MRM PHASE 3 DEVELOPMENT PROJECT

ENVIRONMENTAL IMPACT STATEMENT

TERRESTRIAL FLORA

Prepared for

MET Serve
MINING & ENERGY TECHNICAL SERVICES PTY LTD

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xstrata
zinc

by

EcoScience NT

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Document Summary

Company:	**EcoScience NT**
Project Manager:	Kristin Metcalfe, Principal, Consultant Environmental Scientist
Title:	MRM PHASE 3 DEVELOPMENT PROJECT EIS, Terrestrial Flora
Author/s:	Kristin Metcalfe
Client:	METServe Pty Ltd, for Xtrata Zinc
Client Contact:	Brett Harwood, Principal Consultant Environment 1300 078518 M: 0416 206122 brett.harwood@metserve.com.au Anthony Bianco, Senior Environmental Consultant, 1300 078 518 anthony.bianco@metserve.com.au
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Contact:	Kristin Metcalfe, ecoscience@bigpond.com, (08) 89854074 (M) 0417853752

Dr Kristin Metcalfe
Principal, Senior Environmental Scientist
EcoScience NT ABN: 75 713926974
29 Ostermann Street
Coconut Grove,
NT 0810

EXECUTIVE SUMMARY

EcoScience NT was commissioned by METServe, on behalf of Xstrata Zinc Pty Ltd, to conduct a Terrestrial Flora Assessment for the proposed McArthur River Mine (MRM) Phase 3 Development Project. The proposed project will increase bulk concentrate production using ore from an expanded open pit mining operation. Specifically, the Phase 3 project involves the expansion of three main areas: the overburden emplacement facility (OEF), the tailings storage facility (TSF) and the existing mine pit. The project area for the current survey of terrestrial flora comprised only these three proposed mine expansion areas.

The objective of this study was to survey the terrestrial flora within the project area and conduct an assessment of any potential environmental impacts arising from the Phase 3 project on the existing vegetation, particularly any flora of conservation significance. In recognition of the amount of previous information on flora collected at MRM during the last three decades, field work for the current project was to be minimal and mainly involve the verification of previous work.

Previous comprehensive surveys of terrestrial flora in the wider project area (i.e. the MRM mining leases and the adjacent Glyde River area) were conducted in February and April 2003 for the McArthur River Open Cut Project (URS, 2005). The 2003 surveys provided detailed information on flora from 54 study sites sampled in accordance with standard NRETAS survey methodology (i.e. full floristics and cover data recorded within 20 m × 20 m quadrats). The 2003 surveys built on baseline data from a number of other previous flora surveys and monitoring projects within the MRM mining lease. Surveys for the current project, conducted over three days between the 28th and the 30th of May 2011, involved field assessment of terrestrial flora and verification of existing vegetation mapping within the Phase 3 project area.

To assess the environmental values of terrestrial flora communities within the project area, METServe specified that EcoScience NT undertake the following scope of works:

- A literature and database review to identify species of conservation significance known from the region —to enable these species to be targeted during the field survey;
- Field verification /data collection to ground-truth existing vegetation mapping, identify and examine habitats that may contain species protected under legislation and to conduct broad-scale rapid assessments for threatened species; and
- Preparation of a report describing flora communities present within the project area, noting any important ecological processes, particularly the presence/absence of any threatened species or habitats, and potential impacts on the existing environment.

SITE DESCRIPTION

The project area is located approximately 60 kilometres south-west of Borroloola, 440 km south-east of Katherine and 900 kilometres south-east of Darwin, in the Gulf Region of the Northern Territory. The Bing Bong loading facility is located 120 kilometres to the north, on the Gulf of Carpentaria.

Xstrata Zinc is proposing to expand the existing open-cut silver, lead and zinc mine and bulk concentrate processing operations within the current MRM mining lease area. The Phase 3 Development Project would be located within five mining leases (MLN 1123 to MLN 1125) which cover an area of approximately 1,200 ha on McArthur River station.

FIELD SURVEY METHODS

To map and confirm the extent of vegetation communities, ground-truthing of previous mapping was conducted across the project area. Study plots were used at key locations to verify communities and to ascertain the vegetation type present in areas proposed for extension of mining operations.

Prior to fieldwork, a desktop review of existing information identified priority flora species and communities for assessment during field surveys. Habitats potentially supporting species of conservation significance were targeted for species occurrence and important ecological systems assessed in relation to potential environmental impacts. Plant species in study plots were listed as well as opportunistic records, to maximise the species list for the project area.

FLORA SURVEY RESULTS

Vegetation communities in the 780 ha area affected by the proposed Phase 3 development project were correctly represented in previous stratification of the mining lease. The proposed project will be sited within four vegetation communities and will mainly affect two lowland Eucalypt-dominated woodland communities but to a lesser extent will also affect two riverine communities.

The proposed Tailings Storage Facility (TSF) occurs within the Inland Bloodwood community, and the open pit expansion, and the North and East Overburden Emplacement Facilities, mainly occurs in Coolibah/Atalaya/Bauhinia open woodland. These communities are bordered in some areas by riverine woodland on tributary creeks and riparian open forest vegetation fringing the original McArthur River channel. Expansion of the open pit and construction of the East OEF will require clearing of some remnant riparian corridor vegetation, now bypassed by the river diversion.

Multivariate analysis of 16 flora study sites surveyed in the current assessment, combined with data from 22 sites surveyed during the 2003 surveys for the Open Cut Project EIS, verified the presence of four distinct vegetation communities in the project area.

A total of 123 plant species were recorded during the 3 day field survey in May 2011, including 30 species not recorded during the 2003 surveys. Overall, during the 2005 and 2011 surveys, a tally of 381 species was recorded from the wider MRM survey area.

No threatened species have been recorded during any surveys to date and no habitats likely to support threatened species occur within, or immediately adjacent to the Phase 3 project area. No endemic flora species, or species of potential conservation significance (e.g. species listed as near-threatened or data- deficient) are known from, or were recorded within, the Phase 3 project area. Previous surveys have identified that the primary habitats supporting threatened species are the sandstone plateau and vine-thicket communities, which are located outside the current project area.

The number of introduced weeds has increased from 15 to 28 species, of which 9 species were not previously recorded. One Class A declared weed and 5 Class B species occur on the mining leases and represent identified priority species for control. Weeds are actively managed in accordance with a current EMP and WMP, with annual control conducted in association with the Katherine Weed Management Branch.

Clearing will be required within the four main vegetation communities with 65 ha required for the open pit, 150 ha for the adjacent East and South OEF, 485 ha for the North OEF and five associated dams, with approximately 75 ha required for the final TSF footprint. Some temporary clearing of native vegetation will be required for extension of the mining camp and processing plant, which is located within the Inland Bloodwood and Coolibah/Atalaya/Bauhinia communities.

POTENTIAL ENVIRONMENTAL IMPACTS

A range of potential impacts on flora and nature conservation values may occur as a result of the Phase 3 Development Project. These include:

- Land clearing which would reduce the current extent of vegetation communities by over 1,200 ha with associated loss of faunal habitats.
- The most extensive areas of habitat loss are associated with the OEFs, comprising 150 ha for the new East and South OEF and the existing North OEF, which will increase in size by 485 ha.
- Loss of habitat may result in a reduction of local populations of individual species and more generally in loss of biological diversity from the local area.
- The most significant potential impacts on flora are associated with the clearing of riparian corridor vegetation currently remaining behind the McArthur River diversion and potential impacts associated with construction of the East and South OEF.
- Construction of the East and South OEF will reduce the buffer between the McArthur River diversion channel and the main bund wall to approximately 75m for the open pit and may result in further habitat fragmentation of the river channel if the rehabilitation of the McArthur River diversion channel and the East OEF is not adequately managed.
- Tall grassland (*Chionachne cyathopoda*) on the banks of the McArthur River and within the Phase 3 project area represents habitat for near-threatened bird species, the Purple-crowned Fairy Wren and White-browed Robin.
- Diversion of a minor drainage line near the North OEF will result in the loss of stands of Gutta Percha (*Excoecaria parviflora*) and Coolibah (*Eucalyptus microtheca*).
- Land clearing and construction activities associated with the project may increase soil erosion, contributing to siltation, sedimentation and decline in habitat quality of downstream terrestrial and aquatic ecosystems.
- Expansion of the TSF and particularly the OEF significantly increases the risk of contamination of freshwater streams and riverine habitats downstream of the minesite from acid mine leachate and heavy metals, and environment management strategies for this infrastructure need to be adequately implemented.
- The TSF is located in close proximity to Surprise Creek, and its dependent ecological systems. Increasing the capacity of the TSF may increase the likelihood of negative impacts on the creek from siltation, contamination and changes in drainage
- Terrain disturbance and construction activities are likely to contribute to the introduction and spread of additional weed species in the project area.

MANAGEMENT RECOMMENDATIONS

The following mitigation strategies are recommended to reduce the potential environmental impacts of the proposed activities on terrestrial flora. Management strategies for the project area may include, but are not limited to:

- Prevent environmental impacts through appropriate design, layout and planning of Phase 3 facilities and infrastructure e.g. avoid drainage lines wherever possible, and maintain wide buffer zones between riparian habitats and Phase 3 developments;
- Every effort should be made to keep the proposed disturbance envelope to a minimum recognition of the intrinsic value of native vegetation;

- Native vegetation removal should be conducted only after areas to be cleared have been clearly delineated and identified to equipment operators, and appropriate erosion and sediment control structures are in place.
- Ensure that a comprehensive system of diversion drains and sediment traps are constructed around the expanded TSF to reduce downstream impacts from acidic drainage, heavy metals in leachate, and siltation /sedimentation.
- Regular monitoring of the effectiveness and stability of capping for the TSF should be conducted, particularly during the wet season. If erosion occurs, contingency plans must be in place to undertake remedial action, particularly given the close proximity of the TSF to Surprise Creek, a major tributary of the McArthur River.
- To maintain the integrity of vegetated land that is not cleared, appropriate erosion and sediment controls are recommended to prevent sediment deposition in remaining habitat.
- In addition to rehabilitation management strategies for the McArthur River diversion adjacent to the East and South OEFs, introduce an appropriate environmental offset that provides habitat for the Purple-Crowned Fairy Wren.
- This may comprise, under relevant strategies outlined in the Draft Northern Territory Government Environmental Offsets Policy and Policy for Vegetation Management Offsets, the management of an area of riparian corridor habitat, preferably upstream of, but close to MRM, containing tall grass and associated vegetation suitable for the Purple-Crowned Fairy Wren
- Methodologies for rehabilitation and re-vegetation should use the most appropriate species for the landscape elements of the site. Such methodologies should include habitat matching of species, and locally sourced seed, to ensure rehabilitation success.
- It is recommended that recreated landforms and diversions of three minor drainage lines associated with construction of the North OEF and the TSF are contoured to resemble the original local topography, and that they include rocks of different sizes and woody debris to reduce scouring from high rainfall events and to facilitate seedling establishment.
- To reduce the long-term and cumulative impacts on downstream habitats of potential acid mine drainage, waste rock should as far as possible be backfilled into the open pit during the mine life, if practicable.
- Regular monitoring of sub-surface and surface water quality at strategic locations surrounding the North OEF to ensure that contaminants do not enter natural drainage lines.
- Adequate and ongoing maintenance and management of TSF and OEF perimeter drains and bores is essential to reduce impacts on nearby riparian systems and downstream habitats.
- A rehabilitation strategy should be developed for the project area. This strategy should embody the concepts and recommendations presented above and include provision for monitoring of rehabilitation progress over the life of the operation.
- Additional specific mitigation strategies should be applied to ecologically important features of conservation and management significance - such as the McArthur River riparian corridor and the Surprise Creek riverine communities - that provide potential habitat for the near-threatened bird species, Purple-crowned Fairy Wren and White-browed Robin.

CONCLUSIONS

Desktop and field assessment of the potential impacts on terrestrial flora indicate that vegetation clearing and other disturbance associated with the Phase 3 Development project will not affect any threatened plant species nor will it significantly impact on the regional occurrence of the four main vegetation communities affected.

Expansion of the existing TSF by 80 ha, construction of the 150 ha East and South OEF (sited

outside the existing open pit bund wall) and expansion of the North OEF by a further 485 ha represent significant environmental modifications. Construction of these facilities poses substantial risks to surrounding habitats, associated with contamination and altered patterns of drainage, particularly for downstream riparian and aquatic ecosystems. Rehabilitation and environmental management strategiesare need to be adequately implemented to offset these impacts.

It is recommended that the NT Draft Policy for Vegetation Management Offsets may be applied to the McArthur River Riparian Corridor vegetation community. This structurally complex, floristically diverse and ecologically important community has been significantly impacted by the 5.5 km long river diversion, with further anticipated loss of remnant patches of riverine forests associated with the Phase 3 project. Management of an equivalent area of upstream, nearby riparian habitat with suitable conditions and vegetation for the near-threatened Purple-crowned Fairy Wren and White-browed Robin may offset some impacts associated with the proposed development. Rehabilitation and environmental strategies associated with the McArthur River diversion and the East and South OEFs need to be adequately implemented to further assist in mitigating impacts on the riparian corridor.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

MRM PHASE 3 DEVELOPMENT PROJECT EIS

TERRESTRIAL FLORA

1 INTRODUCTION

On behalf of Xstrata Zinc, METServe Pty Ltd commissioned EcoScience NT to conduct a Terrestrial Flora Assessment for the proposed McArthur River Mine (MRM) Phase 3 Development Project. The McArthur River mine is now ranked as the world's second largest zinc resource, and the current study is part of an environmental and feasibility study being conducted by Xstrata Zinc to investigate an integrated development plan that involves increasing capacity at MRM for processing by it's European and Canadian smelters. The proposed plan would increase MRM mine production to approximately 5 million tonnes per year and increase bulk zinc/lead concentrate volume to 800,000 tonnes per annum.

The Phase 3 Development Project involves the expansion of three main areas: the overburden emplacement facilities (OEF), the tailings storage facility (TSF) and the existing open-cut mine pit. The area of the pit would be expanded by 65 ha to a total of 210 ha, but would not extend beyond the boundary of the current bund wall. The project area for the current survey comprised only the area within, and immediately surrounding, these three mine expansion areas (Figure 1).

The objective of this study was to conduct a survey of flora of the Phase 3 Development project area and make an assessment of any potential environmental impacts on existing vegetation arising from the project, particularly on flora of conservation significance. In recognition of the amount of previous information on flora collected at MRM during the last two decades, field work for the current project was to be minimal and mainly involve the verification of previous work (METServe, March 2011).

Previous surveys of terrestrial flora of the wider project area (the MRM mining leases and the Glyde River area) were conducted for the McArthur River Open Cut Project in 2003 (URS, 2005). The 2003 surveys provided comprehensive information on flora from 54 study sites sampled in accordance with standard NRETAS survey methodology (i.e. full floristics and cover data from within 20 m × 20 m quadrats) and from 3 transects within the river diversion area. The 2003 surveys built on baseline data from a number of other previous flora surveys and monitoring projects within the project area. Surveys for the current project, undertaken over three days from the 28th - 30th of May 2011, involved field verification of previous vegetation mapping and existing information on terrestrial flora.

1.1 Scope of works

To assess the environmental values of terrestrial flora communities within the project area, METServe Pty Ltd commissioned EcoScience NT to undertake the following scope of works:

- A literature and database review to identify species of conservation significance known from the region to enable these species to be targeted during the field surveys;
- Field verification /data collection to ground-truth existing vegetation mapping, identify and examine habitats that may contain species protected under legislation and to

conduct broad-scale rapid assessments for threatened species; and

- Preparation of a report describing flora communities present within the project area, any important ecological processes, the presence/absence of any threatened species or habitats, and discussion of potential impacts on the existing environment.
  - Further detail is provided in the document MET Serve 20110316MRM Scope of Works – Terrestrial Flora (MET Serve, March 2011).

2 PROJECT AND SITE DESCRIPTION

2.1 Project location

The project area is located approximately 60 kilometres south-west of Borroloola, 460 kilometres south-east of Katherine and 900 kilometres south-east of Darwin in the Gulf Region of the Northern Territory. The Bing Bong loading facility is located 120 kilometres to the north, on the Gulf of Carpentaria.

The McArthur River minesite is located on five contiguous mining leases (MLN's 1121, 1122, 1123, 1124 and 1125)located on the McArthur River Pastoral lease, which have a combined total area of 11,543 ha. The project area for the current survey was limited to the mine expansion areas only and is described in the following section.

2.2 Project layout

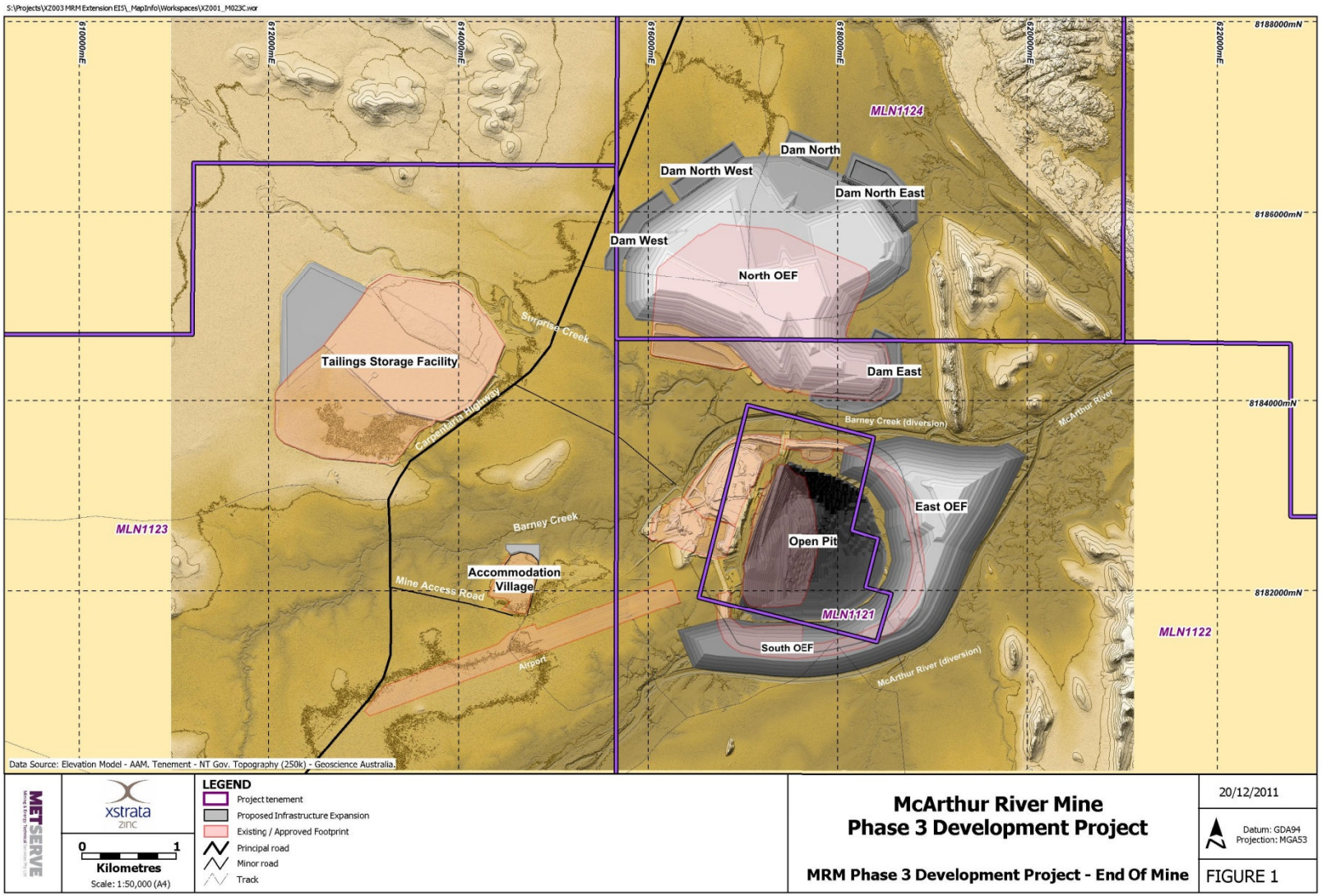
Xstrata Zinc is proposing to expand the existing open-cut base metals (silver, lead and zinc) mine and bulk concentrate processing operations within the current MRM mining lease area. The proposed project infrastructure and pit layout, superimposed on the current mine site area, is detailed in Figure 1. In particular, the existing TSF will be expanded by addition of a new cell on the western boundary.

The overall footprint of the open pit will increase in area from 65 to 210 ha and remain within the current bunded area and there is no intention for further diversions of the McArthur River or Barney Creek (Xstrata Zinc, 2011). The proposed Phase 3 development would expand production of the current open pit to a total annual capacity of approximately 5 million tonnes (Mt) and is planned for commencement in 2012.

The Phase 3 expansion project will result in an extra 500 million tonnes of overburden which will be stored in above-ground overburden emplacement facilities (OEF). The majority of the overburden from the Phase 3 Development Project will be stored at the existing overburden emplacement facility (OEF) located to the north of the mine area. The existing North OEF will be upgraded with the construction of five new dams and a realignment of a minor drainage line for water management.

However, it is proposed that approximately 27% of the waste would be stored in a new OEF to the east of the pit, comprising the area between the 5.5 km long river diversion and the existing bund. Hence although the open pit will not expand beyond the current boundary of the bund wall, a major OEF will lie outside the bund and will eventually be constructed approximately 75 m from the McArthur river channel for a distance of several kilometres. The proposed layout plan, as it will appear at mine closure in 2035, is shown in Figure 1.

Figure 1: McArthur River mine indicating the mining lease area, and the current project area, comprising extension of existing TSF, OEF and mine pit areas.



3 RELEVANT LEGISLATION AND POLICIES

The conservation status of fauna and flora may be considered within the context of federal (*Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999)* or Northern Territory environmental legislation (*Parks and Wildlife Conservation (TPWC) Act 2000).*

The EPBC act relates to proposals that may have a significant impact on matters of national environmental significance whilst Northern Territory legislation concerns the management and conservation of native species and communities within the Northern Territory framework. Hence, it is possible that a species may have a different conservation status listing under different legislation and under different jurisdictions, as the threats to species varies in different locations within Australia. Under Northern Territory legislation, the categories and criteria used for listing/delisting threatened species within the NT is based on IUCN definitions.

Legislation relevant to the assessment of flora of the project area is discussed below.

3.1 NORTHERN TERRITORY PARKS & WILDLIFE CONSERVATION ACT 2000

The Parks and Wildlife Commission Act (NT) is an Act to establish a Commission to establish and manage, or assist in the management of, parks, reserves, sanctuaries and other land, to encourage the protection, conservation and sustainable use of wildlife, to establish a land-holding corporation in connection with those purposes, and for related purposes.

The most relevant portions of the Northern Territory Parks and Wildlife Conservation Act 2000 (TPWC Act) to the project are found in Section 9 which pertains to threatened wildlife which includes both animal or plant species that the Minister identifies as threatened wildlife under section 30, or those defined as:

- Extinct wildlife;
- Critically Endangered wildlife;
- Endangered wildlife;
- Vulnerable wildlife;

The TPWC Act is relevant to the Project should any flora or fauna species of conservation significance (as detailed in the TPWC Act) occur within the project area or be subject to threatening processes. Plant species classified under the above categories are on the NT Government website and are listed in Appendix 1 (NRETAS, 2011).

3.2 COMMONWEALTH EPBC ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance.

Under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), an action will require approval from the Federal Environment Minister if the action has, will have, or is likely to have a significant impact on a Matter of National Environmental Significance, where Matters of National Environmental Significance are:

- World Heritage properties;
- National Heritage places;
- RAMSAR wetlands of international importance;
- Listed threatened species and communities;
- Migratory species protected under international agreements;
- Nuclear actions; and
- The Commonwealth marine environment.

Of the above Matters of National Environmental Significance, none were applicable to the project area, and the Phase 3 Development project was not determined to be a 'Controlled Action' underneath the Federal EPBC Act. Hence this project will only be assessed under the NT process and not assessed under guidelines provided in the EPBC Act.

3.3 NORTHERN TERRITORY GOVERNMENT ENVIRONMENTAL OFFSETS POLICY

A draft Environmental Offset Policy was released by the Northern Territory Government on 28 October 2010. Environmental offsets are measures taken by developers to compensate for residual effects of their projects that cannot be avoided, mitigated or repaired at the site of development reasonable cost. Environmental offsets should be considered as part of an Environmental Impact Statement and in the development of an Environmental Management Plan.

At the time of writing, the draft policy had not yet been implemented by a change in laws, but as a working policy for a 2 year period. During the interim 2 years from October 2010, regulators are to apply its provisions when considering permits, licences or other authority to undertake and operate a development affecting Territory environments.

A key feature of offsets is that they can assist to reduce costs of environmentally sound development. Offsets take over when the most cost-effective treatments of damage have been exhausted at a development site. A point is reached when pursuing slight improvements becomes so expensive that it is better to seek greater environmental benefits in another way at another place. Environmental offsets are only applicable however, when the impacts cannot be avoided or minimised, and if all other Government environmental standards have been met.

3.4 POLICY FOR VEGETATION MANAGEMENT OFFSETS

A vegetation management offset is a legal arrangement or agreement that, over time, guarantees to maintain the extent, structure and function of:

- Regional ecosystems;
- Essential habitat; and

- Vegetation associated with watercourses; natural wetlands; and natural significant wetlands.

The riparian corridor habitat on the McArthur River is likely to meet the requirements for a vegetation management offset, given the substantial loss of remnant vegetation and fauna habitat associated with construction of the 5 km diversion channel for the open cut project in 2006. Furthermore, expansion of the pit and East OEF for the Phase 3 development project will further reduce the remaining area of riparian corridor and terrestrial woodland habitat in the outer bund area.

Moreover, construction of the South OEF may preclude the successful rehabilitation of a substantial area of riparian vegetation along the western bank of the existing river diversion. Maintenance of the proposed 75 m wide buffer zone between the McArthur River diversion and the East OEF, and its successful revegetation with appropriate riparian corridor species, will be important for re-establishment of a functional terrestrial wildlife corridor in this area. Associated with the Phase 3 development there may be a further risk of contamination of riverine ecosystems (e.g. Surprise Creek, which abuts the TSF) and in the longer term from acid rock drainage associated with expansion of the North OEF (potentially affecting Barney Creek)if environmental mitigation and management strategies are not adequately implemented. In addition, some loss of habitat (including stands of Gutta Percha, *Excoecaria parvifolia*) will occur due to diversion of a small drainage line near the North Dam of the North OEF.

Populations of Purple-crowned Fairy-wrens and White-browed Robins (URS, 2005) utilise disjunct patches of riparian open forest near the pit (also observed during this survey at Site M14, Figure 3). Approximately 1.7 kilometres of suitable habitat have been lost due to the previous river diversion and the current Phase 3 Project will result in clearing of a further 1.7 kilometers of riverine corridor vegetation. Remaining areas of this habitat are typically heavily impacted by grazing and associated weed invasion, which eliminates or excludes the tall grasses (*Chionachne cyathopoda*) that the Fairy-wrens depend upon for habitat.

A number of criteria will apply to a vegetation management offset, but reservation and management of an area of riparian corridor vegetation on the McArthur River containing suitable habitat for the near –threatened species Purple-crowned Fairy-wren (*Malurus coronatus mcgillavrayi*) and White-browed Robin (*Poecilodiyas superciliosa cerviniventris*) should be given consideration. The adequate implementation of ongoing revegetation works and planned rehabilitation of the McArthur River diversion are also important strategies for the conservation of these species.

4 DATABASE SEARCH & LITERATURE REVIEW

Although the first decline and pilot plant was constructed on the MRM mine site in 1975, development only commenced in 1995, and during the last two decades, a substantial amount of information has been collected on the flora and fauna of the area. Database searches collate information on flora species identified in the region from previous surveys, Government records and other sources. A review of such databases can facilitate the formulation of specific field survey techniques for species of special interest. However, database searches and other sources revealed that no threatened species have been recorded within the MRM mining leases and few species of conservation significance have been identified in the region surrounding the project area. These findings are outlined in the

following sections.

4.1 THREATENED FLORA

Review of the EPBC Act Online Database and the Northern Territory Herbarium Database indicated no threatened species (i.e. species listed as extinct, critically endangered, endangered or vulnerable) have been identified in the vicinity of the project area (Appendix 1). The EPBC Act Database search and the Northern Territory Herbarium (IUCN) search pertained to a radius of approximately 20 km from a central point within the project area (Figure 3). No threatened flora or species of special conservation significance were identified in either of these searches.

A small number of species of conservation importance (i.e. species listed as near-threatened or data deficient) which have potential conservation significance—as their classifications may be upgraded in future—have been recorded within the surrounding region (Table 1). However, it is unlikely that populations of any of these species will be impacted by the project, if they occur within the project area, as the primary habitat for these species is located elsewhere (Table 1). The likelihood of occurrence of these species is discussed in more detail in Section 8.0.

Table 1: Characteristics of Near-threatened and Data deficient flora species recorded from the surrounding region, noting habitat and classification under Commonwealth and NT legislation (Source: NT Herbarium).

Species Identification		Conservation Status		Present within the Phase 3 Project area
Scientific Name	**Habitat**	**EPBC**	**NT PWC Act**	
Calytrix mimiana	Sandstone plateau	Not Listed	Near Threatened	Not detected
Ophioglossum gramineum	Sandstone plateau	Not Listed	Near Threatened	Not detected
Astrebla lappacea	Black soil plain	Not Listed	Data deficient	Not detected
Dicarpidium monoicum	Sandstone plateau	Not Listed	Data deficient	Not detected
Hibiscus setulosis	Sandstone plateau, vine thicket	Not Listed	Data deficient	Not detected
Nephrolepis arida	Moist crevices, Glyde River gorge	Not Listed	Data deficient	Not detected
Portulaca oligosperma	Sandstone plateau	Not Listed	Data deficient	Not detected
Rothia indica spp. *australis*	Sandy soils, riverine corridor	Not Listed	Data deficient	Not detected

4.2 PREVIOUS SURVEYS

Prior to environmental studies commissioned for the MRM Draft EIS in 1992 there was little specific information concerning the vegetation of the MRM project area. Early land system surveys undertaken by the CSIRO (Scott and Speight 1966) provided a generalised overview of the plant communities of the region, listing dominant species and identifying common genera. Later surveys by Aldrick and Wilson (1990) and Wood, Sivertsen and Olsen (unpublished) provide plant community descriptions to accompany land systems mapping at 1:250,00 and 1:85,000 respectively. Wilson *et al*. (1990) mapped the vegetation of the area at a scale of 1:1,000,000 during production of the vegetation map of the Northern Territory. Collectively these studies provide a useful baseline for more detailed surveys.

The draft EIS for the initial MRM project characterised and mapped the vegetation of the original mine impact areas and provided floristic information from transects and 10 m × 10 m quadrats at specific sites (Hollingsworth Dames and Moore 1992). Data from 11 transects was presented as profile diagrams, providing information on vegetation structure and species composition at sites most likely to be impacted by the proposed development. On the basis of air photo interpretation and ground truthing these initial surveys identified 16 vegetation types (or map units) from 3 broad habitat types – riverine communities (3 map units), lowland plains (8 map units) and undulating hills and plateaux (5 map units).

Duff and Orr (1992) re-assessed the vegetation communities of the original MRM project area through classification of sampling sites using multivariate analysis. Thirty-one sites were sampled using 20 m × 20 m plots according to a CCNT vegetation survey format. These data were classified using multivariate statistical procedures (DECORANA and TWINSPAN) and from this classification they defined just 10 vegetation community types. However, a revised vegetation map based on this classification was not produced and the original data from this study is unavailable.

The survey by Duff and Orr (1992) also established permanent 10 m × 10 m vegetation monitoring plots in riparian vegetation along the McArthur River and Barney Creek. Riparian monitoring within the mine site area has continued to date (Bellairs, 1999; ERA, 1994; 1995; URS, 2003;) characteristically using quadrat-based sampling techniques (Table 2).

Owing to loss of primary quantitative data sets, incompatible data collection methods and previous use of now-obsolete plant nomenclature (unresolvable because voucher collections were not prepared for permanent storage in the NT Herbarium), the most substantial flora information available derives from the 1992 and 2005 EIS surveys (URS, 2005).

4.2.1 Flora Records

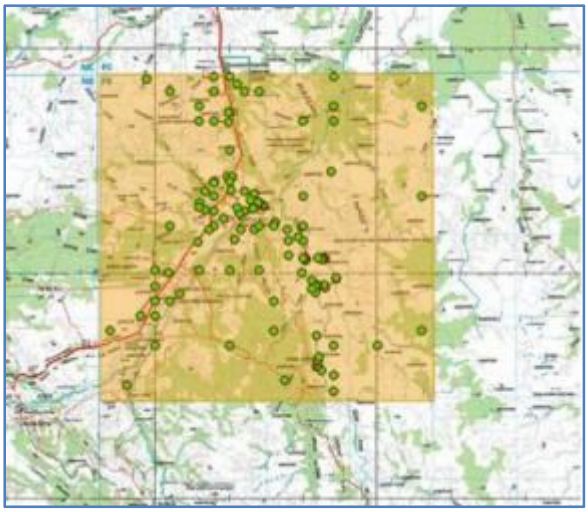
A search of the NT Herbarium database for flora records from the MRM region returned 486 records from an approximately 20 km radius of the project area (Figure 2) including collections dating back to 1911. The majority of species records (176) were collected by Brennan and Metcalfe in 2003 for the MRM Open Cut EIS, with 156 collected by Lyn Craven in the 1970's.

4.2.1 Flora Transects

A total of 11 flora transects have been surveyed in the MRM mining lease, 9 were established for the original MRM surveys (Hollingsworth Dames and Moore 1992) with

3 recent transects located in riverine habitats, close to the minesite (URS 2005, Figure 3). Flora within the upper, mid and lower strata was recorded at 5 m intervals along 50 m transects. Profile diagrams showing vegetation structure and composition were compiled on the basis of this data (Hollingsworth Dames & Moore, 1992; URS, 2005).

Figure 2: Location of previous records for flora from the region surrounding the project area.



4.2.2 Flora Survey Quadrats

A total of 54 quadrats were surveyed according to standard NT Government (NRETAS) methodology for the Open Cut EIS (URS, 2005). This involved full floristic assessment, basal area and percentage cover estimates within 20 m × 20 m quadrats.

Survey effort of previous baseline surveys is summarized in Table 2. Data from sixteen 20 m × 20 m verification quadrats obtained during the current survey was combined with previous data (excluding the Glyde River sites) and examined using multivariate analysis, to characterize vegetation within the Phase 3 project area (Section 6). The location of sites surveyed in May 2011 (yellow symbols) and in 2003 (red symbols) is shown in Figure 3.

4.2.3 Vegetation Mapping

The vegetation communities of the Northern Territory have been mapped and described by Wilson et al. (1990) at a scale of 1: 1,000,000. Three vegetation types occur within the project area at that scale (with dominant species *Eucalyptus tectifica*, *E. leucophloia* and *E. microtheca*) all of which occur extensively elsewhere in the Northern Territory (Wilson *et al.*, 1990).

Previous vegetation mapping of the project area, from aerial photography and detailed field assessment, identified 9 distinct vegetation types, with the predominant vegetation formation associated with flat to undulating woodlands which fringe the McArthur River to the east and west. A number of other mapped vegetation communities, including sandstone plateau, vine-thicket, Snappy Gum (*E. leucophloia)* and White Gum woodland (*Corymbia bella*) occur within the mining leases or wider survey area, but outside the current project area (Table 3, Figure 4).

Ground truthing of the area during field surveys verified previous mapping which distinguished 4 communities (Map units 5, 6, 8 and 9) within the current Phase 3 project

area (Table 3). The distribution and extent of these four communities is shown in Figure 4, and their characteristics including conservation values are described in Section 6.0

Table 2: Summary of previous baseline flora surveys, monitoring and management programs and methods of quantitative assessment.

YEAR	AUTHOR	METHODS
	BASELINE SURVEYS	
1992	Hollingsworth Dames and Moore. McArthur River Project Draft Environmental Impact Statement. Volumes 1 and 2 (reviewed).	40 sampling locations Ten 50m transects Fourteen 10 × 10 m quadrats
1992	Duff, G and Orr, T. Vegetation Survey of the McArthur River Mining Lease. Tropintel Environmental Consultants	Thirty one 20m × 20 m quadrats Eighteen 10m × 10 m permanent monitoring quadrats
1996	Smith, N. Flora and Fauna of Boomerang Creek,Gulf Country, Northern Australia. Report to Ashton Mining Ltd.	Fifty four 20m × 20m quadrats
2005	URS. MRM Open Cut Project EIS. Terrestrial Flora.	Fifty 20 m × 20m quadrats Eleven 50 m transects
	MONITORING PROGRAMS	
1993	McArthur River Mining Pty Ltd (1993) Environmental Monitoring Program	
1994	ERA Environmental Services (1994) Riparian Vegetation Monitoring of the McArthur River Project Area - Stage 1 Plot Establishment and Descriptions	Ten 30m × 30m quadrats Photo-monitoring
1995	ERA Environmental Services (1995) Riparian Vegetation Monitoring Stage 2 First Year Monitoring – 1995 Wet Season.	Ten 30m × 30m quadrats Photo-monitoring
2009	Sean Bellairs, Charles Darwin University Assessment of vegetation development associated with the Barney Creek diversion, 2009 report.	Nine 30 m × 30 m quadrats on Barney Creek
2009	ERA Environmental Monitoring Services. Riparian Vegetation Monitoring, Stage 4, Fifth Year Monitoring	Sixteen 30 m × 30 m quadrats, 8 control and 8 impact on Surprise Creek and McArthur River
	MANAGEMENT PROGRAMS	
1993	ERA Environmental Services. Revegetation and Stablisation Plan for the Construction Phase 1993.	
1993	McArthur River Mining Pty Ltd. Environmental Management Plan	
1994	McArthur River Mining Pty Ltd. Environmental Mangement Plan Construction Phase	
1997	Ferguson, Kim. Vegetating the Tailings Runoff.	
1994	MRM. Weed Management Plan	
2003	MRM . Weed Management Plan	
2005	MRM. Environmental Management Plan	

Table 3: Summary table of the nine vegetation communities and their dominant species identified during previous mapping of the wider survey area (after URS, 2005).

MAP UNIT	PROPOSED PHASE 3 FACILITY	VEGETATION COMMUNITY AND DESCRIPTION
UPLAND COMMUNITIES		
1	No impact. Outside project area	**Sandstone Plateau** ***Eucalyptus phoenicea/Corymbia capricornia*** **Open Woodland** Eucalypt community in rugged sandstone plateaux areas east of the project area and at Glyde River.
2	No impact. Outside project area	**Hill Woodland** ***Erythrophleum chlorostachys/Terminalia canescens*** **Low open Woodland** Mixed species on rocky hills e.g. Mt Stubbs, Emu Hill, with *E. chlorostachys* and *T. canescens*.
3	No impact. Outside project area	**Dry Vine-Thicket** ***Ficus* spp./ *Vitex glabrata/ Strychnos*** **Shrubland** Scree slopes and riparian areas with *Ficus* spp., *Pouteria sericea, Vitex glabrata* and *Strychnos lucida*.
4	No impact. Outside project area	**Snappy Gum** **Open Woodland** *Eucalyptus leucophloia* low open woodland on low ridges of ranges to east of the project area.
LOWLAND WOODLAND COMMUNITIES		
5	TSF and mining camp extension	**Inland Bloodwood** ***Corymbia terminalis/Eucalyptus chlorophylla*** **Woodland to open woodland** Extensive woodlands on lowland plains bordering the McArthur. *C. terminalis* dominan but varies with changes in drainage favouring *E. chlorophylla* and *E. tectifica* - either singly or as co-dominants.
6	North OEF and open pit expansion	**Coolibah** ***Bauhinia cunninghamii/Eucalyptus microtheca/Atalaya hemiglauca*** **Low open woodland to shrubland** Low open community on poorly drained floodplain areas with cracking clays. Extensive areas to east and west of McArthur River. Dominance varies locally between *Bauhinia, Atalaya hemiglauca* and Coolibah (*Eucalyptus microtheca)* with Gutta Percha (*Excoecaria parvifolia)* in drainage areas.
7	No impact. Outside project area	**Ghost Gum Woodland** ***Corymbia bella*** **Woodland to Open Woodland** A distinctive community with sparse Ghost Gum (*Corymbia bella)* dominant in upper stratum to 10m.
DRAINAGE AREAS		
8	North OEF and open pit expansion	**Riverine woodland** ***Casuarina cunninghamii/Lophostemon grandiflorus*** **Woodland to open woodland** Variable community typically forming narrow linear bands on smaller tributary creeks (eg. Barney & Surprise). Dominant species include *Casuarina cunninghamii, Eucalyptus camaldulensis* with *Terminalia bursarina, Excoecaria parvifolia* and *Lophostemon grandiflorus* .
9	East OEF and open pit expansion	**Riparian corridor** ***Melaleuca argentea*** **Woodland to open forest** Larger drainage lines with dense tree layer (8 to 23m) & mid-stratum of riparian species (2 to 6m), with terraced banks & sandy levees. The species characteristic of this unit is *Melaleuca argentea.* Sub-dominants include *Casuarina cunninghamii* and *Nauclea orientalis* with *Barringtonia acutangula.*

Figure 3: Location of flora survey quadrats and transects from previous surveys of the project area (red) and verification quadrats sur veyed for the current Phase 3 investigations (yellow).

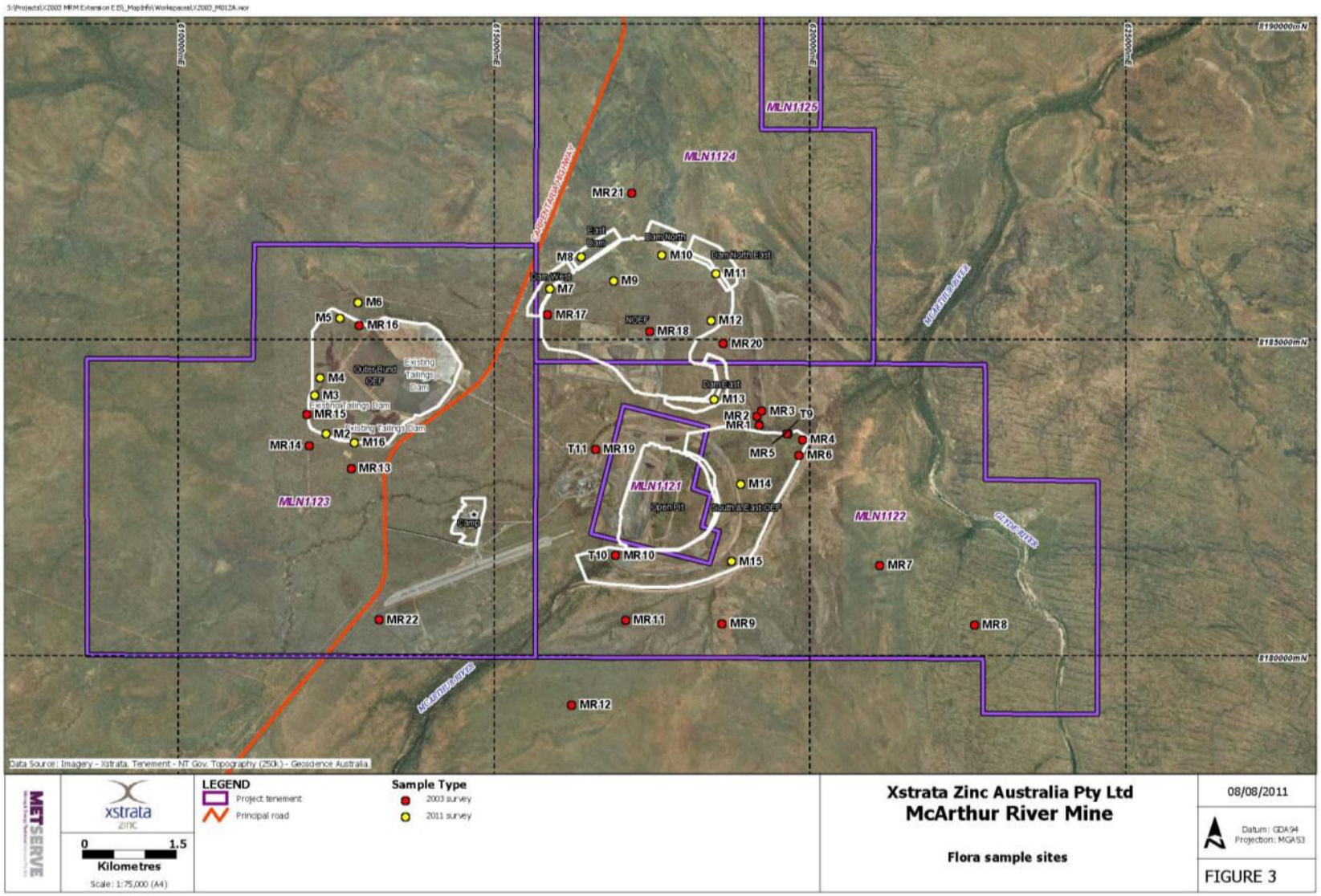
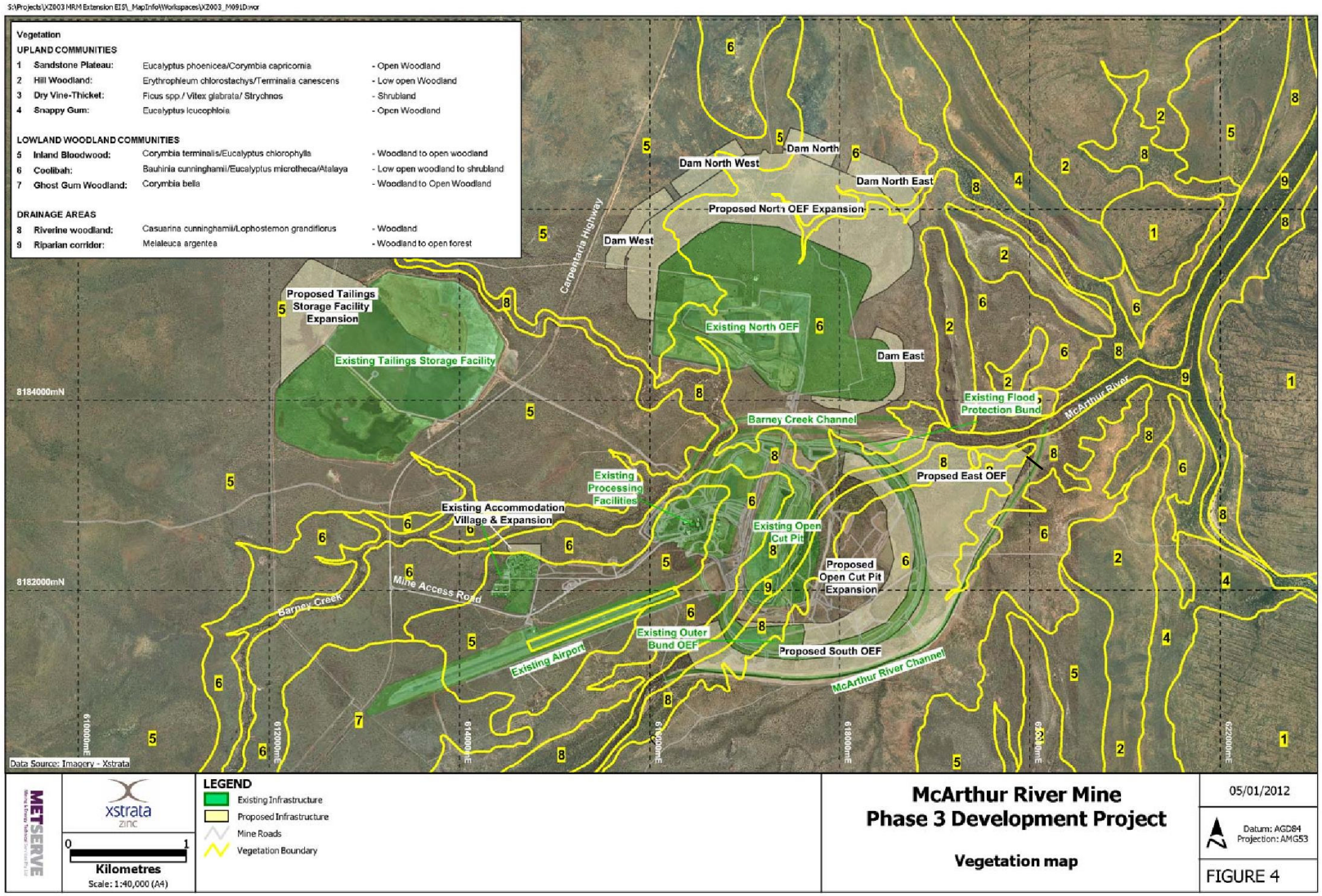


Figure 4: Previous vegetation map of the McArthur River mine compiled prior to the open cut development, and verified during the current study, showing the distribution of two main upland and two lowland communities within the Phase 3 Development project area.



5 FIELD SURVEY METHODOLOGY

A single dry season field survey of terrestrial flora of the project area was undertaken by EcoScience NT Vegetation Ecologist, Kristin Metcalfe, accompanied by MRM Rehabilitation Officer Jason Desmond, over three days from 28th to 30th of May 2011.

The method used for this survey was based on that currently employed for regional surveys in the Top End by NRETAS and comprised vegetation assessment within 20 m × 20 m quadrats. Similar methodology has been used previously to characterise the flora of Kakadu National Park (Duff et al. 1991, Orr et al. 1990) and for large scale mapping of Northern Territory vegetation (Wilson et al. 1990) as well as the most recent major survey of the MRM mining leases (URS, 2005). Each 20 m × 20 m survey site was characterised in terms of a range of environmental and floristic attributes including:

- Global Positioning System (GPS) location.
- Topographic position.
- Searches of the site for species of conservation significance.
- Basal area of upper and mid-stratum trees (using a Bitterlich gauge, BAF 0.25).
- Height range and average height of upper, mid and ground stratum.
- Estimated % cover of upper, mid and lower stratum.
- Plant species list for the upper and mid stratum.
- % cover for each species present.
- Site disturbance including fire, feral animals and weeds.
- All sites were photographed, using a labelled site marker board.

To conform with project scope and objectives (verification of mapping only) more detailed assessment of vegetation and habitat (e.g. recording all ground stratum species; estimation of percentage ground cover; soil type and geology) and classification of vegetation communities using NVIS techniques was not undertaken during this survey.

Field and desktop information, specialist advice and NT government websites were used to assess the conservation significance of the major vegetation communities present in terms of the likelihood of threatened species occurring there. The quality of habitat was assessed on the basis of the severity and extent of previous clearing, mining impacts, weed invasion, impacts from feral animals, grazing, erosion and sedimentation.

5.1 Existing Flora

The field data obtained allowed dominant species to be determined and classification of the vegetation to be recorded for comparison with previous stratification of vegetation for the project area.

Species present at each site were recorded and any plants not previously recorded were collected to maximise the species inventory for the area. Over 70 plant species were collected for botanical identification by the Northern Territory Herbarium.

The conservation values of plant species and communities were assessed by comparison with established governmental listings at local (Northern Territory Herbarium database), regional (Leach *et al.*1992; NRETAS website 2011;) and national levels (Environment Australia Website, 2011; IUCN, 2007). Common names for plant species were listed according to Anon (1994), Barrs (1999) and Milson (2000a, 2000b). Scientific names were listed in accordance with the Northern Territory Herbarium Plant Species Checklist (NRETA, 2007).

5.2 Data analysis

After plant identifications were completed at the NT Herbarium all field data were transcribed from standard field proformas into *Access* database files. A sites by species matrix was created from the 16 sampling sites surveyed during this survey, collated with 22 woodland, hill woodland and riparian sampling sites surveyed in 2003, using presence /absence of trees and shrubs, and perennial grass and sedge species. This matrix formed the basis for determining community relationships amongst the study sites. Annual ground cover species were not used in the matrix due to expected wide variation in the response of these species to local conditions, particularly disturbance. Plant community relationships were determined by classifying and ordinating the data matrix using *Primer* mutivariate software with the Bray-Curtis site similarity measure.

5.3 Vegetation Mapping

Verification of vegetation mapping was undertaken through the use of aerial photographs and ground-truthing using a GPS, and compiled with the findings of the field survey.

Sixteen quadrats, 20 m × 20 m in size, were established at all key locations within the Phase 3 project area. Detailed quantitative assessment using NVIS field survey techniques was beyond the scope of the current survey, which conformed instead with the previous major flora survey in 2005, being based on very similar NRETAS vegetation assessment techniques.

Study sites were located in key locations within each of the proposed Phase 3 development areas including five sites within the extension of TSF; one site on Surprise Creek; seven sites within the north OEF extension— including the five proposed new dams; two sites in the east and south OEF and 1 site in remnant riparian vegetation on the McArthur River in pit expansion area. The 16 study sites were established in locations throughout the project area to ensure that previous descriptions, summary data and mapping for these locations were appropriate (Figure 3).

Groupings or clustering of sites using multivariate analysis indicated their floristic similarity and verified the position of vegetation map unit boundaries within the project area (see Section 6.0, Plant Communities).

5.4 Survey for Species of Conservation Significance

Research into the growth form, ecology and appearance of any species of conservation significance that might be present in habitats within the project area was undertaken prior to field surveys. Due to the unlikelihood of any threatened species occurring in the habitats involved, the search was expanded to include endemic, data deficient and near-threatened species.

When a habitat suitable for a species of conservation significance was located, a specific survey for that species was undertaken. In this instance, the method used was the random meander technique, in which areas of suitable habitat were traversed in no set pattern whilst searching for particular plant species. If there was any uncertainty in identifying the species, a specimen was collected for confirmation by the Northern Territory Herbarium. The likelihood of any species of conservation significance occurring in the project area is discussed in Sections 6.1 and 7.0.

5.5 Plant Identification

All dominant plants representative of each vegetation community were identified using reference materials and taxonomic keys (e.g. Brennan 2007; Dunlop *et al*. 2005; Milson 2000a, 2000b;). For plant species that could not be identified in the field, a sample was collected, pressed and forwarded to the Northern Territory Herbarium for identification. A total of 73 plant species were collected during the current survey.

Eucalyptus chlorophylla amongst Inland Bloodwood vegetation community, which occurs extensively to the west of the McArthur River.

6 PROJECT AREA FLORA RESULTS AND DISCUSSION

PLANT SPECIES

A total of 123 plant species were recorded within the Phase 3 project area during the three day field survey in May 2011, including 30 species not recorded during the 2003 surveys. Appendix 2 lists all plant species recorded and indicates the family, lifeform, life cycle (annual or perennial), native or introduced status, and conservation listing. The habitat(s) in which each species was recorded was also listed. The species list is however, a checklist of species observed and not a complete inventory.

Overall, 381 species were recorded from the wider MRM survey area during both the 2005 and 2011 surveys and of that total, 28 were introduced weeds. The 381 plant species draw from 85 families and 226 genera. The most speciose plant families were Poaceae (60 species); Fabaceae (34 species); Myrtaceae (24 species) and Cyperaceae (20 species).

No endemic flora species, threatened flora or species of potential conservation significance (i.e. species listed as near-threatened or data- deficient) were recorded within the Phase 3 project area. Flora of conservation significance is discussed in more detail in Section 8.

PLANT COMMUNITIES

Vegetation within the wider survey area has been classified into nine main communities, comprising four upland, three lowland woodland and two riverine vegetation types. The characteristics of these vegetation communities are summarised in Table 3.

Four main vegetation communities occur within the Phase 3 project area and their distribution across the site was found to correlate well with the existing vegetation map of the MRM mining lease area (Figure 4).

Table 4 summarises the main structural characteristics (i.e. average height and percentage cover of each stratum, total basal area) of vegetation at the 16 study sites surveyed during this assessment, indicating the vegetation community, map unit, location relative to the Phase 3 development and the number of weed species observed at each site. Appendix 3 presents photographs of the vegetation at each study site and indicates the Stage 3 facilities proposed at each location.

Ground-truthing and verification of vegetation by assessment at 16 new study sites, confirmed that the 2005 stratification (URS, 2005) provided accurate representation of the existing vegetation communities. Multivariate analyses of study sites surveyed in 2005 (prefix MR) and sites examined in 2011 (prefix M) verified that four main communities occur in the current project area, as follows;

- Community 5– Inland Bloodwood (Woodland to open woodland).
- Community 6– Coolibah/ Bauhinia/ Atalaya (Open Woodland).
- Community 8– Riverine Woodland (Woodland to Open Woodland).
- Community 9– Riparian Corridor (Open Forest).

This community structure corresponded to a cut level on the classification dendrogram at around 20% site similarity (Figure 5). The floral similarity between sites and the groups of sites in each community type is illustrated in the ordination plot (Figure 6).

Figure 6 clearly shows that plant assemblages in riverine environments along the McArthur River, Barney and Surprise Creeks (in the top left of the ordination, indicated by triangular symbols in blue) differ greatly from those in lowland woodland environments (in the centre of the ordination, with green, pink and red symbols). Similarly, the plant composition of sites in dry upland areas (yellow symbols, from hill woodland sites) is very different from lowland woodlands, and those along creeks and rivers—as shown by the gradient of site types from top left to bottom right across the ordination diagram.

Figure 5: Dendrogram of classification of the vegetation at study sites surveyed in 2005 and 2011.

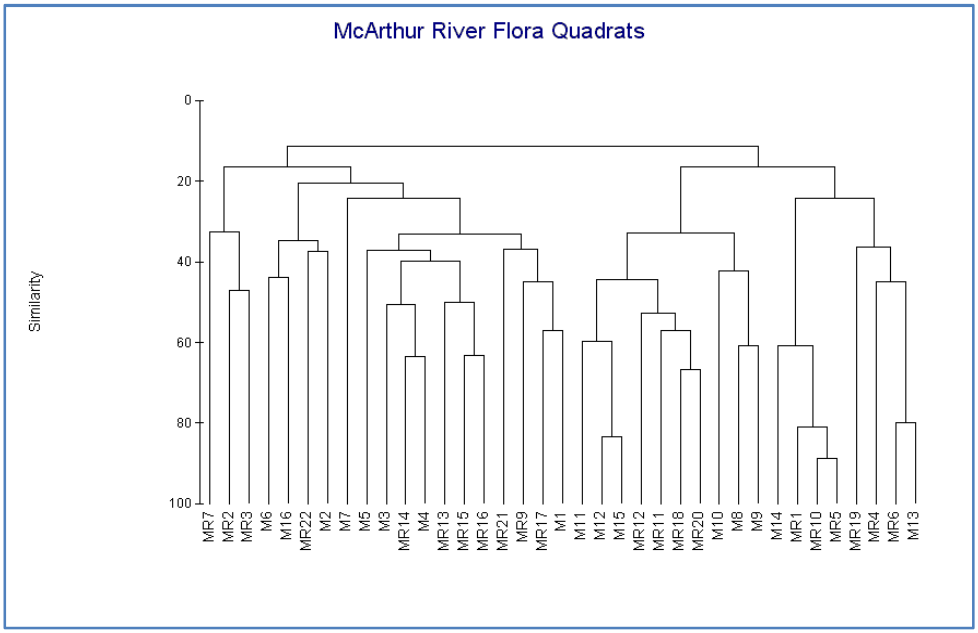
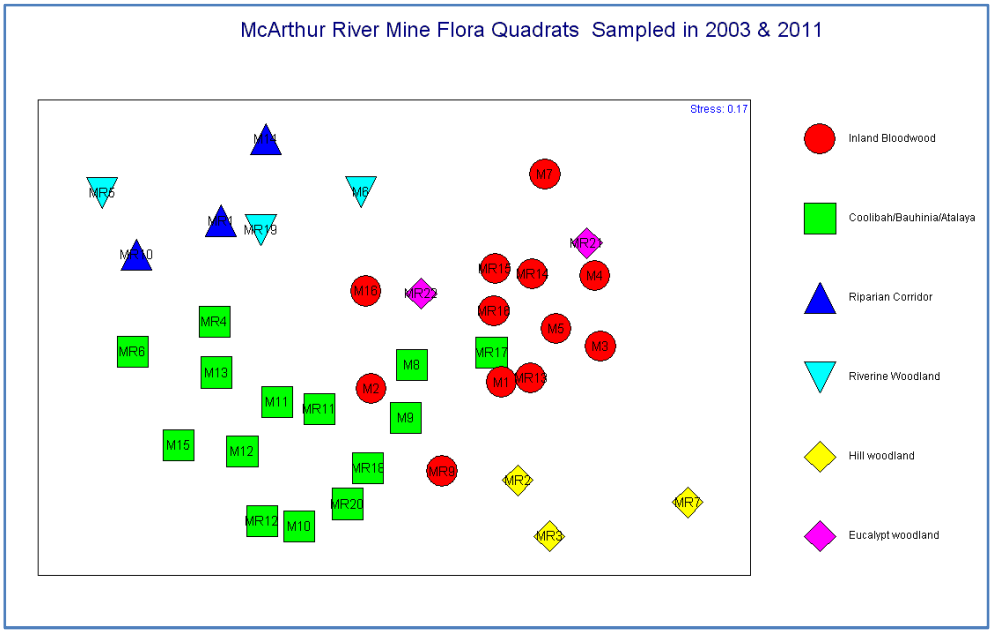


Figure 6: Ordination plot showing the floristic relatedness between the survey sites and the vegetation community groups derived from the classification.



Descriptions of each vegetation community, with comments on their conservation status are presented in the following section.

VEGETATION COMMUNITIES

Based on the current and previous studies, nine distinct vegetation communities occur within the local area surrounding the McArthur River mine site.

To the east of the McArthur River mine, and fringing the Glyde River, the dominant vegetation is characteristic of sandstone geological formations (Bukalara sandstone). These sandstone areas are bordered by a non-contiguous line of low hills including Mt Stubbs, located adjacent to the minesite.

West of these upland areas lies extensive Eucalypt-dominated woodland on flat to gently undulating plains, with open woodlands on poorly drained floodplain soils. Cracking clays are common in the vicinity of the pit and north OEF and mainly support open woodland and shrubland communities with minor grassland areas.

The braided channel of the McArthur River is bordered by tall, structurally complex riparian vegetation and the main tributary creeks (Surprise Creek and Barney Creek) which intersect with the minesite support more open riverine woodland. These riverine areas experience erosion and depositional processes and the vegetation communities associated with broad drainage areas are subject to seasonal waterlogging and inundation.

The native vegetation of the project area forms part of an environmental and floristic continuum with the small seasonal depressions, drainage ways and floodplain areas associated with the Barney and Surprise Creek catchments supplying these seasonal streams and their associated ecological systems. During the wet season, these drainage features and ephemeral water bodies link up and form an integral part of the McArthur River catchment. These riverine habitats generally represent valuable fauna corridors and are recognised by NRETAS (2006) as being important for biodiversity conservation. In this context, it is important that developments such as the proposed Phase 3 expansion, as far as possible, avoid habitat fragmentation and changes to the natural pattern of drainage.

Of the nine main vegetation communities (Table 3) four are upland communities on sandstone, or on low, rocky hills —habitats which mainly occur outside the project area. Three communities are lowland woodland communities, and two are riparian or riverine communities. The Phase 3 Development Project will mainly affect two lowland woodland communities (described in Sections 6.1 and 6.2) and to a lesser extent, two drainage communities (Section 6.3 and 6.4).

Table 4: Summary table of vegetation characteristics at flora study sites assessed during this survey, 28 – 30 May 2011.

Site	Location	Vegetation Community	Upper stratum % cover	Mid stratum % cover	Ground stratum % cover	Upper stratum av. ht	Mid sratum av. ht	Ground stratum av. ht	Total basal area upper stratum (m^2 ha)	Total basal area mid stratum (m2 ha)	No. of weed species
M1	TSF Extension	Inland bloodwood	4	35	95	5.3	4.5	0.4	1.75	3.75	1
M2	TSF Extension	Inland bloodwood	13	20	75	5	3	0.6	5.25	3.75	2
M3	TSF Extension	Inland bloodwood	6	15	98	6	3	0.8	5	1.525	2
M4	TSF Extension	Inland bloodwood	12	18	88	6	2.2	0.5	6.25	38	3
M5	TSF Extension	Inland bloodwood	22	28	92	6.5	2.5	0.8	7.25	1.25	0
M6	Surprise Creek	Riverine woodland	45	55	98	16	4	0.5	6.75	3	3
M7	West Dam, OEF Extension	Inland bloodwood	11	7	80	7	3.5	0.4	3.5	2.25	0
M8	North West Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	3	1	100	5.5	2	0.7	0.75	1.25	0
M9	OEF Extension	Coolibah/ Bauhinia/ Atalaya	5	4	100	5	1.2	0.7	0.75	1.5	1
M10	North Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	0.1	1	90	5	2.5	0.6	0	0	1
M11	North East Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	8	35	65	5	3	0.6	4	1	2
M12	OEF Extension	Coolibah/ Bauhinia/ Atalaya	5	65	70	6	2	0.1	1	1.25	1
M13	East Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	15	26	74	7	3	0.1	8.5	1.25	3
M14	Open Pit Expansion	Riverine corridor	85	65	100	19.5	5	1.5	9	20	3
M15	Outer Bund Eastern OEF	Coolibah/ Bauhinia/ Atalaya	9	55	80	7	3	0.9	5.75	1.5	2
M16	Outer Bund Eastern OEF	Riverine woodland	15	45	30	8	2	0.5	6.5	1.25	2

LOWLAND WOODLAND COMMUNITIES

6.1 COMMUNITY 1 – Inland Bloodwood (Map unit 5)

6.1.1 Location

The Inland Bloodwood community occurs extensively on lowland plains to the west of the McArthur River. Located on well-drained soils in flat to gently undulating country this community generally intergrades with Coolibah open woodland community, particularly toward drainage areas. The proposed Phase 3 addition to the TSF (Cell 4) is located entirely within the Inland Bloodwood community and has an 80 ha footprint.

6.1.2 Community Description

The Inland Bloodwood community is dominated by *Corymbia terminalis* with co-dominant species *Eucalyptus chlorophylla* and *Eucalyptus tectifica.* Common canopy species include E*rythrophleum chlorostachys* and *Corymbia confertiflora.* Dominance varies continually throughout this community in response to local variations in soil properties and drainage. For example, *Eucalyptus chlorophylla* may be locally dominant near the TSF and patches of *Corymbia grandiflora* occur north-west of the minesite. The vegetation structure also varied from open woodland to woodland with minor areas of shrubland generally associated with seasonal waterlogging.

Beneath the generally open canopy, low tree species included with *Bauhinia cuninghamii, Atalaya* spp. over a moderate to dense shrub layer of *Terminalia canescens* and *Acacia* spp. with a grassy layer of *Heteropogon contortus* and *Chrysopogon fallax* (Figure 7). Other canopy trees include *C. confertiflora* and *E. tectifica* with other sparse understory species including Quinine Bush (*Petalostigma pubescens*), *Hakea arborescens* and *Dodonaea oxyptera*. Canopy cover of the upper stratum is approximately 11% with an average height of 6 m. Average mid-stratum height was 3.1 m with 20% cover, with grasses and subshrubs to 88 % cover occupying the ground layer to approx. 0.6 m.

Figure 7: Community 5– Inland Bloodwood (Woodland to open woodland) occurs extensively in the western project area and is dominant in the vicinity of the TSF.

Species listed in Table 5 are indicative of the dominant species recorded within this community. A full list of species is presented in Appendix 2.

Table 5: Dominant flora of the Inland Bloodwood vegetation community.

Stratum	Relative Dominance	Scientific Name	Common Name
Canopy	Dominant	*Corymbia terminalis*	Inland Bloodwood
	Occasional	*Eucalyptus chlorophylla*	
	Occasional	*Eucalyptus tectifica*	Darwin Box
Understorey	Occasional	*Bauhinia cunninghamii*	
Shrub Layer	Dominant	*Terminalia canescens*	
	Associated	*Atalaya hemiglauca*	Whitewood
	Occasional	*Petalostigma pubescens*	Quinine Bush
Groundcover	Dominant	*Chrysopogon fallax*	Golden Beard Grass
	Dominant	*Heteropogon contortus*	Black Spear Grass
	Associated	*Dodonaea oxyptera*	

6.1.3 Conservation Value

Species

Searches for species of conservation significance were unproductive and indicated that no threatened plant species occur in the Inland Bloodwood community in the project area.

Weed species including *Cenchrus pedicellatum*, *Xanthium strumarium, Stylosanthes hamata, S. scabra* and *Passiflora foetida* were observed in disturbed areas around the tailings storage facility. Of these weed species, only *Xanthium strumarium* is currently listed as a Class B species. Impacts of grazing were evident throughout this community.

Community

Disturbance to the Inland Bloodwood community within the project area will mainly be required for upgrading Cell 4 of the TSF (total footprint of 80 ha) with minor clearing in other areas for expansion of the accommodation village and construction in the north and north-eastern sections of the North OEF.

Overall, the condition of Inland Bloodwood in the project area is healthy. Intact stands of this community are abundant in the region and it is unlikely that disturbance within the project area will significantly impact on the regional occurrence of this community.

6.2 COMMUNITY 2 – Coolibah (Map Unit 6)

6.2.1 Location

The Coolibah community (or *Eucalyptus microtheca/ Bauhinia cunninghamii/Atalaya hemiglauca* vegetation type) is located on poorly drained floodplain soils with cracking clays. Extensive areas of this community occur to the east and west of the McArthur River. Almost the entire North OEF is located within Coolibah open woodland and it also comprises the most extensive community within the proposed East OEF between the main bund wall and the McArthur diversion channel.

6.2.2 Community Description

Coolibah open woodland is generally dominated by *Eucalyptus microtheca* which forms a very sparse, open canopy, generally above a sparse to mid-dense shrub layer of *Bauhinia cunninghamii* and/or *Acacia farnesiana*.

Dominance varies locally between *E. microtheca*, *Bauhinia cunninghamii* and *Atalaya hemiglauca* in response to subtle changes in soils and drainage. In different areas within the project area, each species may form almost monospecific stands, becoming co-dominant or sub-dominant in others. Minor drainage lines in this community typically supported stands of Gutta Percha (*Excoecaria parvifolia*) trees with occasional *E. microtheca*.

Upper stratum canopy cover is approximately 6% with an average height of 5.7 m and mid-stratum cover is 26% with average ground cover of 82% (Table 4). *Acacia farnesiana* and *Carissa lanceolata* are low tree and shrub species characteristic of this unit.

Areas of black soil grassland tend to intergrade with shrubland and low open woodland in this community (Figure 8, Appendix 3). The ground layer typically comprises dense grasses and sedges including species such as *Brachyachne convergens* and *Eulalia aurea*. Ground layer species also include grasses such as *Iseilema macrantherum* with dense perennial forbs such as *Flemingia pauciflora,* with sedges to 20% cover.

Figure 8: Coolibah open woodland community in which *Eucalyptus microtheca, Bauhinia cunninghamii* and *Atalaya hemiglauca* were the dominant upper stratum species.

Species listed in Table 6 are indicative of the dominant species recorded within this community. A full list of species is presented in Appendix 2.

Table 6: Dominant flora of Coolibah open woodland vegetation community.

Stratum	Relative Dominance	Scientific Name	Common Name
Canopy	Dominant	*Eucalyptus microtheca*	Coolibah
	Dominant	*Bauhinia cunninghamii*	Bauhinia
	Dominant	*Atalaya hemiglauca*	Whitewood
	Occasional	*Excoecaria parvifolia*	Gutta Percha
Understorey	Dominant	*Bauhinia cunninghamii*	Bauhinia
	Occasional	*Atalaya hemiglauca*	
Shrub Layer	Dominant	*Acacia farnesiana*	Needlebush
	Associated	*Carissa lanceolata*	Conker Berry
Groundcover	Dominant	*Brachyachne convergens*	
	Associated	*Eulalia aurea*	Silky Browntop

6.2.3 Conservation Value

Species

Searches for threatened species were unproductive suggesting that no species of special conservation significance occur within this vegetation community.

Three weed species, *Sida acuta, Stylosanthes hamata* and *Malvastrum americanum* were observed within Coolibah open woodland. These species were restricted to small areas, and only made up a very small percentage of the vegetative groundcover observed. *Malvastrum americanum*, for example, only occurred on the fringes of minor drainage basins within the proposed north OEF extension. Dense grass cover was a characteristic of seasonally saturated clay soils in this community.

Community

The estimated total disturbance of the Coolibah Open Woodland within the project area is over 500 ha, which includes an area exceeding 400 ha in the North OEF and over 100 ha in the East OEF (refer to Table 10 for areas of vegetation clearance and Figure 4 for community location and proposed project infrastructure).

Overall, the condition of Coolibah open woodland in the project area is healthy. Intact stands of this community are abundant in the region and it is unlikely that disturbance within the project area will significantly impact on the regional occurrence or viability of this community.

DRAINAGE AREAS

6.3 COMMUNITY 3 – Riverine Woodland (Map Unit 8)

6.3.1 Location

The Riverine woodland community generally occurs within linear corridors fringing the major tributary creeks within the project area, particularly Surprise Creek and Barney Creek. It comprised a mixed species woodland formation on creek margins.

6.3.2 Community Description

Characterised by variable species composition, a number of tree species may be dominant in this community including *Lophostemon grandiflorus, Casuarina cunninghamii, Terminalia bursarina* and *Excoecaria parvifolia* (Figure 9). Common secondary trees may include *Terminalia platyphylla, Eucalyptus microtheca, E. camaldulensis* and *Corymbia bella*. Mid-stratum low trees and shrubs included *Planchonia careya, Hakea arborescens* and *Acacia* spp.

Upper stratum canopy cover was approximately 30% with an average height of 10 m. Average height of the mid-stratum was approx. 3 m with 50% cover. The ground layer is dynamic, being exposed to annual disturbance from flooding and is generally vegetated with 100% cover of grasses and forbs with variable species composition.

Figure 9: Mixed species riverine woodland fringing Surprise Creek, close to the existing TSF embankment.

Species presented in Table 7 are indicative of the dominant species recorded within this community. A full list of species is presented in Appendix 2.

Table 7: Dominant flora of the riverine woodland vegetation community.

Stratum	Relative Dominance	Scientific Name	Common Name
Canopy	Dominant	*Lophostemon grandiflorus*	Swamp box
	Occasional	*Casuarina cunninghamii*	
	Occasional	*Eucalyptus camaldulensis*	River Red Gum
Understorey	Occasional	*Excoecaria parvifolia*	Gutta Percha
Shrub Layer	Dominant	*Terminalia bursarina*	
	Associated	*Helicteres isora*	
	Occasional	*Acacia* spp.	
Groundcover	Dominant	*Urochloa reptans*	

6.3.3 Conservation Value

Species

Unproductive searches for species of conservation significance suggested that no threatened species occur within the riverine woodland community.

A number of weed species occur in this habitat which experiences seasonal disturbance due to flooding, erosion and sediment deposition. Weeds included *Hyptis suaveolens, Xanthium strumarium* and *Sida* spp.

Community

Disturbance of the riverine woodland community will occur during expansion of the north OEF, where a creek diversion is proposed. Remnant Riverine woodland fringing the previous channel of the McArthur river (now bypassed by the 5.5 km long diversion channel) will also be cleared for construction of the East OEF (Figure 4).

Overall, the condition of riverine woodland in the project area is healthy. The northern embankment of the approved TSF does impinge upon this community at Surprise Creek, where in some places the creek is less than 50 m from the dam wall. Other areas of this habitat have been removed from Barney Creek during the diversion of this creek around the open pit. Both these developments within riverine woodland habitat were assessed during the 2005 environmental impact assessment process.

6.4 COMMUNITY 4 – Riparian Corridor (Map Unit 9)

6.4.1 Location

The Riparian corridor community is located on seasonally flooded banks and over-flow channels of larger drainage lines such as the McArthur River.

6.4.2 Community Description

This community forms a dense linear corridor of trees 8 to 23 m high and approx. 85% cover, on terraced banks and sandy levees fringing the McArthur river (Figure 10). *Melaleuca argentea* is the characteristic riparian species with subdominants including *Casuarina cunninghamii, Eucalyptus camaldulensis* and *Nauclea orientalis.*

Upper banks, sandy levees and overflow channels tend to support Ghost Gum (*Eucalyptus bella), Terminalia platyphylla* and Coolibah *(E. microtheca).* The understorey layer is relatively species poor, approx. 5 m tall and 65% cover mainly comprising *Barringtonia acutangula, Pandanus aquaticus* and *Ficus* spp. The ground layer often comprises dense, tall grasses (*Chionachne cyathopoda* and *Mnesithea rottboelioides)* to 100% cover and 1.5 m high.

The noxious weed *Xanthium strumarium* may form dense patches in some areas, amongst other weeds including occasional *Parkinsonia aculeata*, *Alternanthera dentata* and *Passiflora foetida.* Serious environmental weeds such as *Clitorea ternatea, Cenchrus pedicellatum* and *Stachytarpheta* spp. occur in this community, particularly in areas subject to regular disturbance from seasonal flooding.

Figure 10: Riparian corridor community on the banks of the McArthur River forms tall, structurally complex open forest to woodland, typically dominated by *Melaleuca argentea*.

Species presented within Table 8 are indicative of the dominant species recorded within this community. A full list of species is presented in Appendix 2.

Table 8: Dominant flora of the Riverine corridor vegetation community.

Stratum	Relative Dominance	Scientific Name	Common Name
Canopy	Dominant	*Melaleuca argentea*	Silver Paperbark
	Occasional	*Corymbia bella*	Ghost Gum
	Occasional	*Nauclea orientalis*	Leichardt Tree
Understorey	Occasional	*Ficus racemosa*	
Shrub Layer	Dominant	*Barringtonia acutangula*	Freshwater Mangrove
	Associated	*Terminalia platyphylla*	
	Occasional	*Flueggia virosa*	
Groundcover	Dominant	*Alternanthera dentata*	

6.4.3 Conservation Value

Species

Targeted searches for threatened species were unproductive, indicating that no species of conservation significance were evident the riparian corridor community.

Numerous weed species, including a weed of national significance (*Parkinsonia aculeata*) and several Class B species (*Xanthium strumarium, Stachytarpheta* spp.) were observed in this habitat. *Althernanthera dentata* was very abundant, forming the dominant ground cover in some areas.

Community

A 1.7 kilometre stretch of riparian corridor habitat has previously been disturbed during construction of the open pit and riverine bypass. Several small, disjunct areas of remnant riparian corridor vegetation now remain close to the main bund around the pit, and within the area designated for the East OEF. A further 1.7 km of this vegetation community will be cleared for the proposed Phase 3 development project.

Overall, the condition of riparian corridor vegetation in the project area is healthy. However, in the absence of regular seasonal scouring, abundant weeds have proliferated in river bank areas truncated by the riverine diversion. Grazing and impacts from feral animals have also led to habitat degradation in this community.

7 WEEDS

The project area has a long history of land disturbance associated with four main factors: grazing of cattle on McArthur River station; feral animals including donkeys and horses; periodic, often severe, disturbance from flood events; and major terrain disturbance from mining.

Previous surveys recorded a total of 18 weed species within the wider MRM survey area (Table 8) including three declared Class B noxious weeds (NT Weeds Management Act 2001). One Class A species (to be eradicated) occurs within the mining lease but was not observed during this survey. In all, a total of 28 species have been recorded and the current survey resulted in 9 new species, recorded from within the three proposed mine expansion areas.

Weed distribution and abundance in riverine areas varies in response to the scouring effect of wet season flooding, evident by the dense growth of weeds along sections of the McArthur cut off by the diversion. Extensive disturbance associated with the river diversion and Barney Creek diversion also poses significant challenges for weed control and management. Weed control is conducted by Xtrata Zinc in association with the Katherine Weed Management Branch with the last major control effort conducted in October 2010. Ongoing and integrated weed management is necessary as weeds are continually introduced from upstream where they are prevalent.

McArthur River Mining has a comprehensive weed management plan for the mine site and surrounding area, which is reviewed every three years. The Plan identifies both high priority weed species including one Class A noxious weed (to be eradicated) and several Class B species (growth and spread to be controlled). The primary species identified for control comprise Devil's Claw *Martynia annua* (Class A), Horehound *Hyptis suaveolens,* Bellyache Bush *Jatropha gossypifolia,* Parkinsonia *Parkinsonia aculeata* and Noogoora Burr *Xanthium strumarium* (Class B). Individual strategies to remove and control each of these five species within the project area are described in the weed management plan.

Within the mining lease area *Parkinsonia aculeata* occurs only as scattered plants which are actively targeted in the current weed management program. Infestations of *Martynia annua,* mainly occur outside the mining lease , on the southern site of the river close to the old McArthur River station where they are targeted by aerial spraying by helicopter.

Noogoora Burr (*Xanthium strumarium*) occurs in dense thickets in riverine habitats on the McArthur River, on tributary creeks and in depressions. *Hyptis suaveolens and Aerva javanicus* have similar patterns of distribution, favouring disturbed areas. *Cenchrus pedicellatum*, not recorded in previous surveys has established dense stands around mining infrastructure. These five species represent the most serious environmental weeds in the current project area.

Table 9: Weed species recorded within the wider project area and their classification.

Weed species	Common Name	Classification (Weeds Management Act, 2001)	Wider project area (2003 surveys)	Phase 3 project area (2011 surveys)
Aerva javanica		—		●
Alternanthera dentata		—		●
Bidens bipinnata	Cobbler's Peg	—	●	●
Chionachne hubbardiana		—	●	
Cenchrus pedicellatum	Mission Grass	—		●
Clitorea ternatea	Butterfly Pea	—	●	●
Corchorus olitorius		—	●	
Digitaria bicornis		—	●	
Echinochloa colona	Barnyard Grass	—	●	
Eragrostis amabilis		—	●	
Heliotropium indicum		—	●	
Hyptis suaveolens	Horehound	Class B	●	●
Martynia annua	Devil's Claw	Class A		
Malvastrum americanum		—		●
Mitracarpus hirtus	Berrimah Weed, White Eye	—	●	●
Parkinsonia aculeata	Parkinsonia, Jerusalem thorn	Class B	●	●
Passiflora foetida	Wild Passionfruit	—	●	●
Physalis minima	Wild Gooseberry	—	●	
Portulaca pilosa		—	●	
Scoparia dulcis		—	●	●
Sida acuta	Spinyhead Sida	Class B		●
Stachytarpheta spp.	Snakeweed	Class B		●
Stylosanthes hamata	Verano	—	●	●
Stylosanthes scabra		—		●
Trianthema portulacastrum	Giant Pig Weed	—	●	
Tridax procumbens	Singapore daisy	—		●
Urochloa mosambicensis		—		●
Xanthium strumarium [=Xanthium occidentale]	Noogoora Burr	Class B	●	●
		Total	**18**	**18**

8 SPECIES OF CONSERVATION SIGNIFICANCE

8.1 Threatened Flora

Under Northern Territory legislation (TPWC Act, 1999) and Commonwealth legislation (EPBC Act, 2000) species that have been classified as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable are considered *threatened.* A search of the Northern Territory Herbarium (IUCN, Holtze), NRETAS databases and DSEWPC's EPBC Act Protected Matters databases revealed no records of threatened species from within the Phase 3 project area, nor within a search area of 20 kilometres surrounding the mine (Section 4.2).

There are very few plant species in the region surrounding the McArthur River mine project area with significant conservation values. None of the 183 plant species recorded during this survey, nor any of the 381 species observed during both the 2003 and 2011 surveys, have significant declared IUCN threat codes (i.e. endangered or vulnerable).

In previous surveys which covered a larger project area, one species, a tiny fern *Ophioglossum gramineam* which is listed as near-threatened (one of the lower risk IUCN categories) was recorded in the sandstone plateau environment in which it is has a wide but sparse distribution. *Calytrix mimiana* is another near-threatened species from the sandstone plateau habitat which is known from outside the MRM lease area, closer to Caranbirini waterhole (Table 1, Section 8.2). However, neither of these species will be affected by the Phase 3 development as their habitats do not occur within the current project area.

Similarly, of the 8 species regarded as data deficient (i.e. poorly known species with a lower IUCN threat code, than near-threatened), and the 9 species recognised as endemic to the NT, none are likely to be significantly affected by the proposed developments. Either their habitats do not occur within the project area, or in the case of data deficient species *Astrebla lappacea* (from black soil plain) and *Rothia indica* spp. *australis* (from riverine corridor on sandy soils), neither species is known to be highly restricted to the project area.

All other species recorded during this field survey were listed as 'least concern' on NT and Commonwealth Government databases and IUCN listings. Of the 73 species collected from the project area during the May survey for identification by the Northern Territory Herbarium, none were of special conservation significance i.e. listed as threatened under Commonwealth (EPBC Act, 1999) or Northern Territory (TPWC Act, 2000) legislation.

Prior to field assessment the following species were researched and where appropriate, were targeted during searches of the project area in May 2011:

Ophioglossum gramineum, status: near threatened

A tiny fern recorded once on the sandstone plateau near the Glyde River during the 2003 surveys. It is widely, though sparsely distributed throughout the NT and is also known from WA and Qld. The environment in which it was found would not be affected by proposed Phase 3 mine expansion.

Portulaca oligosperma, status: data deficient

Portulaca oligosperma is a very small annual ground cover species which was collected from

one site on the sandstone plateau during the 2003 surveys. It is known from just 13 records in the NT. The environment in which it was found would not be affected by the proposed Phase 3 mine developments.

Nephrolepis arida, status: data deficient

The collection of this fern from damp crevices along the gorge of the Glyde River was the first record of the species from the eastern side of the Top End (ABRS 1998). All other, albeit sparse, records have been from the Victoria River district or from the Kimberley in WA. The distribution of the species elsewhere in the region is unknown. The environment in which it was found would not be affected by proposed Phase 3 mine developments.

Rothia indica subsp. *australis*, status data deficient

Rothia indica is an endemic, annual, herbaceous plant which was collected from a single site on an unconsolidated sandy bank along the Glyde River gorge, during the 2003 surveys. There is no evidence that this species is particularly confined to the local region. Although it has been infrequently sampled in the NT, other records of it indicate that it occurs across a wide area of the NT. The environment in which it was found may potentially occur on the McArthur River as well, but is highly unlikely that it would be affected by proposed Phase 3 mine developments.

Astrebla lappacea, status: data deficient

A perennial species of Mitchell grass found at a single site on a black soil plain on the eastern side of the McArthur River. Although not detected during the current survey it is possible that it may also occur on the western side of the river, and some of the local population of this species could be lost during construction of the north or the east OEF. However there is no evidence to suggest that this species is confined to the local region. It is predominantly known from scattered records throughout the extensive, more southerly Mitchell grass plains of the NT and Qld.

Endemic species

The 9 endemic species previously recorded from the wider project area were *Gomphrena floribunda, Cleome microasustralica, Euphorbia armstrongiana, E. mitchelliana, Sauropus rigidulus, Leptosema villosum, Rothia indica* subsp. *australis, Mitrasacme glaucescens* and *Pityrodia angustisepala (*Appendix 2*)*. The significance of *Rothia indica* was discussed above. All the remaining endemic species except, *Euphorbia mitchelliana* were only found in elevated sandstone plateau environments. These species would not be affected by proposed Phase 3 mine developments and in any case they are all widely distributed in sandstone environments elsewhere in the NT.

E. mitchelliana, is a small diffuse annual herb which was recorded from the inland bloodwood community. While some local populations could be affected by expansion of the TSF and other facilities this species is also widespread elsewhere in the Top End of the NT.

Comments on the conservation status of other flora species

The initial draft EIS for the MRM project area (Hollingsworth Dames and Moore, 1992) indicated that two potentially rare species, *Calytrix mimiana* and *Sesbania erubescens* might occur within the mine site leases. *Calytrix mimiana* is a specialist sandstone species and is currently listed as data deficient. It has not been recorded in any surveys of the mine site area and the environment in which it grows would not be affected by proposed developments. The nearest known populations are some 20km from the mine.

Sesbania erubescens is also listed as data deficient and is a rarely collected upright annual shrub with a wide geographical distribution (Briggs and Leigh 1984). It has bright purple flowers but was not observed in the project area.

Hibiscus setulosus is also listed as data deficient and is an erect, prickly shrub to 2 m high, known from rugged sandstone or rocky slopes. It was collected from sandstone habitats in 2003 with one other collection from the area in the 1970's. Also occurs in WA.

Dicarpidium monoicum is a nominally monotypic genus endemic to Australia. *D. monoicum* is a rare pink-flowered shrub or tree, with monoecious flowers. F. Mueller who originally described it refers it to the sandstone tableland of the Gulf of Carpentaria - "Macarthur river and Seven Emu creek". Two collections have been made within the local region (within a 20 km radius of the minesite), the first by Mueller in 1856 and the second by Ingrid Meek in 2003. It should be unaffected by the current development proposal however, as its primary habitat is sandstone tableland, which occurs outside the Phase 3 project area.

A high proportion of Northern Territory orchid and cycad species (families Orchidaceae and Cycadaceae) have rare status due to their relatively restricted distribution patterns (Ian Cowie pers. comm). The presence of cycads and orchids is of some botanical importance. *Cycas angulata* is a distinctive localised cycad species from the Borroloola region but has not been recorded from the McArthur River area. One orchid species, *Cymbidium canaliculatum*, was observed during the 2011 survey, in the vicinity of the TSF. This species is, however, a hardy, widely distributed orchid that grows in the hollow limbs of trees, with a conservation status of lc (least concern).

In conclusion, the number of threatened plant species listed for the Gulf Coastal bioregion, which encompasses the MRM project area is 24, representing 2.6% of the bioregional species tally (Connors, Woirnarski and Oliver 1996). This figure is relatively low, especially in comparison with the same data for the Top End Coastal bioregion with 163 threatened species (representing 8.6% of species tally). Thus on a regional basis, it is unlikely that species of high conservation significance are present but have remained undetected by flora surveys within the wider project area. Furthermore, given the lack of suitable habitat (e.g. sandstone, vine-thicket and riverine) and the level of previous disturbance (from mining, grazing and feral animals) rarity within the Phase 3 project area is unlikely.

8.2 Communities and habitats of conservation significance

The Bukalara Range that occurs to the east of the project area supports distinctive vegetation communities that are largely restricted to rocky (*Eucalyptus leucophloia* open woodland) and sandstone areas (*E. phoenicia*/*Corymbia capricornia* open woodland). Intervening low hills, scree slopes and rocky buttes in the area may also support small, dry

vine forest or vine thicket communities. Vine forest communities are often floristically diverse and the sandstone habitats contain plant species of botanical importance. The North Bukalara Range is regarded as significant at both the national and Territory level, and is listed on the Register of the National Estate (*Amytornis* or Carpentarian Grasswren site).

Also listed on the Register of the National Estate is the Caranbirini Conservation Reserve (NRETAS website 2011). Located approximately 20 km north of the MRM mine site leases, and encompassing the near-permanent Caranbirini waterhole and a variety of different vegetation communities including sandstone habitats.

Both the Caranbirini Conservation Reserve and the North Bukalara Range are located within the 1,105 km^2 Borroloola Area, a registered Site of Conservation Significance (SOCS No. 38) described as being of national conservation significance. The southern section of the Borroloola Area SOCS overlaps with the northern MRM mining leases and includes the confluence of Barney Creek and the Glyde River with the main channel of the McArthur River. Part of the significance of the Borroloola Area site is that it contains 10 threatened vertebrate fauna species and one data deficient plant species *Stylidium stenophyllum,* which is endemic just to the Gulf Fall region (NRETAS website 2011). The type location for *Stylidium stenophyllum* is the deep crevices amongst beehive sandstone rock formations, a habitat not found within the MRM lease area.

Indeed, within the Phase 3 project area, the two main vegetation communities comprise Eucalypt-dominated woodlands with *C. terminalis* and *E. microtheca* (described in detail in Section 6) and these do not have special conservation status. The other two communities within the project area comprise riparian and riverine woodland communities, and a very minor area of hill woodland in the north east section of the proposed East OEF (Figure 4).

Riverine communities, although having no formal conservation status, are ecologically important, due to their significance as a resource and habitat for fauna, and their functional role as corridors through a largely arid landscape. Riparian vegetation and closed forests typically associated with waterways and wetlands are considered sensitive and significant vegetation communities of importance in maintaining water quality and biodiversity protection (NRETA, 2006).

Riverine communities and natural wetland habitats occur downstream and upstream of the project area and *Melaleuca* habitats such as these are referred to as sensitive and significant vegetation communities in the *Northern Territory Planning Scheme* (NTG, 2007). Indeed, it is recommended in Clause 8.1 that the native vegetation in drainage lines, wetlands and watercourses should not be cleared at all. If clearing vegetation in these habitats is unavoidable, the Northern Territory Government *Land Clearing Guidelines* recommend that mitigation measures be adopted to minimise impacts (NRETA, 2006).

Overall, the results indicate that no plant species or communities of declared conservation significance are present within the MRM Phase 3 project area. Thus the proposed development is unlikely to have an impact on any flora of high conservation value.

9 POTENTIAL ENVIRONMENTAL IMPACTS & MANAGEMENT RECOMMENDATIONS

A range of potential impacts on nature conservation values may occur as a result of the Phase 3 development project and these are listed under separate subheadings in this section. However, to reduce potential environmental impacts from the proposed mining activities, recommended mitigation strategies may include, but are not limited to, the following associated environmental management recommendations, listed directly below the corresponding potential impact.

9.1 Vegetation clearing and loss of habitat

9.1.1 Potential impacts

The potential impacts of the proposed Project could include the following:

- Land clearing will reduce the current extent of vegetation communities and associated faunal habitats. In all, the total area of vegetation to be cleared for Phase 3 developments will be over 780 ha (Table 10) with the most extensive areas of habitat loss associated with the OEFs: comprising 150 ha for the new South and East OEF and the North OEF will be extended by 374 ha, with a further 110 ha cleared for the associated dams and creek diversion.

Table 10: Areas of proposed vegetation clearing for Phase 3 Development project.

Description	Area (ha)
Open pit	65
Outer Bund - Eastern OEF	150
Northern OEF	374
East Dam	29
North-East Dam	25
North Dam	14
North-West Dam	19
West Dam	20
North OEF Diversion	4
Tailings Footprint	80
Total	**780**

- Loss of vegetation may cause fragmentation or loss of individual species' local population and diminished area of native vegetation and fauna habitat may result in a loss of biological diversity at a local scale.
- The majority of the overburden from the Phase 3 Development Project will be stored at the existing overburden emplacement facility (OEF) located to the north of the mine area. Phase 3 will expand the area of the North OEF from 375 ha to 860 ha. However, approximately 27% of the waste would be stored in a new OEF to the east and south of the pit, including around the existing bund. The outer bund covers an

area of 150 ha, supports remnant vegetation including section of the McArthur River that were truncated by the diversion.

- As the river diversion is still in the early phases of rehabilitation, and revegetation efforts are hampered by severe seasonal flooding, with concomitant scouring and erosion and deposition of riverbank sediments, these areas of remaining riverine corridor vegetation are important. Remnant forests that still support complex vegetation—but functionally are more similar to backwater swamps or overflow channels—provide habitat, forest refuges and provide an excellent source of plant seed (including key species *Barringtonia acutangula, Casuarina equisitifolia, Corymbia bella* and *Nauclea orientalis*) for the 5.5 km long diversion channel. Furthermore, existing areas of tall grass currently represent habitat for Purple-crowned fairy wrens (pers. obs.) and White-browed robins (both species are listed as Near-threatened under NT legislation).
- Creating an OEF in the east bund will result in a new landform located 75 m away from the McArthur River diversion. This proximity to the McArthur River channel —characterized by significant wet-season flooding to heights of over 20m—may impact on the existing riverine environment.
- The proposed East and South OEF will diminish the area of remnant riparian and woodland habitat and significantly alter the hydrodynamic characteristics of the East Bund area (which currently allows for substantial over-bank flows during the wet season). In terms of ecological processes, it may have the potential to reduce the corridor effect provided by existing vegetation along the McArthur River if the rehabilitation strategies of the OEFs, including the re-establishment of vegetation corridors with native species, are not adequately implemented.
- Additional specific mitigation strategies should be applied to features of conservation and management significance, including the riparian corridor and riverine woodland community, tall grass or areas of suitable riparian habitat for the Purple-crowned Fairy-wren and White-browed robin, and areas of particularly dense or ecologically important weed species (e.g Devils Claw infestations).

9.1.2 Management and mitigation measures

Recommended measures to manage and/or mitigate the possible impacts of vegetation clearing and loss of habitat are listed below:

- Avoid environmental impacts through appropriate design and planning of project infrastructure and layout.
- Manage an equivalent area of riparian corridor habitat suitable for conservation of the Purple-crowned Fairy Wren, White-browed robin and biodiversity values of the river system generally, in accordance with the draft NT Environmental Offsets policy.
- Restrict vegetation clearing to the project footprint and ensure that every effort is made to minimise disturbance to native vegetation, in recognition of its intrinsic value, its functional role in soil stabilisation and as a habitat for fauna.
- Progressive rehabilitation of disturbed areas and completed mining facilities should be conducted to minimise the time topsoil is stored in stockpiles and to reduce the potential for erosion and weed invasion of areas requiring rehabilitation.

- It is recommended that the methodologies for the rehabilitation/re-vegetation works for the project use the most appropriate species for the landscape elements of the site. Such methodologies should include habitat matching of species to ensure rehabilitation success.
- Recommended native plant species for rehabilitation in specific areas, observed to be growing successfully on site are listed in Table 11.
- To facilitate rehabilitation in river diversion areas that are exposed to seasonal scouring by floods, it is recommended that rocks of varying sizes be placed at regular intervals along the banks and that woody debris (including large trunks and branches) also be incorporated into new landscapes. These elements act as effective barriers to scour and erosion, encourage sediment deposition and provide niches for seed germination (similar principles are discussed in the principles of Landscape Function Analysis).

Table 11: Table of selected plant species observed within the project area and recommended for successful rehabilitation of specific habitats.

Phase 3 Development Area	Plant Species	Growth Form
Tailings storage facility	*Senna notabilis*	Shrub
Tailings storage facility	*Acacia hammondi*	Shrub
Tailings storage facility	*Acacia thomsonii*	Shrub
Tailings storage facility	*Helicteres isora*	Shrub
Tailings storage facility	*Heteropogon contortus*	Grass to 1.5 m
Riverine diversion	*Acacia holosericea*	Shrub
Riverine diversion	*Acacia umbellata*	Shrub
Riverine diversion	*Acacia thomsonii*	Shrub
Riverine diversion	*Barringtonia acutangula*	Low tree
Riverine diversion	*Chrysopogon elongatus*	Grass
Riverine diversion	*Eucalyptus camaldulensis*	Tree
Riverine diversion	*Gossypium australe*	Shrub
Riverine diversion	*Melaleuca argentea*	Tree
Riverine diversion	*Terminalia platyphylla*	Tree

9.2 Erosion and sedimentation

9.2.1 Potential impacts

The potential impacts of the proposed Project could include the following:

- Land clearing and OEF construction activities associated with the Phase 3 development project may increase soil erosion, inadvertently causing silting, sedimentation or contamination of riverine habitats and waterholes downstream.

- Increased runoff from the TSF may increase the risk of erosion of bund walls and surrounding soils.
- Siltation and sedimentation may contribute to decline in habitat quality of downstream terrestrial and aquatic ecosystems.

9.2.2 Management and mitigation measures

Recommended measures to manage and/or mitigate the possible impacts of soil erosion and sedimentation include:

- Adequate buffer areas should be retained between new mining facilities and drainage lines wherever possible. Although the recommended buffer for wetlands and wildlife corridors in the Northern Territory is generally identified as 200 metres in Section 8 of the Land Clearing Guidelines (NRETA, 2006), this guideline is not applicable to mine developments.
- Native vegetation removal should be conducted only after the areas to be cleared have been clearly delineated and identified to equipment operators and supervisors; and appropriate erosion and sediment control structures are in place.
- Adequate monitoring of erosion prevention structures and of siltation in downstream habitats needs to be incorporated in the Phase 3 project. Management of sediment movement in open pit, TSF and OEF areas should include contingency planning for incidents associated with extreme weather and flood events.
- Comprehensive erosion and sedimentation controls are recommended for extensions to the OEF and TSF to prevent sediment deposition and to maintain the integrity of surrounding remnant vegetation and downstream drainage habitats.

9.3 Contamination from acid rock drainage and leachate

9.3.1 Potential impacts

The potential impacts of the proposed Project could include the following:

- Acid rock drainage (ARD) from the North OEF may have a significant impact on adjacent vegetation communities and downstream habitats, particularly freshwater aquatic flora if OEF design and environmental management strategies are not effective.
- Surprise Creek, which flows into Barney Creek and then the McArthur plays an important role in dilution of contaminants, however if ARD from the expanded OEF is not controlled this may have cumulative downstream impacts.
- Large trees along drainage lines play a major role in bank stabilisation. Tree death along drainage lines from acid conditions and/or altered patterns of drainage (either waterlogging or droughting associated with major infrastructure impacting ground and surface water flows) may lead to erosion of the banks and habitat degradation.
- If TSF capping design and environmental management strategies are not effective, high wet season rainfall and the incidence of cyclones creates potential for soil erosion of the capping of the TSF (800 mm) which could potentially expose tailings for release into the environment.

9.3.2 Management and mitigation methods

Recommended measures to manage and/or mitigate the possible impacts of acid rock drainage are listed below:

- It is recommended that tailings dams when capped be adequately contoured to allow proper drainage of the surface and prevent rill erosion (which could expose tailings and contribute to sedimentation and pollution of drainage lines).
- Consolidation of the surface of TSF through adequate capping and rehabilitation is very important to reduce impacts on terrestrial and aquatic ecosystems, particularly over the longer term, after mine closure.
- It is recommended that recreated landforms are contoured to resemble the original local topography, and include hill slopes and rocky drainage lines wherever practicable.
- Monitoring of acid rock drainage should continue throughout the life of the mine, and after mine closure to ensure that on-going pollution of the McArthur River and its tributaries is avoided.

9.4 Weed invasion and spread

9.4.1 Potential impacts

The potential impacts of the proposed Project on introduced weeds could include the following:

- The introduction of new weed species and spread of weeds within and around the project area may lead to habitat degradation, loss of foraging and essential habitat for fauna, increased fire risk, reduced accessibility, loss of biodiversity, competition and exclusion of native flora species.

9.4.2 Management and mitigation measures

Recommended measures to manage and/or mitigate the possible impacts of weed invasion and spread include:

- Implementation of a weed management plan including monitoring of its success.
- A rehabilitation strategy should be developed for the Project Site. This strategy should embody the concepts and recommendations presented above and include provision for monitoring of rehabilitation progress over the life of the operation.

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APPENDICES

Appendix 1: List of threatened flora of the Northern Territory

	Critically Endangered
ELAEOCARPACEAE	*Elaeocarpus miegei*
MIMOSACEAE	*Acacia sp.* Graveside Gorge
	Endangered
ANNONACEAE	*Xylopia monosperma*
ARACEAE	*Typhonium jonesii*
	Typhonium mirabile
	Typhonium taylori
ARECACEAE	*Ptychosperma macarthurii* Darwin Palm
BURMANNIACEAE	*Burmannia sp.* Bathurst Island
CLUSIACEAE	*Garcinia warrenii*
CYPERACEAE	*Baumea arthrophylla*
	Bolboschoenus caldwellii
HYMENOPHYLLACEAE	*Cephalomanes obscurum*
LAURACEAE	*Cryptocarya hypospodia*
MIMOSACEAE	*Acacia peuce* Waddy Wood
ORCHIDACEAE	*Habenaria rumphii*
RUBIACEAE	*Tarennoidea wallichii*
SAPINDACEAE	*Toechima sp.* East Alligator
STERCULIACEAE	*Helicteres sp.* Glenluckie Ck
	Vulnerable
ADIANTACEAE	*Adiantum capillus-veneris* Venue-hair Fern
ANNONACEAE	*Mitrella tiwiensis*
APIACEAE	*Actinotus schwarzii* Flannel Flower
	Platysace saxatilis
ARECACEAE	*Livistona mariae subsp. mariae* Red Cabbage Palm
ASCLEPIADACEAE	*Hoya australis subsp.oramicola*
ASTERACEAE	*Minuria tridens*
	Olearia macdonnellensis
CONVOLVULACEAE	*Ipomoea sp.* Stirling
CUCURBITACEAE	*Mukia sp.* Tobermorey Station
CYCADACEAE	*Cycas armstrongii*
CYPERACEAE	*Eleocharis papillosa* Dwarf Desert Spike-rush
	Mapania macrocephala

EUPHORBIACEAE	*Ricinocarpos gloria-medii* Glory of the Centre
Appendix 1 Cont..	
GLEICHENIACEAE	*Gleichenia sp.* Victoria River
	Sticherus flabellatus var *compactus*
HERNANDIACEAE	*Hernandia nymphaeifolia*
LAMIACEAE	*Wrixonia schultzii*
LAURACEAE	*Endiandra limnophila*
LENTIBULARIACEAE	*Utricularia dunstaniae*
	Utricularia singeriana
MALVACEAE	*Hibiscus brennanii*
	Hibiscus cravenii
MARATTIACEAE	*Angiopteris evecta*
MELASTOMATACEAE	*Pternandra coerulescens*
MIMOSACEAE	*Acacia latzii* Latz's Wattle
	Acacia pickardii Birds Nest Wattle
	Acacia praetermissa
	Acacia undoolyana Undoolya Wattle
MYOPORACEAE	*Eremophila sp.* Valley Rainbow, Valley Fuschia Bush
MYRTACEAE	*Lithomyrtus linariifolia*
	Thryptomene hexandra Palm Valley Myrtle
ORCHIDACEAE	*Calochilus caeruleus*
	Luisia teretifolia
	Malaxis latifolia
	Malaxis marsupichila
	Thrixspermum congestum
	Zeuxine oblonga
PANDANACEAE	*Freycinetia excelsa*
	Freycinetia percostata
POACEAE	*Triodia fitzgeraldii*
PONTEDERIACEAE	*Monochoria hastata*
RUTACEAE	*Boronia quadrilata*
	Boronia viridiflora
SANTALACEAE	*Dendromyza reinwardtiana*
	Santalum acuminatum
TILIACEAE	*Schoutenia ovata*

Appendix 1 Cont..

Commonwealth listed, Not threatened in NT	
ARECACEAE	*Arenga australasica*
CYPERACEAE	*Eleocharis retroflexa*
EUPHORBIACEAE	*Sauropus filicinus*
GOODENIACEAE	*Goodenia quadrifida*
POACEAE	*Ectrosia blakei*
SOLANACEAE	*Solanum carduiforme*
ZAMIACEAE	*Macrozamia macdonnellii*

Appendix 2: Plant Species List

Recorded plant species and their occurrence in quadrats during field surveys of the MRM project area and the Glyde River. Data obtained during 3 surveys (Feb and March 2003, and May 2011).

NB A - annual, P - perennial, Tr - tree, Sh - Shrub, Aq - aquatic, Fo - forb, Fe - fern, Vn - vine, lc - least concern, ne -not evaluated; upper case -endemic; * - introduced; dd - data deficient.

Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community 1 Sandstone plateau	2 Hill woodland	3 Vine thicket	4 Inland bloodwood	5 Snappy gum woodland	6 Coolibah/ Bauhinia/ Atalaya	7 Corymbia bella w'land	8 Riverine woodland	9 Riverine corridor	10 Disturbed	Recorded during May 2011 survey	New species record
ACANTHACEAE	Dicliptera sp.		A	Fo		1								1			
ACANTHACEAE	Dicliptera arnhemica		A	Fo	lc						1					•	•
ACANTHACEAE	Hygrophila angustifolia		A	Fo	lc									2			
ACANTHACEAE	Nelsonia campestris		A	Fo	lc			1					1	4			
ACANTHACEAE	Rostellularia adscendens subsp. indeterminate		A	Fo	infra						4		1	3			
ADIANTACEAE	Cheilanthes brownii		P	Fe	lc	1		1									
ADIANTACEAE	Cheilanthes contigua		P	Fe	lc		1										
AIZOACEAE	Trianthema portulacastrum	X	A	Fo	lc*			1						2			
AMARANTHACEAE	Achyranthes aspera		A	Fo	lc				1		1		1	2		•	
AMARANTHACEAE	Aerva javanica	X	A	Fo	lc*										1	•	•
AMARANTHACEAE	Alternanthera denticulata		A	Fo	lc			1						2			
AMARANTHACEAE	Alternanthera dentata	X	A	Fo	lc*								1	1		•	•
AMARANTHACEAE	Alternanthera nana		A	Fo	lc				2								
AMARANTHACEAE	Alternanthera nodiflora		A	Fo	lc								2	1			
AMARANTHACEAE	Amaranthus pallidiflorus		A	Fo	lc									1			
AMARANTHACEAE	Gomphrena flaccida		A	Fo	lc	2											
AMARANTHACEAE	Gomphrena floribunda		A	Fo	NE			1									
AMARANTHACEAE	Gomphrena lanata		A	Fo	lc	3											
AMARANTHACEAE	Ptilotus corymbosus var. indeterminate		A	Fo	lc		1		1								
AMARANTHACEAE	Ptilotus exaltatus var. exaltatus		P	Fo	lc				1						1	•	•
AMARANTHACEAE	Ptilotus fusiformis var. indeterminate		P	Fo	lc				1								
AMARANTHACEAE	Ptilotus polystachyus var. indeterminate		A	Fo	lc	1											
AMARANTHACEAE	Ptilotus spicatus subsp. indeterminate		A	Fo	lc						2						
ANACARDIACEAE	Buchanania obovata		P	Tr	lc	2		2									
APIACEAE	Trachymene sp.		P	Fo				1									
APOCYNACEAE	Carissa lanceolata		P	Sh	lc				5		2	1				•	
APOCYNACEAE	Wrightia saligna		P	Tr	lc						2					•	•
APONOGETONACEAE	Aponogeton vanbruggenii		P	Aq	lc									2			
ASCLEPIADACEAE	Gymnanthera oblonga		P	Vn	lc									1			
ASCLEPIADACEAE	Sarcostemma viminale subsp. indeterminate		P	Fo	lc			1									
ASCLEPIADACEAE	Tylophora flexuosa		P	Vn	lc			1									
ASTERACEAE	Bidens bipinnata	X	A	Fo	lc*		2				1					•	

Appendix 2 cont.. Plant Species List

NB A - annual, P - perennial; Tr - tree, Sh - Shrub; Aq - aquatic; Fo - forb; Fe - fern; Vn - vine; lc - least concern; ne -not evaluated; upper case -endemic; * - introduced; dd - data deficient.

Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community										Recorded during May 2011 survey	New species record
						1	2	3	4	5	6	7	8	9	10		
						Sandstone plateau	Hill woodland	Vine thicket	Inland bloodwood	Snappy gum woodland	Coolibah/ Bauhinia/ Atalaya	Corymbia bella w/land	Riverine woodland	Riverine corridor	Disturbed		
ASTERACEAE	Blumea saxatilis		A	Fo	lc			1	1							•	
ASTERACEAE	Pterocaulon serrulatum		A	Fo	lc				2						1	•	•
ASTERACEAE	Pterocaulon sphacelatum		A	Fo	lc		1		2								
ASTERACEAE	undetd sp.		A	Fo		1											
ASTERACEAE	Xanthium strumarium	X	A	Sh	lc*			1			4		3	5		•	
BIGNONIACEAE	Dolichandrone heterophylla		P	Tr	lc				4		2					•	
BIXACEAE	Cochlospermum fraseri subsp. indeterminate		P	Sh	lc		1										
BIXACEAE	Cochlospermum gillivraei		P	Sh	lc		1		1							•	
BIXACEAE	Cochlospermum gregorii		P	Sh	lc	4		3	1								
BORAGINACEAE	Ehretia saligna var. indeterminate		P	Sh	lc		1				2					•	
BORAGINACEAE	Heliotropium indicum	X	A	Fo	lc*								1	2			
BORAGINACEAE	Heliotropium sp.		A	Fo		1											
BORAGINACEAE	Heliotropium tenuifolium		A	Fo	lc							1					
BORAGINACEAE	Trichodesma zeylanicum var. indeterminate		P	Fo	lc				1		2						
BYBLIDACEAE	Byblis liniflora		A	Fo	lc	1											
CAESALPINIACEAE	Bauhinia cunninghamii		P	Tr	lc		2		5		8	1	2			•	
CAESALPINIACEAE	Chamaecrista absus var. absus		A	Fo	lc		1										
CAESALPINIACEAE	Erythrophleum chlorostachys		P	Tr	lc		3		8				1			•	
CAESALPINIACEAE	Parkinsonia aculeata	X	P	Sh	lc*				1		1			1			
CAESALPINIACEAE	Senna notabilis		P	Sh	lc				1						3	•	•
CAESALPINIACEAE	Senna venusta		A	Fo	lc	2		2									
CAPPARACEAE	Capparis lasiantha		P	Vn	lc				1		1					•	
CAPPARACEAE	Cleome cleomoides		P	Fo	lc			1									
CAPPARACEAE	Cleome microaustralica		A	Fo	LC	4		2	1								
CAPPARACEAE	Cleome viscosa		A	Fo	lc		1									•	
CARYOPHYLLACEAE	Polycarpaea corymbosa var. indeterminate		A	Fo	lc				1					1			
CARYOPHYLLACEAE	Polycarpaea spirostylis		A	Fo	lc	2											
CASUARINACEAE	Casuarina cunninghamiana subsp. miodon		P	Tr	lc						1		2	4		•	
CELASTRACEAE	Maytenus cunninghamii		P	Tr	lc				2							•	
CHARACEAE	Chara sp.		A	Aq										1			
COMBRETACEAE	Terminalia bursarina		P	Tr	lc								2	1		•	
COMBRETACEAE	Terminalia canescens		P	Sh	lc		3		10							•	
COMBRETACEAE	Terminalia platyphylla		P	Tr	lc						2		1	3		•	
COMBRETACEAE	Terminalia volucris		P	Sh	lc				3			1		1		•	
COMMELINACEAE	Commelina ciliata		A	Fo	lc						1						

Appendix 2 cont.. Plant Species List

NB A - annual, P - perennial; Tr - tree, Sh - Shrub; Aq - aquatic; Fo - forb; Fe - fern; Vn - vine; lc - least concern; ne -not evaluated; upper case -endemic; * - introduced; dd - data deficient.

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COMMELINACEAE	Commelina ensifolia		A	Fo	lc	1	2										
COMMELINACEAE	Murdannia graminea		P	Fo	lc				1								
CONVOLVULACEAE	Bonamia pannosa		A	Fo	lc	3		1	4								
CONVOLVULACEAE	Evolvulus alsinoides var. indeterminate		A	Fo	lc		1		5							•	
CONVOLVULACEAE	Ipomoea coptica		P	Vn	lc						1						
CONVOLVULACEAE	Ipomoea eriocarpa		P	Vn	lc				2								
CONVOLVULACEAE	Ipomoea polymorpha		P	Vn	lc	1			1								
CONVOLVULACEAE	Ipomoea sp.		P	Vn										1			
CONVOLVULACEAE	Operculina aequisepala		P	Vn	lc				1		1			1		•	
CONVOLVULACEAE	Polymeria ambigua		P	Fo	lc				1								
CONVOLVULACEAE	Polymeria longifolia		P	Fo	lc						1						
CONVOLVULACEAE	Xenostegia tridentata		P	Vn	lc	1	2		1								
CUCURBITACEAE	Cucumis melo		A	Vn										1			
CUCURBITACEAE	Cucumis melo subsp. indeterminate		A	Vn	lc		2		1				2	4			
CUCURBITACEAE	Trichosanthes cucumerina		A	Vn	lc			1									
CYPERACEAE	Bulbostylis barbata		A	Se	lc	8	2	4	3					7			
CYPERACEAE	Cyperus castaneus		A	Se	lc	1											
CYPERACEAE	Cyperus cuspidatus		A	Se	lc	2		1									
CYPERACEAE	Cyperus difformis		A	Se	lc			1									
CYPERACEAE	Cyperus iria		A	Se	lc									1			
CYPERACEAE	Cyperus microcephalus subsp. saxicola		P	Se	lc	1											
CYPERACEAE	Cyperus portae-tartari		A	Se	lc			1									
CYPERACEAE	Cyperus pulchellus		A	Se	lc	2		2									
CYPERACEAE	Cyperus sp.		A	Se				1			3		1				
CYPERACEAE	Cyperus squarrosus		P	Se	lc	2		2									
CYPERACEAE	Fimbristylis depauperata		A	Se	lc			1									
CYPERACEAE	Fimbristylis littoralis		A	Se				1									
CYPERACEAE	Fimbristylis rupestris		A	Se	lc		1										
CYPERACEAE	Fimbristylis sp.		A	Se		1								1			
CYPERACEAE	Fimbristylis sphaerocephala		A	Se	lc	2		2									
CYPERACEAE	Fimbristylis trigastrocarya		A	Se	lc	1											
CYPERACEAE	Fuirena ciliaris		A	Se	lc							1					
CYPERACEAE	Rhynchospora exserta		A	Se	lc							1					
CYPERACEAE	Scleria sp.		A	Se		1											
CYPERACEAE	undetd sp.		A	Se										1			
DAVALLIACEAE	Nephrolepis arida		P	Fe	DD			1									
DILLENIACEAE	Hibbertia lepidota		P	Fo	lc	6											
DROSERACEAE	Byblis liniflora		A	Fo		2		1									

Appendix 2 cont.. Plant Species List

NB A - annual, P - perennial; Tr - tree, Sh - Shrub; Aq - aquatic; Fo - forb; Fe - fern; Vn - vine; lc - least concern; ne -not evaluated; upper case -endemic; * - introduced; dd - data deficient.

Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community 1 Sandstone plateau	2 Hill woodland	3 Vine thicket	4 Inland bloodwood	5 Snappy gum woodland	6 Coolibah/ Bauhinia/ Atalaya	7 Corymbia bella w'land	8 Riverine woodland	9 Riverine corridor	10 Disturbed	Recorded during May 2011 survey	New species record
ERIOCAULACEAE	Eriocaulon patericola		A	Aq	lc	1											
ERYTHROXYLACEAE	Erythroxylum ellipticum		P	Tr	lc				1							•	
EUPHORBIACEAE	Antidesma ghesaembilla		P	Sh	lc			1	1				1	2		•	
EUPHORBIACEAE	Antidesma parvifolium		P	Sh	lc			2						1		•	
EUPHORBIACEAE	Breynia cernua		P	Tr	lc			1	1					1		•	
EUPHORBIACEAE	Bridelia tomentosa		P	Sh	lc								1	1		•	•
EUPHORBIACEAE	Euphorbia armstrongiana		P	Fo	LC	1		1									
EUPHORBIACEAE	Euphorbia mitchelliana		P	Fo	LC				1								
EUPHORBIACEAE	Euphorbia schultzii		P	Fo	lc	1			1								
EUPHORBIACEAE	Euphorbia tannensis subsp. eremophila		A	Fo	lc	1											
EUPHORBIACEAE	Euphorbia vachellii		A	Fo	lc		1						1	2			
EUPHORBIACEAE	Excoecaria parvifolia		P	Sh	lc				1		4		3			•	
EUPHORBIACEAE	Flueggea virosa subsp. melanthesoides		P	Sh	lc		1	1	7		4		1	5		•	
EUPHORBIACEAE	Leptopus decaisnei		A	Fo	lc		1										
EUPHORBIACEAE	Mallotus nesophilus		P	Sh	lc		1										
EUPHORBIACEAE	Petalostigma pubescens		P	Sh	lc				4				1			•	
EUPHORBIACEAE	Phyllanthus carpentariae		A	Fo	lc	5		1									
EUPHORBIACEAE	Phyllanthus hebecarpus		A	Fo	lc						1					•	•
EUPHORBIACEAE	Phyllanthus maderaspatensis var. angustifolius		A	Fo	lc						3		3	3			
EUPHORBIACEAE	Phyllanthus minutiflorus		A	Fo	lc			1									
EUPHORBIACEAE	Phyllanthus reticulatus		P	Sh	lc									1			
EUPHORBIACEAE	Sauropus rigidulus		P	Sh	LC	1											
EUPHORBIACEAE	Sauropus sp.		A	Fo					1								
FABACEAE	Abrus precatorius subsp. precatorius		P	Vn	lc								1			•	•
FABACEAE	Aeschynomene indica		A	Sh	lc						1						
FABACEAE	Alysicarpus muelleri		A	Fo	lc						1						
FABACEAE	Cajanus scarabaeoides var. indeterminate		P	Vn	lc	1		1	1		1						
FABACEAE	Cajanus sp.		A	Vn		1	1										
FABACEAE	Clitoria ternatea	X	P	Vn	lc*						1			1	1	•	
FABACEAE	Crotalaria medicaginea		A	Fo	lc		1										
FABACEAE	Crotalaria montana		A	Fo	lc		2		8		2						
FABACEAE	Desmodium filiforme		A	Fo	lc			1						1			
FABACEAE	Flemingia pauciflora		P	Fo	lc						5	1				•	
FABACEAE	Galactia tenuiflora		P	Vn	lc		1		1								
FABACEAE	Indigofera colutea		A	Fo	lc	1	1		3								

Appendix 2 cont.. Plant Species List

NB A - annual, P - perennial, Tr - tree, Sh - Shrub, Aq - aquatic, Fo - forb, Fe - fern, Vn - vine, lc - least concern, ne -not evaluated, upper case -endemic, * - introduced, dd - data deficient.

Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community 1 Sandstone plateau	2 Hill woodland	3 Vine thicket	4 Inland bloodwood	5 Snappy gum woodland	6 Coolibah/ Bauhinia/ Atalaya	7 Corymbia bella w'land	8 Riverine woodland	9 Riverine corridor	10 Disturbed	Recorded during May 2011 survey	New species record
FABACEAE	Indigofera haplophylla		A	Fo	lc	3											
FABACEAE	Indigofera hirsuta		A	Fo	lc				1								
FABACEAE	Indigofera linifolia		A	Fo	lc		1		1								
FABACEAE	Jacksonia dilatata		P	Sh	lc	3											
FABACEAE	Jacksonia vernicosa		P	Sh	lc	2											
FABACEAE	Leptosema villosum		A	Fo	LC	1											
FABACEAE	Rhynchosia minima		P	Vn	lc				3		2						
FABACEAE	Rothia indica subsp. australis		A	Fo	DD									1			
FABACEAE	Sesbania brachycarpa		A	Sh	lc						2						
FABACEAE	Stylosanthes hamata	X	P	Fo	lc*				2		1		1		3	•	
FABACEAE	Stylosanthes scabra	X	P	Fo	lc*				1				1		1	•	
FABACEAE	Templetonia hookeri		P	Sh	lc	1											
FABACEAE	Tephrosia brachyodon var. indeterminate		A	Sh	lc				1								
FABACEAE	Tephrosia conspicua		A	Sh	lc	2											
FABACEAE	Tephrosia D78772 Pentecost River		A	Sh	lc	1											
FABACEAE	Tephrosia leptoclada		P	Fo	lc		1										
FABACEAE	Tephrosia spechtii		A	Sh	lc	2		1									
FABACEAE	Tephrosia sp.		A	Fo							1					•	
FABACEAE	Uraria lagopodioides		A	Fo	lc		1										
FABACEAE	Vigna radiata var. sublobata		A	Vn	lc				1		1						
FABACEAE	Zornia muriculata subsp. angustata		A	Fo	lc		1										
FABACEAE	Zornia prostrata var. indeterminate		A	Fo	lc	1											
GOODENIACEAE	Goodenia leiosperma		A	Fo	lc				1							•	•
GOODENIACEAE	Goodenia janamba		A	Fo	lc				1			1					
GOODENIACEAE	Goodenia pilosa		A	Fo	lc	1											
GOODENIACEAE	Scaevola revoluta subsp. revoluta		P	Sh	ne	3											
HAEMODORACEAE	Haemodorum sp.		P	Fo		1											
HALORAGACEAE	Gonocarpus leptothecus		A	Fo	lc	2											
HALORAGACEAE	Myriophyllum callitrichoides subsp. callitrichoides		A	Aq	lc	1											
HYDROCHARITACEAE	Blyxa sp.		A	Aq										1		•	
LAMIACEAE	Basilicum polystachyon		A	Fo	lc									1			
LAMIACEAE	Premna serratifolia		P	Sh	lc				1				1			•	•
LAMIACEAE	Hyptis suaveolens	X	A	Fo	lc*								2	2	1	•	
LAURACEAE	Cassytha capillaris		P	Vn	lc	2											
LAURACEAE	Cassytha filiformis				lc				1							•	
LECYTHIDACEAE	Barringtonia acutangula subsp. acutangula		P	Sh	lc									14		•	
LECYTHIDACEAE	Planchonia careya		P	Sh	lc				1				1			•	

Appendix 2 cont.. Plant Species List

NB A - annual, P - perennial; Tr - tree, Sh - Shrub; Aq - aquatic; Fo - forb; Fe - fern; Vn - vine; lc - least concern; ne -not evaluated; upper case -endemic; * - introduced; dd - data deficient.

Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community 1 Sandstone plateau	2 Hill woodland	3 Vine thicket	4 Inland bloodwood	5 Snappy gum woodland	6 Coolibah/ Bauhinia/ Atalaya	7 Corymbia bella w/land	8 Riverine woodland	9 Riverine corridor	10 Disturbed	Recorded during May 2011 survey	New species record
LILIACEAE	Iphigenia indica		P	Fo	lc	1											
LOGANIACEAE	Mitrasacme connata		A	Fo	lc		1										
LOGANIACEAE	Mitrasacme glaucescens		A	Fo	LC	1											
LOGANIACEAE	Mitrasacme scrithicola		A	Fo	lc			1									
LOGANIACEAE	Strychnos lucida		P	Sh	lc								1	3		•	
LORANTHACEAE	Amyema bifurcata var. indeterminate		P	Ep	lc				1								
LYGODIACEAE	Lygodium microphyllum		P	Fe	lc			1									
LYTHRACEAE	Ammannia multiflora		A	Fo	lc			1			1		2	1			
MALVACEAE	Abelmoschus ficulneus		A	Fo	lc						4						
MALVACEAE	Abutilon andrewsianum		A	Fo	lc		2		2		1					•	
MALVACEAE	Brachychiton diversifolius subsp. diversifolius															•	
MALVACEAE	Gossypium australe		P	Sh	lc				2		2				1	•	
MALVACEAE	Hibiscus fluvialis		A	Sh	lc	1					1		1		1	•	•
MALVACEAE	Hibiscus leptocladus		A	Sh	lc	1											
MALVACEAE	Hibiscus meraukensis		A	Sh	lc		1		1							•	
MALVACEAE	Hibiscus panduriformis var. indeterminate		A	Sh	lc								1				
MALVACEAE	Hibiscus setulosus		A	Sh	ne	1		1									
MALVACEAE	Hibiscus zonatus		A	Sh	lc	3		2									
MALVACEAE	Malvastrum americanum	X	P	Sh	*lc						1						
MALVACEAE	Sida acuta	X	P	Fo	*lc						1		1		1	•	•
MALVACEAE	Sida sp.		A	Fo	lc	2											
MALVACEAE	Sida spinosa		A	Fo	lc		1		3		4		2			•	
MELIACEAE	Owenia vernicosa		P	Tr	lc	1	1	2									
MENISPERMACEAE	Tinospora smilacina		P	Vn	lc			2									
MENYANTHACEAE	Nymphoides crenata		P	Aq	lc								1				
MIMOSACEAE	Acacia alleniana		P	Sh	lc	3		1									
MIMOSACEAE	Acacia colei		P	Sh	lc				1								
MIMOSACEAE	Acacia difficilis		P	Sh	lc								1			•	•
MIMOSACEAE	Acacia drepanocarpa subsp. drepanocarpa		P	Sh	lc	1		1						1			
MIMOSACEAE	Acacia farnesiana		P	Sh	lc						8		1	1		•	
MIMOSACEAE	Acacia gonoclada		P	Sh	lc				1								
MIMOSACEAE	Acacia hammondii		P	Sh	lc	2			1							•	
MIMOSACEAE	Acacia latescens		P	Sh	lc	5		1	1							•	
MIMOSACEAE	Acacia latifolia		P	Sh	lc	3											
MIMOSACEAE	Acacia monticola		P	Sh	lc	4		2									
MIMOSACEAE	Acacia orthocarpa		P	Sh	lc	2											

Appendix 2 cont.. Plant Species List

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						Vegetation Community											
Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	1	2	3	4	5	6	7	8	9	10	Recorded during May 2011 survey	New species record
						Sandstone plateau	Hill woodland	Vine thicket	Inland bloodwood	Snappy gum woodland	Coolibah/ Bauhinia/ Atalaya	Corymbia bella w'land	Riverine woodland	Riverine corridor	Disturbed		
MIMOSACEAE	Acacia platycarpa		P	Sh	lc	2		1									
MIMOSACEAE	Acacia plectocarpa subsp. tanumbirinensis		P	Sh	lc			1									
MIMOSACEAE	Acacia sp.		P	Sh		2											
MIMOSACEAE	Acacia thompsonii		P	Sh	lc				3							•	•
MIMOSACEAE	Acacia torulosa		P	Sh	lc	1		1									
MIMOSACEAE	Acacia umbellata		P	Sh	lc										1	•	•
MIMOSACEAE	Neptunia dimorphantha		P	Fo	lc				2		2					•	
MIMOSACEAE	Neptunia major		P	Fo	lc						1	1				•	
MORACEAE	Ficus aculeata var. aculeata		P	Sh	lc			2	1					1		•	
MORACEAE	Ficus carpentariensis		P	Sh		1								3			
MORACEAE	Ficus cerasicarpa		P	Sh	lc	1		2						1			
MORACEAE	Ficus coronulata		P	Sh	lc									8		•	
MORACEAE	Ficus racemosa var. racemosa		P	Tr	lc									2		•	
MORACEAE	Ficus subpuberula		P	Tr	lc			2									
MORACEAE	Ficus virens var. indeterminate		P	Tr	lc			1									
MYRTACEAE	Calytrix brownii		P	Sh	lc	1		2									
MYRTACEAE	Calytrix exstipulata		P	Sh	lc	4		2	1								
MYRTACEAE	Corymbia aspera		P	Tr	lc	1		3									
MYRTACEAE	Corymbia bella		P	Tr	lc							1	1	4		•	
MYRTACEAE	Corymbia capricornia		P	Tr	lc	4	1										
MYRTACEAE	Corymbia confertiflora		P	Tr	lc				3							•	
MYRTACEAE	Corymbia grandifolia subsp. indeterminate		P	Tr	lc				1							•	
MYRTACEAE	Corymbia terminalis		P	Tr	lc				10		1	1				•	
MYRTACEAE	Eucalyptus camaldulensis subsp. indeterminate		P	Tr	lc								2	6		•	
MYRTACEAE	Eucalyptus chlorophylla		P	Tr	lc				7							•	
MYRTACEAE	Eucalyptus herbertiana		P	Tr	lc	4		1									
MYRTACEAE	Eucalyptus leucophloia subsp. euroa		P	Tr	lc		1										
MYRTACEAE	Eucalyptus microtheca var. microtheca		P	Tr	lc						6		2	1		•	
MYRTACEAE	Eucalyptus miniata		P	Tr	lc	2											
MYRTACEAE	Eucalyptus phoenicea		P	Tr	lc	4	1										
MYRTACEAE	Eucalyptus tectifica		P	Tr	lc				9							•	
MYRTACEAE	Lithomyrtus hypoleuca		P	Sh	lc	1											
MYRTACEAE	Lophostemon grandiflorus subsp. indeterminate		P	Tr	lc								2	6		•	
MYRTACEAE	Melaleuca argentea		P	Tr	lc									5		•	

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Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community 1 Sandstone plateau	2 Hill woodland	3 Vine thicket	4 Inland bloodwood	5 Snappy gum woodland	6 Coolibah/ Bauhinia/ Atalaya	7 Corymbia bella w'land	8 Riverine woodland	9 Riverine corridor	10 Disturbed	Recorded during May 2011 survey	New species record
MYRTACEAE	Melaleuca bracteata		P	Tr	lc				1								
MYRTACEAE	Melaleuca citrolens		P	Sh	lc				1								
MYRTACEAE	Melaleuca leucadendra		P	Tr	lc									2		•	
MYRTACEAE	Melaleuca viridiflora		P	Tr	lc	1			2		1					•	
MYRTACEAE	Syzygium eucalyptoides subsp. eucalyptoides		P	Tr	lc									6			
NAJADACEAE	Najas sp.													1			
NO FAMILY	Herb sp.		A	Fo									1	3			
NYCTAGINACEAE	Boerhavia schomburgkiana		A	Fo	lc			1					1				
NYMPHAEACEAE	Nymphaea sp.		P	Aq									1	2		•	
OLEACEAE	Jasminum elongatum (syn aemulum)		P	Vn	lc			1	1							•	
OLEACEAE	Jasminum molle		P	Vn	lc				3				1	1		•	
ONAGRACEAE	Ludwigia octovalvis subsp. indeterminate		A	Fo	lc			1			1		2	2		•	
ONAGRACEAE	Ludwigia perennis		A	Fo	lc			1			2		1	2		•	
OPHIOGLOSSACEAE	Ophioglossum gramineum		A	Fe	nt	1											
ORCHIDACEAE	Cymbidium canaliculatum		P	Fo ep	lc				1							•	•
PANDANACEAE	Pandanus aquaticus		P	Tr	lc									3		•	
PASSIFLORACEAE	Passiflora foetida	X	P	Vn	lc*		1	1	1				3	8		•	
PLUMBAGINACEAE	Plumbago zeylanica		P	Fo	lc		1				1						
POACEAE	Alloteropsis semialata		P	Gr	lc				1								
POACEAE	Aristida holathera var. indeterminate		A	Gr	lc				2								
POACEAE	Aristida latifolia		P	Gr	lc				2		2						
POACEAE	Astrebla elymoides		P	Gr	lc						1						
POACEAE	Astrebla lappacea		P	Gr	dd						1						
POACEAE	Astrebla squarrosa		P	Gr	lc						1						
POACEAE	Bothriochloa ewartiana		P	Gr	lc							1					
POACEAE	Brachyachne convergens		P	Gr	lc				2		3						
POACEAE	Cenchrus pedicellatum	X	A	Gr	lc*								1		1	•	•
POACEAE	Chionachne cyathopoda		P	Gr	lc									1		•	•
POACEAE	Chionachne hubbardiana	X	A	Gr	lc						2						
POACEAE	Chrysopogon elongatus		P	Gr	lc									6	1	•	
POACEAE	Chrysopogon fallax		P	Gr	lc				6		1		2			•	
POACEAE	Cymbopogon procerus		P	Gr	lc		1										
POACEAE	Dichanthium sericeum subsp. indeterminate		P	Gr	lc				1		2		1			•	
POACEAE	Digitaria bicornis	X	A	Gr	lc*		1	1	1				1	1			
POACEAE	Digitaria brownii		A	Gr	lc		1										
POACEAE	Echinochloa colona	X	A	Gr	lc*			1					3	3		•	

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POACEAE	Ectrosia leporina		A	Gr										1			
POACEAE	Elytrophorus spicatus		A	Gr	lc				1								
POACEAE	Enneapogon decipiens		A	Gr	lc				1								
POACEAE	Eragrostis amabilis	X	A	Gr	lc*									1			
POACEAE	Eragrostis cumingii		A	Gr	lc			2	1				1	1			
POACEAE	Eragrostis tenellula		A	Gr	lc			1	4		4		2	1		•	
POACEAE	Eriachne avenacea		P	Gr	lc	1										•	
POACEAE	Eriachne ciliata		A	Gr	lc	5		1	3								
POACEAE	Eriachne obtusa		P	Gr	lc				3							•	
POACEAE	Eriachne pulchella subsp. dominii		A	Gr	lc				1								
POACEAE	Eriachne sp.		A	Gr		1											
POACEAE	Eulalia aurea		P	Gr	lc		1		3		2	1					
POACEAE	Heteropogon contortus		P	Gr	lc		2		3				3			•	
POACEAE	Iseilema macratherum		A	Gr	lc								1			•	•
POACEAE	Iseilema sp.		A	Gr					1		4	1					
POACEAE	Mnesithea formosa		A	Gr	lc		3		3								
POACEAE	Mnesithea rottboeliodes		P	Gr	lc								1			•	•
POACEAE	Ophiuros exaltatus		P	Gr	lc						1					•	•
POACEAE	Panicum decompositum var. indeterminate		P	Gr	lc				2		4						
POACEAE	Paspalidium jubiflorum		P	Gr	lc								1	3		•	
POACEAE	Paspalidium rarum		A	Gr	lc	2			1								
POACEAE	Paspalum scrobiculatum		A	Gr	lc									2			
POACEAE	Perotis rara		A	Gr	lc		1	1	4								
POACEAE	Schizachyrium D21454 wingless		A	Gr	lc	1											
POACEAE	Schizachyrium fragile		A	Gr	lc	4			3								
POACEAE	Sehima nervosum		P	Gr	lc				4		1						
POACEAE	Setaria apiculata		A	Gr	lc		2		3							•	
POACEAE	Sorghum timorense		A	Gr	lc						2	1				•	
POACEAE	Sporobolus australasicus		A	Gr	lc				1								
POACEAE	Thaumastochloa major		A	Gr	lc				1							•	•
POACEAE	Themeda triandra		P	Gr	lc				2		3						
POACEAE	Triodia affin. bynoei		P	Gr		3											
POACEAE	Triodia bitextura		P	Gr	lc		2										
POACEAE	Triodia sp.		P	Gr		6		3									
POACEAE	undetd sp.		P	Gr										4			
POACEAE	Urochloa mosambicensis	X	P	Gr	lc*				1						1	•	•
POACEAE	Urochloa pubigera		A	Gr	lc		1		2								

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						1 Sandstone plateau	2 Hill woodland	3 Vine thicket	4 Inland bloodwood	5 Snappy gum woodland	6 Coolibah/ Bauhinia/ Atalaya	7 Corymbia bella w'land	8 Riverine woodland	9 Riverine corridor	10 Disturbed		
POACEAE	Urochloa reptans		A	Gr	lc						1		3	3			
POACEAE	Urochloa subquadripara		A	Gr	lc		1										
POACEAE	Whiteochloa capillipes		A	Gr	lc								1				
POACEAE	Yakirra australiensis var. indeterminate		A	Gr	lc		1										
POACEAE	Yakirra pauciflora		A	Gr	lc				1								
POLYGALACEAE	Polygala arvensis		A	Fo	ne				2								
POLYGALACEAE	Polygala D19911 Top End		A	Fo	ne	1											
POLYGALACEAE	Polygala D25064 Mudginberri		A	Fo	lc		2		4								
POLYGALACEAE	Polygala exsquarrosa		A	Fo	lc	1	1										
POLYGALACEAE	Polygala longifolia		A	Fo	lc				1								
POLYGALACEAE	Polygala rhinanthoides var. minor		A	Fo	lc				1		1						
PORTULACACEAE	Calandrinia quadrivalvis		A	Fo	lc	1											
PORTULACACEAE	Portulaca bicolor var. indeterminate		A	Fo	lc	1			1								
PORTULACACEAE	Portulaca oleracea		A	Fo	lc								2	1			
PORTULACACEAE	Portulaca oligosperma		A	Fo	dd									1			
PORTULACACEAE	Portulaca pilosa	X	A	Fo	lc*									2			
PROTEACEAE	Grevillea decurrens		P	Sh	lc	1											
PROTEACEAE	Grevillea heliosperma		P	Sh	lc				1							•	•
PROTEACEAE	Grevillea refracta subsp. indeterminate		P	Sh	lc	1											
PROTEACEAE	Grevillea refracta subsp. refracta		P	Sh	lc	3											
PROTEACEAE	Grevillea wickhamii subsp. aprica		P	Sh	lc	3											
PROTEACEAE	Hakea arborescens		P	Sh	lc				5		1					•	
RHAMNACEAE	Alphitonia excelsa		P	Tr	lc			1									
RHAMNACEAE	Ventilago viminalis		P	Tr	lc						1					•	•
RUBIACEAE	Gardenia ewartii subsp. indeterminate		P	Sh	lc				2								
RUBIACEAE	Gardenia pyriformis subsp. indeterminate		P	Sh	lc			1									
RUBIACEAE	Mitracarpus hirtus	X	A	Fo	lc*								1	3	1	•	
RUBIACEAE	Nauclea orientalis		P	Tr	lc									7		•	
RUBIACEAE	Oldenlandia galioides		A	Fo	lc									1			
RUBIACEAE	Oldenlandia mitrasacmoides subsp. indeterminate		A	Fo	lc	2	1										
RUBIACEAE	Oldenlandia sp.		A	Fo									1				
RUBIACEAE	Pavetta sp.		P	Sh				2						1			
RUBIACEAE	Spermacoce A63546 lignosa		A	Fo	lc	3											
RUBIACEAE	Spermacoce dolichosperma		A	Fo	ne				4								

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Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community										Recorded during May 2011 survey	New species record
						1	2	3	4	5	6	7	8	9	10		
						Sandstone plateau	Hill woodland	Vine thicket	Inland bloodwood	Snappy gum woodland	Coolibah/ Bauhinia/ Atalaya	Corymbia bella w'land	Riverine woodland	Riverine corridor	Disturbed		
RUTACEAE	Boronia lanceolata		P	Sh	lc	1											
RUTACEAE	Boronia lanuginosa		P	Sh	lc	3											
SANTALACEAE	Santalum lanceolatum		P	Sh	lc			1									
SAPINDACEAE	Atalaya hemiglauca		P	Tr	lc				4		8			3		•	
SAPINDACEAE	Atalaya variifolia								1							•	•
SAPINDACEAE	Distichostemon hispidulus var. indeterminate		P	Sh	lc	7											
SAPINDACEAE	Dodonaea oxytera		P	Sh	lc				6							•	
SAPOTACEAE	Pouteria sericea		P	Tr	lc			3						2			
SCROPHULARIACEAE	Adenosma muelleri		A	Fo	lc	2		2									
SCROPHULARIACEAE	Lindernia D46758 Open throated		A	Fo	ne	1											
SCROPHULARIACEAE	Lindernia lobelioides		A	Fo	lc	3											
SCROPHULARIACEAE	Peplidium sp.		A	Aq		1											
SCROPHULARIACEAE	Scoparia dulcis	X	A	Fo	lc*			1									
SCROPHULARIACEAE	Stemodia lythrifolia		A	Fo	lc	1		1									
SIMAROUBACEAE	Brucea javanica		P	Sh	lc			1									
SOLANACEAE	Physalis minima	X	A	Fo	lc*		1	3					1	6			
SOLANACEAE	Solanum echinatum		A	Fo	lc	1											
SOLANACEAE	Solanum sp.		A	Fo				1									
STACKHOUSIACEAE	Stackhousia intermedia		A	Fo	lc		1										
STERCULIACEAE	Brachychiton collinus		P	Tr	lc			1									
STERCULIACEAE	Brachychiton diversifolius subsp. diversifolius		P	Tr	lc				5				2			•	
STERCULIACEAE	Helicteres cana		P	Sh	lc				2							•	
STERCULIACEAE	Helicteres isora		P	Sh	lc								1			•	•
STERCULIACEAE	Melhania oblongifolia		P	Fo	lc		1		5		1					•	
STERCULIACEAE	Melochia corchorifolia		A	Fo	lc						2		2				
STERCULIACEAE	Waltheria indica		P	Fo	lc				6				1			•	
TACCACEAE	Tacca leontopetaloides		P	Fo	lc	1		1						1			
THELYPTERIDACEAE	Cyclosorus interruptus		P	Fe	lc			1									
THYMELAEACEAE	Thecanthes punicea		A	Fo	lc							1					
TILIACEAE	Corchorus aestuans		A	Fo	lc		1		2		4		1	1			
TILIACEAE	Corchorus fascicularis		A	Fo	lc								1				
TILIACEAE	Corchorus olitorius	X	A	Fo	lc*						3						
TILIACEAE	Corchorus pumilio		A	Fo	lc				2								
TILIACEAE	Corchorus sidoides subsp. Indeterminate		A	Fo	lc	3	1	2									
TILIACEAE	Grewia retusifolia		P	Sh	lc				5			1	1			•	
TILIACEAE	Triumfetta sp.		A	Fo										1			

Appendix 2 cont.. Plant Species List

NB A - annual, P - perennial, Tr - tree, Sh - Shrub; Aq - aquatic; Fo - forb; Fe - fern; Vn - vine; lc - least concern; ne -not evaluated; upper case -endemic; * - introduced; dd - data deficient.

Family	Species	Weed	Perennial/ Annual	Lifeform	Conservn Status	Vegetation Community										Recorded during May 2011 survey	New species record
						1	2	3	4	5	6	7	8	9	10		
						Sandstone plateau	Hill woodland	Vine thicket	Inland bloodwood	Snappy gum woodland	Coolibah/ Bauhinia/ Atalaya	Corymbia dalla w'land	Riverine woodland	Riverine corridor	Disturbed		
VERBENACEAE	Pityrodia angustisepala		P	Sh	LC	2											
VERBENACEAE	Pityrodia ternifolia		P	Sh	lc	1											
VERBENACEAE	Stachytarpheta cayennensis	X	P	Fo	lc*											•	•
VERBENACEAE	Vitex glabrata		P	Tr	lc			2					1	3		•	
VIOLACEAE	Hybanthus enneaspermus		A	Fo	lc			1	5				2	1			
VITACEAE	Cayratia trifolia		P	Vn	lc				2					4		•	
VITACEAE	Cissus reniformis		P	Vn	lc	1											
ZYGOPHYLLACEAE	Tribulopis pentandra		A	Fo	lc		1		2								

Appendix 3: Site Photographs

Site	Location	Vegetation Community	Site Photograph
M1	TSF Extension	Inland bloodwood	
M2	TSF Extension	Inland bloodwood	
M3	TSF Extension	Inland bloodwood	
M4	TSF Extension	Inland bloodwood	
M5	TSF Extension	Inland bloodwood	
M6	Surprise Creek	Riverine woodland	

Appendix 3: Site photographs cont..

Site	Location	Vegetation Community	Site Photograph
M7	West Dam, OEF Extension	Inland bloodwood	
M8	North West Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	
M9	OEF Extension	Coolibah/ Bauhinia/ Atalaya	
M10	North Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	
M11	North East Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	
M12	OEF Extension	Coolibah/ Bauhinia/ Atalaya	

Appendix 3: Site photographs cont..

Site	Location	Vegetation Community	Site Photograph
M13	East Dam OEF Extension	Coolibah/ Bauhinia/ Atalaya	
M14	Open Pit Expansion	Riverine corridor	
M15	Outer Bund Eastern OEF	Coolibah/ Bauhinia/ Atalaya	
M16	Outer Bund Eastern OEF	Riverine woodland