebbly conglomerate unconformable to the McArthur River Basin sequence.

Within the Project area, Quaternary sediments overlie the bedrock and consist of colluvial, alluvial, lacustrine sediment including clay, sand and silt, and gravelly residual soils. These strata are overlain by more recent alluvial material deposited on the floodplains, flood terraces, levees and channel floors of the McArthur River and the Glyde River.

1.11 Climate and Atmospheric Characteristics

1.11.1 McArthur River Mine Climate

Long-term climate data recorded at the MRM metrological station is provided in **Table 1-1**. This includes monthly mean temperatures, humidity, rainfall and wind speeds. Refer to **Figure 1-2** for the monthly averages for rainfall and temperature.

The statistical data from the MRM weather station indicates that:

- mean 9:00 a.m. relative humidity is generally higher from December to March and lower from June to October at MRM, which coincides with seasonal patterns of the wet and dry seasons;
- the mean relative humidity recorded at 3:00 p.m. is lower than 9:00 a.m. recordings all year round, with mean 9:00 a.m. recordings ranging from 46% in September to 75% in February;
- mean maximum temperatures range from 29.7–38.5°C;
- highest temperatures have historically been recorded in November, with the average maximum temperature of 38.5°C;
- mean minimum temperatures range from 12.2–25.0°C;
- coolest temperatures occur in July, with an average minimum temperature of 12.2°C; and
- mean daily evaporation is highest in the warmest months of the year, with a mean daily rate of 9.8 millimetres (mm) in November, and lowest in the coolest months, with a mean daily rate of 5.8 mm in June.

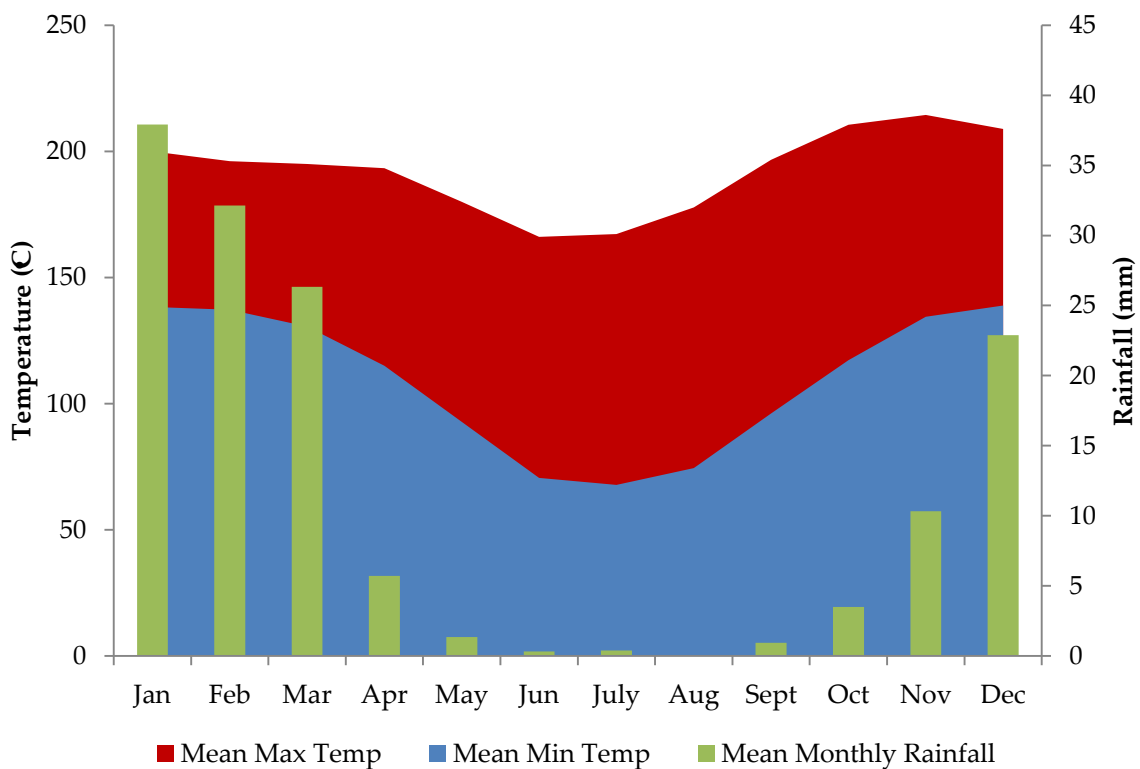


Figure 1-2 MRM Mean Monthly Rainfall (1968-2016) and Temperature (1969-2016)

http://www.bom.gov.au/climate/averages/tables/cw_014704_All.shtml

Table 1-1 Long-Term MRM Climate Data

Month	Temperature (°C) (1969-2016)		Relative Humidity (%) (1969-2016)		Wind Speed (km/h) (1969-2016)		Rainfall (mm) (1968-2016)		Evaporation (mm) (1975-2016)	
	Mean Max	Mean Min	9 a.m.	3 p.m.	9 a.m.	3 p.m.	Mean Monthly	Highest Daily	Highest Monthly	Mean Daily
Jan	36	24.9	71	50	6.9	10.2	210.3	173.4	782.3	7.4
Feb	35.3	24.7	75	53	5.9	9.4	183.2	197.6	660.9	6.8
Mar	35.1	23.5	71	47	5.5	10.1	148.2	124.1	562.1	6.6
Apr	34.8	20.7	59	34	6.9	10.7	33.0	162.2	213.6	6.8
May	32.4	16.7	50	28	8.7	10.2	7.4	86.4	160.1	6.3
Jun	29.9	12.7	48	25	8.7	10.5	1.7	15	18.2	5.8
July	30.1	12.2	48	24	8.1	11	2.3	49	56.6	6.0
Aug	32	13.4	47	21	8.6	11.8	0.3	11.6	12.6	7.1
Sept	35.4	17.3	46	21	9.4	13.1	4.6	48.4	89.6	8.8
Oct	37.9	21.1	48	23	9.3	13.2	20.2	90.6	184.6	9.7
Nov	38.6	24.2	53	30	8.2	12.5	59.5	200.4	290.4	9.8
Dec	37.6	25	62	39	7.2	11.4	121.3	122.4	435.2	8.7
Annual Average	34.6	19.7	57	33	7.8	11.2	801.3	-	-	7.5

http://www.bom.gov.au/climate/averages/tables/cw_014704_All.shtml

Rainfall data indicates that conditions at MRM are highly seasonal with distinct wet and dry seasons. The majority of rainfall occurs between December and March, with limited rainfall and drought like conditions occurring between May and September. According to the Bureau of Meteorology (BOM) data, January has the highest mean rainfall with 210.3 mm and August exhibits the lowest mean rainfall with 0.3 mm. The mean annual rainfall recorded at MRM is 801.3 mm.

Wind roses for the annual and the seasonal periods at MRM are presented in **Figure 1-3**. The wind roses indicate there is a northeasterly prevailing wind throughout the year, with a pronounced south-southeasterly prevailing wind during the dry season.

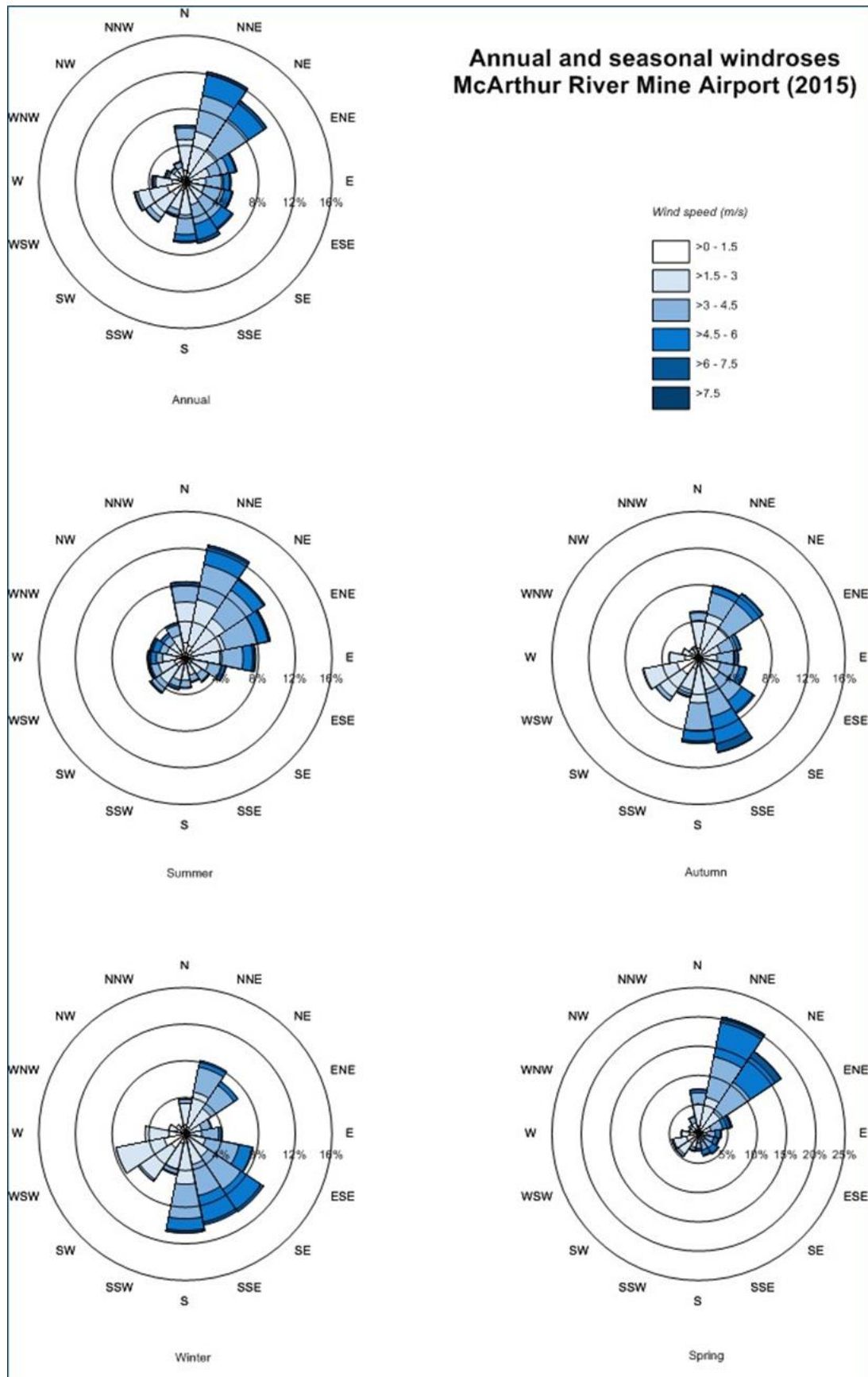


Figure 1-3 MRM Annual and Seasonal Wind Roses

1.11.2 Extreme Events

The following section discusses the magnitude and frequency of potential extreme events such as flooding, cyclones, bushfires, landslides and earthquakes.

1.11.2.1 Flooding/Cyclones

Generally, the cyclone season at MRM extends from November to April, with peak activity in January and February. An influential factor is the El Niño-Southern Oscillation (ENSO) fluctuations, which have a strong impact on patterns of tropical cyclone occurrence in the region. BOM cyclone tracking indicates there have been numerous tropical cyclones in the past 100 years within close proximity to MRM. Proximity of MRM to the tropical coastline may see increased rainfall events over the wet season from December to March due to associated cyclonic activity. BOM predicts an average of 0.1-0.2 cyclones predicted annually for MRM.

Meteorological monitoring has been conducted at the MRM weather station since 1968. The highest daily rainfall event recorded since 1968 was 200.4 mm on 28 November 2013. Potential impacts from flooding and heavy rainfall events assessed for the MRM area are detailed in **Chapter 8 – Water Resources**.

The potential impacts of flooding will be managed in accordance with the MRM Emergency Response Plan. Flood levees will be constructed progressively across the MRM site as required, to limit impacts of flooding on mining activities and any potential for release of contaminants to the environment.

1.11.2.2 Drought

The Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) have identified different regions around Australia deemed drought affected as areas of exceptional circumstances. Exceptional circumstances identification comprises extreme weather conditions, including very low rainfall, exceptionally high temperatures and low soil moisture (DAFF, 2011). The MRM region is not considered to be an EC area.

1.11.2.3 Bushfires

Bushfires and grassfires are an intrinsic component of Australia's environment. Natural ecosystems have evolved with fire and the landscape, and along with its biodiversity, have been shaped both by historic and recent fires. Many of Australia's native plants are fire prone and highly combustible, while numerous species depend on fire to regenerate. Indigenous Australians have long used fire as a land management tool. Fire continues to be used to clear land for agricultural purposes and to protect properties from intense, uncontrolled fires.

Grassfires are fast moving and smoulder briefly. They exhibit a low to medium intensity and primarily damage crops, livestock and farming infrastructure such as fences. Bushfires are generally slower moving, but have a higher heat output and can smoulder for days. Fire in the crowns of the tree canopy can move rapidly.

Fire management or controlled burns within the MRM area are a common occurrence. Every two years, areas within the MRM region are subject to controlled burns to reduce the possibility of uncontrolled fires and to assist in land management (e.g. local Indigenous people in traditional hunting activities).

The peak fire season for MRM is during the late dry season (refer **Figure 1-4**). At those times, the rainfall is considerably lower than the wet season, increasing the amount of dry vegetation available to fuel potential bushfires. Effects may be amplified by natural climatic cycles such as El Niño, which result in periods of increased temperature and reduced rainfall and humidity.

In order to prepare for and manage the threat of bushfires, McArthur River Mining will adopt management strategies set out in the Bushfires Act 2013, implemented by a fully trained MRM Mines Rescue Team. The team will be comprised of senior employees and contractors who are fully qualified, skilled and experienced in occupational first aid and firefighting.

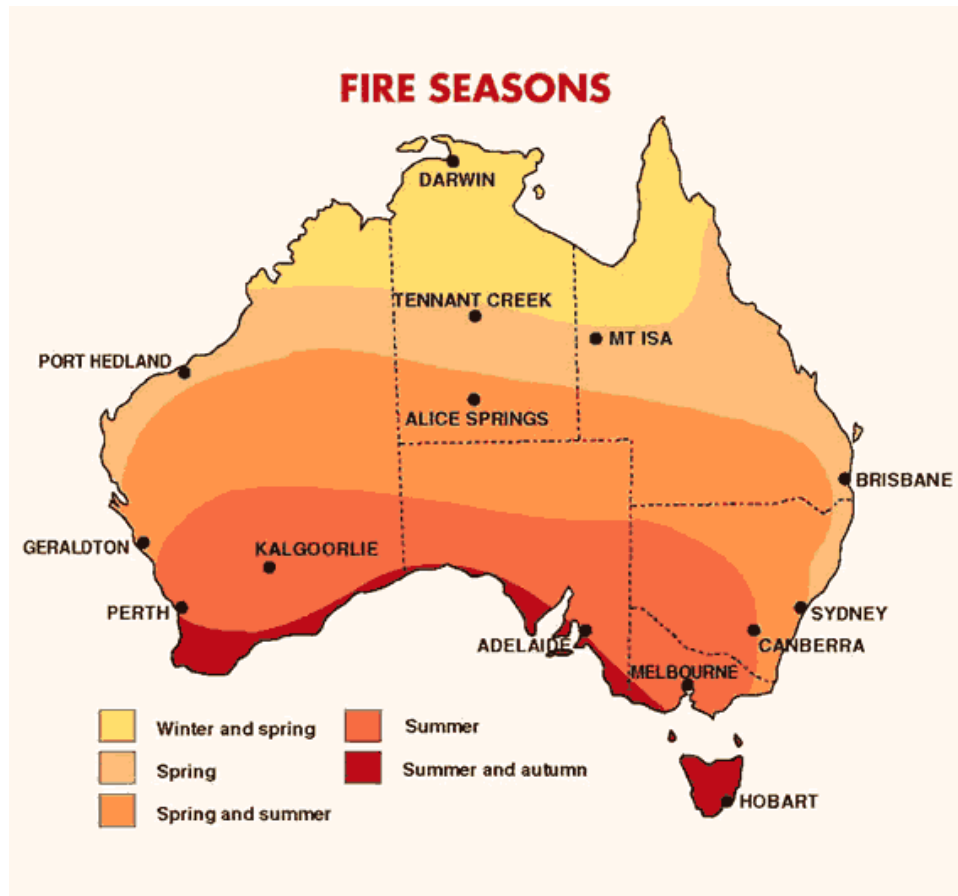


Figure 1-4 Distribution map for various Australian fire seasons (BOM, 2009)

1.11.2.4 Landslides

Landslides can be caused by earthquakes, volcanoes, soil saturation from rainfall, seepage or by human activity (e.g. vegetation removal, construction on steep terrain). Landslides usually involve the movement of large amounts of earth, rock, sand or mud, or a combination of these materials.

Considering the low-lying topography of the MRM area, landslides resulting from natural causes are unlikely. Mining activities have the potential to create localised land slippages within the open cut.

The risk of slumping from the settlement of overburden materials will be reduced with the design and creation of stable landforms. Ongoing monitoring will be undertaken to ensure MRM maintains landforms in a stable and safe condition. Should a geotechnical failure occur at MRM, the potential impacts will be managed in accordance with the principles set out in the site Emergency Response Plan.

1.11.2.5 Earthquakes

The majority of the world's earthquakes occur at tectonic plate boundaries. Australia is located centrally within the Indo-Australian tectonic plate and consequently experiences minor intraplate seismicity compared with locations on the plate boundaries. A search of the Geoscience Australia database indicated that no earthquakes have been recorded within a close proximity to MRM from 1955 to July 2011. The closest significant earthquake (3.6 magnitude) occurred approximately 400 km north of MRM on 14 February 2013.

In the unlikely event of an earthquake, McArthur River Mining will follow the site Emergency Response Plan. Earthquake resistance is incorporated into design criteria for key infrastructure.

1.11.3 Climate Change

Glencore recognises the science of global climate change as laid out by the Intergovernmental Panel on Climate Change (IPCC). Glencore believe this, along with the Conference of Parties (COP21) and public sentiment, will continue to drive a greater number of decisions, policy developments and programmes to restrict GHG emissions. These changes are likely to affect Glencore business. Glencore's response, and management of climate change issues, can be grouped into four broad areas:

1. Internal risk and materiality assessments
2. Management of our energy and carbon footprint
3. Proactive engagement with a range of stakeholders
4. Support for the development of low-emission technologies

(Glencore, 2017).

To complete an assessment of climate change impacts of the Project, McArthur River Mining has investigated potential climate change impacts across all relevant technical disciplines using a climate change impact assessment approach. The impact assessment approach is outlined below.

Identification of climate change variables relevant to the impact assessment such as rainfall, temperature and relative humidity was undertaken. Sensitivity analyses were performed by running a climate change model with an observed climate dataset to establish a baseline level of risk including assessments of:

- the mine operations period (2018-2047) using short-term climate change projections; and
- the post operational period (2047 onwards) using long-term climate change projections.

The model was also run using the same input data modified to represent best, worst and maximum consensus cases. The worst case, best case and maximum consensus climate change scenarios were identified by ranking the significance of each climate variable.

A comparison of historical baseline results with the climate change scenario was assessed to determine how sensitive the design is and whether the potential impact is adverse, beneficial or negligible for each design.

A detailed description of the approach used in assessing the impacts of climate change in this EIS is provided in **Appendix D – Climate Change Assessment Methodology**.

1.12 Current Agreements

A legal agreement between McArthur River Mining and the NT government for the establishment of the MRM Community Benefits Trust (CBT) was documented in July 2007. The agreement detailed among its objectives, to:

- enhance the positive social and economic impact of MRM mining operations resulting from the open cut mining operations on the community and the region as far as is reasonably practicable;
- create jobs and training opportunities; and
- further to this, a specific commitment was made under the Agreement for McArthur River Mining to “establish a target of 20% Indigenous employment across its workforce”.

McArthur River Mining holds Authority Certificates referenced #C2004-007 to 023 issued by AAPA. These Authority Certificates cover all operational areas of the mine.

McArthur River Mining is also a party to the McArthur River Project Agreement dated 25 November 1992 made between the NT of Australia and MIM. The agreement was ratified by the Territory in accordance with the *McArthur River Project Agreement Ratification Act*. The agreement makes provisions for certainty of project operations and the provisions of infrastructure while the Act, in addition to ratifying the agreement, ensures the validity of the mineral titles supporting the mine and an earlier authorisation relating to mine operations.

1.13 Proponents Environmental Record

MRM is a large scale world class mining operation. By its very nature it has and will result in changes to the environment and the community surrounding it. McArthur River Mining takes environmental protection seriously and through its operations and management seeks to foster the benefits of the operation whilst reducing potential impacts on the environment to an acceptable level. As with all large scale mining operations, the potential for environmental incidents exists. However, through the management of hazards and risks, McArthur River Mining has systems in place to manage environmental risks throughout the operation.

Chapter 7 – Project Risk Assessment presents the inherent (existing) risk profile associated with the project and provides a summary of the existing mitigation measures associated with that profile. It also provides the additional mitigation measures proposed as part of the Project and the resulting Project residual risk profile. This chapter demonstrates that through the assessment and management measures proposed, McArthur River Mining is able to reduce its environmental risk profile to an acceptable level.

A number of environmental issues have been presented in the media over recent years. These are discussed further below.

MRM is located within the McArthur River Station Pastoral Lease, a working cattle station which is managed by a Glencore company. Occasionally cattle from the station will break through fences and wander onto the mine site to reach water and food sources.

McArthur River Mining has been working together with the NT DPIR to put a strengthened Cattle Management Plan into action. This action includes:

- strengthening the 34 km of fencing around the site;
- upgrading the strainer posts and gates; and

- regular mustering of cattle (cattle mustered off the mine site are tagged and quarantined for 12 months).

Small rainbow fish and bony bream located adjacent to Barney Creek haul road (within the mine site) were found to have lead concentrations above the maximum permitted in Food Standards Australia and New Zealand (2009) (ERIAS Group, 2016). It was discovered that these small fish were taking up lead from sediments in the creek bed. Since this was first discovered in 2012, McArthur River Mining has undertaken considerable measures to reduce the amount of sediment reaching the creek bed (McArthur River Mining, 2016).

These measures include:

- installation of a sediment catchment runoff system;
- excavation of accumulated sediment from within the creek itself; and
- changes to the bridge design to reduce sediment-rich water running into the creek.

Monitoring of fish health will continue through the Project. Further information is available in **Chapter 9 – Biodiversity**.

In 2014, some material in the top layers of the NOEF began spontaneously combusting. When material containing high enough levels of sulphur and carbon interacts with oxygen it can ignite, releasing sulphur dioxide and smoke into the atmosphere. In November 2014, McArthur River Mining successfully undertook work to control spontaneous combustion on the NOEF with emissions now well under control.

Air quality monitoring stations were installed at Borroloola and Devils Spring to monitor air quality at both locations, specifically targeting sulphur dioxide to compare concentrations to air quality standards. Further information on the results of these assessments is provided in **Chapter 13 – Air Quality**. Implementation of a revised overburden placement method at the NOEF has reduced the potential for significant spontaneous combustion to occur. Further information is available in **Chapter 3 – Project Description and Justification** and **Chapter 6 – Materials Characterisation**.

Following an accidental release of diesel in August 2013, McArthur River Mining was convicted and received a fine as a consequence of a breach of Section 27(7) of the *Mining Management Act*. The area subject to the spill was remediated and procedures were reviewed and amended to reduce the risk of the incident re-occurring.

1.14 Study Team

This EIS has been prepared with significant contributions from a team of consulting technical specialists and McArthur River Mining technical personnel and management. It has also been subject to rigorous peer review and a comprehensive consultation program. **Appendix C – EIS Project Team** provides a summary of the qualifications and contributions made by the various team members.